8. Pollution Prevention

This section focuses on cold climate modifications of non-structural BMPs, or pollution prevention measures. Specifically, it discusses options for controlling pollution from sand and other abrasives, road deicers and airport deicers. It also discusses snow storage techniques to minimize pollutant loads and encourage infiltration of snowmelt.

8.1 Sand (Abrasives)

Abrasives retain traction on roads in icy or snowy conditions. Sand is the most commonly used abrasive, but other materials such as crushed stone or furnace slag are also used. Three measures are proposed to reduce pollution from sand application: use of a clean sand source, street sweeping during and immediately after the spring runoff and operator training focusing on application of the minimum amount of sand necessary.

8.1.1 Clean Sand Source

One way to reduce the water quality impacts of sand application is to use "clean" sand (e.g., free of fine materials). Sand itself can cause water quality and habitat impacts, such as filling in of ponds and wetlands and destruction of downstream habitat. The fine particles mixed in with sand can further increase stream turbidity and carry the majority of pollutants such as phosphorous and metals.

8.1.2 Street Sweeping

Street sweeping during the spring snowmelt can reduce pollutant loads from road sanding. Seventy percent of cold climate stormwater experts (CWP, 1997) recommend street sweeping during the spring snowmelt as a pollution prevention measure. The Minnesota Pollution Control Agency (1989), for example, recommends street sweeping two times per year for pollution prevention: after the spring snowmelt and after leaves fall in the autumn.

8.1.3 Operator Training

One method to reduce unnecessary sand application is to train sand application operators to apply only the amount necessary for the given conditions. Many states offer guidance on the amount of sand necessary for a given amount of snow and road traffic.

8.2 Road Deicers

Deicers, chemicals designed to melt ice and snow on pavement, are another pollutant source in cold climates. Road salt (NaCl) is the most commonly used deicer, primarily because of its low cost (Ohrel, 1995). Several changes can be made to traditional deicing to decrease the impacts to the environment. These include: apply less salt, apply alternate deicers, use additives to reduce deicer application, change the timing of application, modify spreaders and implement salt storage regulations.

8.2.1 Application Rate

Decreasing the application rate can significantly decrease environmental impacts. This measure is controversial because of safety concerns, however (i.e., slippery roads). To avoid applying too much ice to lightly traveled roads, some northern states have adopted specific guidance for road salt application, based on the type of road. For example, Michigan practices a three-tiered system based on road traffic (Gales and Vander Meulen, 1992).

8.2.2 Alternative Deicers

Depending on the environmental problems of an area, deicers other than salt may be used. Unfortunately, most deicers have some negative environmental impacts, and many are more costly than road salt (See Table 8.1).

TABLE 8.1 CHARACTERISTICS OF DEICERS (SOURCE: OHREL, 1995)

Characteristics	Sodium Chloride ($NaCl$)	Calcium Chloride ($CaCl_2$)	CG-90 Surface Saver (Mg, Na and Cl)	CMA ($CaMgC2H_3O_2$)
Soils	Cl complexes release heavy metals; Na can break down soil structure and decrease permeability	Cl complexes release heavy metals; Ca can exchange with heavy metals, increase soil aeration and permeability	Same as NaCl; Mg can exchange with heavy metals	Ca and Mg can exchange with heavy metals. Ca increases soil aeration and permeability.
Vegetation	Salt spray/splash can cause leaf scorch and browning or dieback of new plant growth up to 50' from road; osmotic stress can result from salt uptake; grass more tolerant than trees and woody plants.			Little effect
Groundwater	Mobile Na and Cl ions readily reach groundwater and concentration levels can increase in areas of low flow temporarily during spring thaws. Ca and Mg can release heavy metals from soil.			
Surface Water	Can cause density stratification in small lakes having closed basins, potentially leading to anoxia in lake bottoms; often contain nitrogen, phosphorous and trace metals as impurities, often in concentrations greater than 5 ppm			Depletes O2 in small lakes and streams when degrading
Aquatic Biota	Little effect in large or flowing bodies at current road salting amounts; small streams that are end points for runoff can receive harmful concentrations of Cl; Cl from NaCl generally not toxic until it reaches levels of 1,000 to 36,000 ppm; eutrophication from phosphorous in Cg-90 can cause species shifts			Can cause oxygen depletion
Cost ($/lane mile/ season)	$6,371-$6,909	$6,977-$7,529 plus storage and equipment costs	$5,931-$6,148	$12,958-$16,319
Minimum Operating Temperature	12°F	-20°F	1°F	23°F
Comments	Most commonly used deicer nationwide.	More effective and less harmful than salt. However, overall expense is much higher. CaCl2 is most often used in very low temperature conditions.	Provides some corrosion protection and is cost-competitive. Must be applied in much lower concentrations than salt.	This material is very expensive and starts to act at a slower rate than salt. Most often used on bridges because it is less corrosive than salt.

