RIVER AND LAKE ICE IN THE URBAN HYDROLOGIC SETTING: EXAMPLES OF ENVIRONMENT/ICE REGIME INTERACTION

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ABSTRACT

The theme of *"The Environmental Affects of River Ice"* can be extended to include scenarios which demonstrate how the urban setting, or conditions precipitated by it specifically, may affect floating ice covers. Examples of bio-physical ice interactions are described, including the physical contamination of floating ice during over-ice transportation causing potential eco-health problems and the thermal contamination of floating ice covers reducing their safe load carrying capacity for activities associated with urban recreation.

Proceedings of the Workshop on Environmental Aspects of River Ice, T.D. Prowse (Editor), National Hydrology Research Institute, Saskatoon, Saskatchewan, 1993, NHRI Symposium Series No. 12, p. 339-343.

EXAMPLE #1: THERMAL CONTAMINATION OF FLOATING ICE

Setting: Storm Water Retention Ponds

Indicators:

- Extremely variable ice quality (thickness) during periods when surface run-off and general under-ice circulation are absent.
- Localized zones of open water where bubble plumes are observed to rise to the surface

Consequence:

- Diminished public safety.
- Limited equipment access to the ice surface for the preparation of recreational skating surfaces and winter festival sites.
- Ineffectual utilization of urban park landscape and design.

Probable Mechanism:

- Localized point releases of carbon dioxide and methane derived from the anaerobic decomposition of organic matter located beneath the retention pond structure. Retention pond was excavated from reclaimed land/slough which was once part of a sizable farming operation (Demuth 1991).

Remediation/Prevention:

- Venting of gas production zones to the surface.
- Artificial thickening of ice covers.
- Detailed geophysical investigation including land use history.

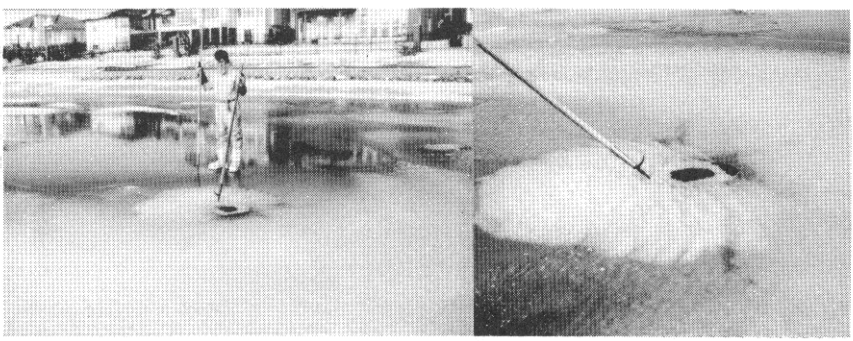

Figure 1. Open water resulting from gas releases below Erindale Lake (storm water retention pond), Saskatoon (Demuth 1991).

EXAMPLE #2: PHYSICAL CONTAMINATION OF FLOATING ICE

Setting: Bridgeways

Indicators:

- High concentrations of oil, lead and road traction agents on ice surface below and along sides of bridgeway.

Consequence:

- Deposition of oil, lead and road traction agents in fragile ecosystems.

Probable Mechanism:

- Lack of confinement of road spray on bridgeways allows accumulation on ice surface below and along bridge-way.
- Ice is carried away at break-up.
- Contaminated ice may ground on shores or shoaling areas.
- Ice melts allowing deposition of contaminants.

Remediation/Prevention:

- Bridgeway design/winter road maintenance programs should incorporate ways to contain (prevent deposition), divert or remove contaminated debris.

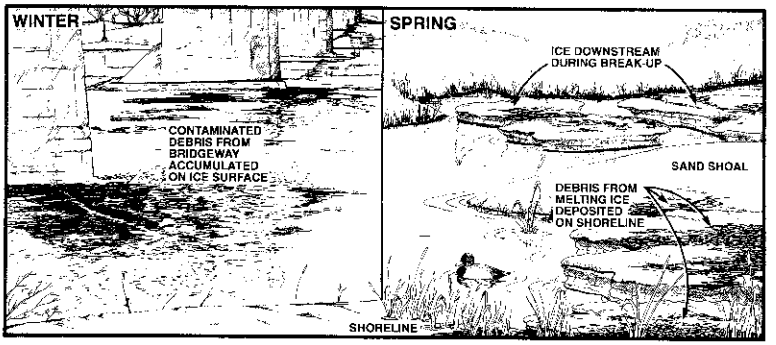

Figure 2. During winter, contaminated debris accumulates on ice surface adjacent to bridgeway. When ice is carried away during spring break-up, individual ice pans may ground on shoal areas or shorelines and allowing deposition of highly concentrated debris bands.

Reference

Demuth, M.N. 1991 Bubble plume effects on the freeze-up of Erindale Lake: A case study. Management of bearing capacity for small lakes. NHRI Contribution CS-91058 to the City of Saskatoon, 39pp.

DISCUSSION

Darryl Calkins

I believe you have identified an area of design that does not consider winter effects on detention basins, whether they are dry or even ice covered.

Reply:

Retention basins are only one example of an urban scenario where floating ice may be affected by bio-physical processes. Here specifically, an incomplete geophysical/land use investigation led to the location and construction of a retention pond on a site where the as-designed characteristics of the pond could not be put into effect.

An additional process worthy of mention, involves the run-off of melting snow and ice from the urban landscape into retention basins, transporting salt, oil and other residues. If the pond is an unlined structure, it may act as a point of focus for the entry of contaminants into groundwater systems.

Pat Chambers

Given that you are not sure if the site of venting may differ between years, how will you decide where to locate the venting pipe?

Rick Cunjack

How precise can you pinpoint the location of the venting points for positioning the discharge pipes?

Reply:

During the first year of observation the initial ice cover was clear and relatively thin, although it permitted travel on foot. Each venting site was easily located. Before a complete survey could be conducted, a significant snow fall had occurred and the ice surface was slushed, obliterating evidence of position for all but the largest venting sites.

Once recorded, the location of venting sites can be set out using standard survey methods. If the ice is clear and relatively thin, locations can be verified. Although

venting pipes may present a solution for mitigating the effects of the larger gas release zones, the most effective solution over larger areas would involve artificial thickening of the ice cover, e.g. flood-freeze.

Bob Costerton:

Have you tested gas venting from bed?

Reply:

No, but they will when the "gas traps" are installed.