OVERVIEW OF DEICING ALTERNATIVES TO PROTECT SOURCE WATER

This section provides an overview of several deicing management measures. The reference materials cited at the end of this document provide additional information. Please keep in mind that individual prevention measures might or might not be adequate to prevent contamination of source waters. Individual measures will likely need to be combined in an overall prevention approach that considers the nature of the potential source of contamination, the purpose, cost, and operational and maintenance requirements of the measures, the vulnerability of the source water, the public's acceptance of the measures, and the community's desired degree of risk reduction.

ALTERNATIVE DEICING CHEMICALS

Alternative deicing chemicals include calcium chloride, magnesium chloride, CMA , and products that are mixtures of chlorides and organic compounds[9]. Although such alternatives are usually more expensive than salt, their use may be warranted in some circumstances, such as near habitats of endangered or threatened species or in areas where the source water already has elevated levels of sodium or chloride. Sensitive areas and ecosystems along highways should be mapped, and the use of deicing alternatives should be targeted to those spots. Other considerations for using alternatives to salt include traffic volume and weather conditions.

5 - Chemistry

The various deicers are effective at different temperatures and have different environmental effects. For example, salt is most effective at temperatures above 20° F. As an alternative, calcium chloride is effective for temperatures that dip below 0°F and is fast acting, making it very useful in some parts of the country. It is, however, more expensive than sodium chloride. In New England, calcium chloride is often used on roadways in areas with high sodium concentrations in source water. It is less harmful to vegetation than sodium chloride, but it is corrosive to concrete and metal. Magnesium chloride is effective in extremely cold temperatures (as low as -13 °F). Magnesium chloride is also safer for vegetation, but can increase flaking of concrete. Calcium magnesium acetate (CMA) has the benefit of low toxicity to plants and microbes, but it is costly and is only effective above 23 °F. CMA can potentially lower dissolved oxygen concentrations in soils and receiving waters, damaging vegetation and aquatic life. Many communities, however, have used CMA with no apparent adverse environmental effects. Combining deicers, such as mixing calcium chloride and salt, can be cost-effective and safe if good information on weather conditions and road usage are available.

Innovative products have allowed some communities to reduce their salt usage. For example, a commercially available beet juice derivative or another product made from the leftover mash of alcohol distilleries can be applied to road surfaces, mixed with a brine for spray application, or used to treat salt. Salt treated with these compounds is effective at much lower temperatures than untreated sodium chloride, and it works quickly. The beet juice derivative, in particular, has been gaining popularity in the Midwestern United States. Communities such as Elkhart and Cloverdale, Indiana, for example, are finding that the beet juice helps salt and sand adhere to roadways, greatly reducing the amount of salt that needs to be applied. These products are biodegradable and are safer for roadside vegetation than sodium chloride. Communities are still gaining experience with these "eco-friendly" alternatives; additional research and experience with these and other alternatives are needed.

DEICING CHEMICALS:

- **Calcium Chloride is: $CaCl_2$**
- **Magnesium Chloride is: $MgCl_2$**
- **CMA (calcium magnesium acetate) is composed of:**
  Calcium carbonate: $CaCO_3$
  Magnesium Carbonate: $MgCO_3$
  Acetic Acid: CH_3COOH
- **Sodium Chloride is: NaCl**

Alternative deicing chemicals include calcium chloride, magnesium chloride, CMA, and products that are mixtures of chlorides and organic compounds

6 - RWIS unit

ROAD WEATHER INFORMATION SYSTEMS (RWIS)

RWIS help maintenance centers determine current weather conditions at a given location. They are a key component of winter maintenance programs in Japan and many Western European countries, and since the mid-1980s increasing numbers of states have been using this technology. Sensors collect data on air and pavement temperatures, levels of precipitation, and the amount of deicing chemicals on the pavement. The data are paired with weather forecast information to predict pavement temperatures for a specific area and to determine the amount of chemicals needed in the changing conditions. Savings from reduced use of deicers can offset the high cost of a RWIS. According to the Federal Highway Administration, the Massachusetts Highway Authority (MHA) saved $39,000 on salt and sand costs in the first year after installing nine RWIS stations. The MHA has estimated that a complete RWIS in Boston could save up to $250,000 per year[10]. A RWIS on a bridge over the James River in Virginia recovered 96 percent of equipment and installation costs over a single mild winter by avoiding unnecessary deicer application[11]. Information gathered through RWIS is also used to target anti-icing treatment (described below). Several states are developing satellite delivery of RWIS information to maintenance workers.