8.2.3 Deicer Additives

In the past, metals have been added to deicers to improve their performance. This practice has been discontinued, however, because of harmful environmental effects (Gales and Vander Meulen, 1992). Recently, an organic additive has been developed that appears to improve the effectiveness of road salt. The additive, Ice Ban, is derived from the beer brewing process. Although the product has not been widely used, evidence from Webster, New York, suggests that it is a cost-effective additive. During the winter of 1995-96, the town saved $58,000 by using this additive (Strable, 1996). Some concern has been raised about the potential BOD loading of this product (Smith, 1997).

8.2.4 Timing of Application

By applying deicers at the appropriate time, the amount of deicing material needed can be decreased. One proposal is to apply deicers before snow falls, based on forecasts. If the forecasted storm does occur, it will take less deicing material to melt snow in this condition. The drawback to this method is that, if forecasting is inaccurate, deicers are applied unnecessarily.

More elaborate data can be used to determine the rate of deicer application. For example, Irondequoit Bridge near Rochester, New York, has sensors in the pavement that record the pavement temperature and moisture content. This data is combined with local weather data to decide how much deicer should be applied (Tallie, 1997). Although this type of system is expensive, it is recommended for bridges that cross a sensitive water body or where corrosion is a particular concern.

8.2.5 Modified Spreaders

Deicers are often over-applied because much of the material bounces off the road surface. One solution to this problem is the use of “zero velocity” spreaders. These spreaders sense the velocity of the spreader compared to the pavement. The salt is spread so that it lands with a velocity of zero relative to the ground. Another modification is to adjust the rate of application based on ground speed. That is, when the truck is moving slower, deicers will be applied at a lower rate.

8.2.6 Salt or Deicer Storage

Many states have developed regulations regarding the storage of deicers, particularly salt. Salt should be stored on an impervious surface to prohibit groundwater contamination. Furthermore, salt piles should be placed in a structure protected from rainfall, eliminating contamination of runoff by exposed salt.

8.3 Airport Deicers

Airports use different deicers than those applied to roads because the corrosion caused by salt-based deicers (e.g., NaCl, $CaCl_2$) raises concerns about safety and damage to airplane parts. Environmental impacts of deicer alternatives are discussed in this section, along with methods to reduce deicer impacts. These include limiting application, treating deicer runoff and deicer recycling.

8.3.1 Airport Deicer Alternatives

The two deicers commonly used on airport runways are glycols and urea. Alternative acetate deicers have been proposed as well (e.g., CMA). The deicer alternatives are described in Table 8.2.

TABLE 8.2 AIRPORT DEICER ALTERNATIVES
(SOURCE: SILLS AND BLAKESLEE, 1992)

	Glycol	Urea	Acetates
Description	Petroleum-based organic compounds, similar to anti-freeze.	Nitrogen-based fertilizer product.	Petroleum-based organic chemicals, such as CMA.
Environmental Impacts	• Extremely high BOD_5 concentrations (Stormwater concentrations between 500 and 5,000 mg/l) • Trace carcinogenic compound (1,4-dioxane in some glycols)	• Toxicity concerns from ammonia formation • Increased nitrogen in water bodies may contribute to algal blooms	• High BOD_5
Comments	Most commonly used airport deicer.	Sometimes used as a glycol alternative, but nitrogen concerns can limit use.	Recently proposed alternative. Pelletized CMA is difficult to apply because jets blow pellets of the runway.

8.3.2 Limit Application

Reducing deicer application rates on airport runways is controversial because of safety risks. There are, however, a few options for deicer application. Hot water can be used to melt ice, but there is a risk of refreezing. When this method is used, a glycol spray should be used immediately after application to prevent refreezing. In addition, anti-icing (i.e., applying deicers prior to ice formation) can reduce required deicer application rates.

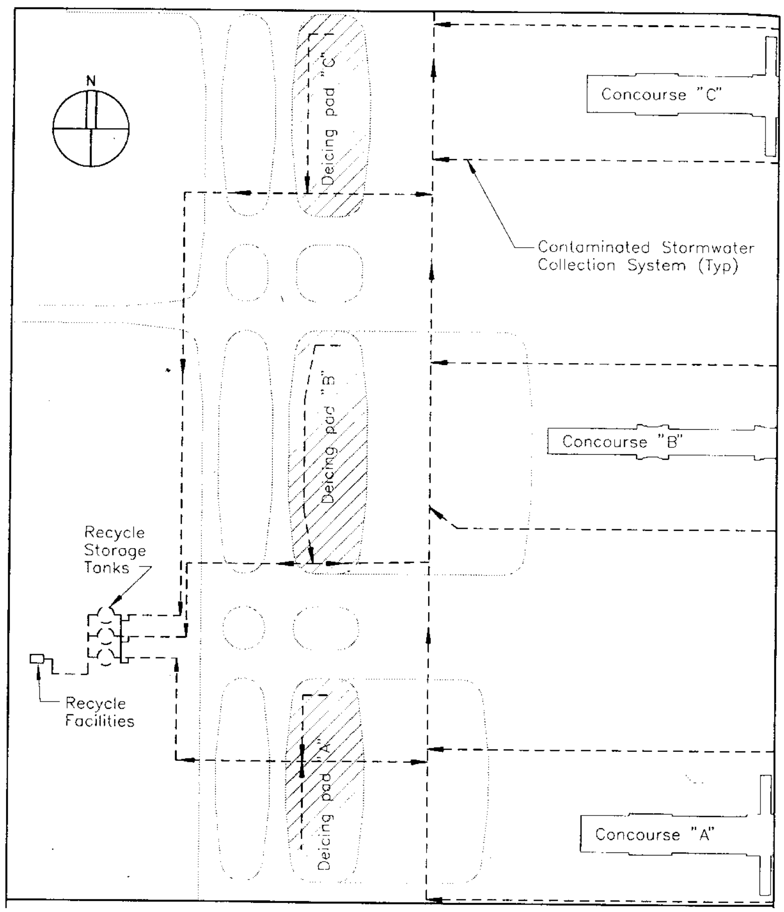
8.3.3 Treatment

One option to treat runoff is the use of aerated basins to reduce the BOD demand and treat nutrients in deicers. Unfortunately, this option is often space-prohibitive, especially in established airports. A second treatment method is to remove deicers from pavement. For example, at Calgary International Airport, absorbent material is applied to pavement immediately after aircraft are sprayed with glycol. This material is then vacuum swept and land filled. This process prevents 40% of glycol from entering stormwater (Sills and Blakeslee, 1992).

8.3.4 Deicer Recycling

Glycol recycling systems have only been used in a few airports worldwide. One example is the Denver International Airport (Figure 8.1; Backer et al., 1993). Glycol used for airplane deicing is captured and recycled. Airplanes are deiced at central facilities (deicing pads) so that the glycol levels will be substantially elevated to make recycling practical. Glycol concentrations greater than 15% need to be maintained at the recycling facility. During the winter season, runoff mixed with glycol from deicing pads is routed to storage tanks and then recycled by boiling off the water in the runoff. During the summer, runoff is pumped to a runoff collection system that leads to a treatment pond.

FIGURE 8.1 AIRPORT DEICER RECYCLING
(SOURCE: BACKER *ET AL.*, 1993)



8.4 Snow Storage

The impacts of snowmelt runoff on aquatic systems can be minimized by storing snow in upland areas to promote infiltration, more nearly approaching pre-development hydrology. It also provides an alternative to disposing of snow directly into streams, reducing the capacity for "shock" loadings. A sample snow storage sizing and location example is included in Appendix C.