5

SUMMARY COMPARISON OF IMPACTS, *PERFORMANCE, AND COSTS OF DEICING MATERIALS*

Exhibit 5.1 presents a summary of areas that may be affected by the use of the various road deicing materials. The numbers in the grid ceils refer the reader to pages of the text that address the specific impacts indicated for the deicer listed.

The following are vulnerable to corrosion damage from some or all of the deicing materials reported on this study:

- Automobiies manufactured before the early and mid- 1980s
- Road surfaces older than 15 years or built without corrosion protection
- Bridges built before 1985, built with little or no corrosion prevention, or currently receiving low maintenance

The following environmental sectors are vulnerable to some or all of the deicing materials reported on in this study:

- Salt-sensitive trees located adjacent to roadways
- Small streams, lakes, and wetlands having low water exchange and receiving large quantities of deicing runoff
- Wells that pump from aquifers vulnerable to deicing materials applied to roadways
- Habitats that support endangered and threatened species and are located adjacent to roadways

Exhibit 5.2 presents a summary of the performance and estimated costs of each deicer, based on available information. The deicing ability, corrosiveness, estimated economic costs per e-mile, application rate, capital costs for spreading equipment, storage requirements, and applicator safety requirements for each deicer are quantified relative to the other deicers. Because some of the deicers evaluated in the study either are newly developed or have not yet been widely field tested, specific values do not exist for some variables.

Exhibit 5.1: References to Pages in Text that Address Deicer Impacts

Material	Corrosion Effects						Environmental Effects[1]						
	Autos	Road Surface		Bridges			Vegetation	Surface Water			Ground-water		
	Manufactured Before Early to Mid-1980s	No Corrosion Prevention	>15 Years Old	Pre-1985	No Corrosion Prevention	Low Maintenance	Forest Species Sensitivity[2]	Small Streams with Low Water Exchange	Lakes with Low Water Exchange	Wetlands with Low Water Exchange	Vulnerable Aquifers	Critical Habitat for Endangered and Threatened Species	Other Impacts
Sodium Chloride	49	50	50	49	49	49	33	36, 37	36, 37	36, 37	36, 37, 40	33, 86	33, 35, 38
Calcium Chloride[3]	51	51	51	51	51	51	43	43	43	43	43	43, 86	33, 38, 43
CMA	50	50	50	50	50	50	42, 43, 44	42, 43, 44	42, 43, 44	42, 43, 44	43, 44	42, 43, 44	41, 42, 43, 45
CG-90 Surface Saver	51	51	51	51	51	51	33, 44	36, 37, 44	36, 37, 44	36, 37, 44	36, 37, 40, 44	33, 86, 44	33, 38
Verglimit[4]	51	51	51	51	51	51	43	43	43	43	43	43, 86	33, 43, 38
CMS-B[5]	—	—	—	—	—	—	—	—	—	—	—	—	—
Sand	51	51	51	51	51	51	45	45	45	45	45	45	45

SOURCE: Public Sector Consultants, Inc.

[1]Measurable environmental impacts will occur only in very specific situations; e.g., small lakes with partially closed basins receiving highway drainage can be density stratified and thermal overturn may not occur in spring.

[2]Forests are categorized by type. Entire forest types are not threatened, but individual trees of salt-sensitive species can suffer damage when located close to a heavily used roadway. Forest types containing sensitive species are white/red/jack pine, maple/yellow birch, spruce/fir, and oak/hickory.

[3]Studies have not been conducted examining the specific effects of calcium chloride. Because chloride is the predominant component, effects similar to those of sodium chloride can be expected.

[4]Verglimit contains small quantities of calcium chloride that are not expected to have significant impacts on either the environment or corrosion.

[5]CMS-B is a new material, and its corrosive and environmental effects are unknown. The predominant component is potassium chloride, which contains chloride, and effects similar to those from salt may occur.

Exhibit 5.2: Summary of D[illegible]rs' Effectiveness and Cost

NOTE: The extent to which a circle is filled in indicates only how a deicer compares to others in the particular variable; i.e., most versus least deicing ability or cost.

Material	Performance		Minimum Effective Temperature (Degrees)[2]	Material Cost/Ton	Estimated Economic Costs/Mile[3]	Additional Costs; Not Quantity but Necessary for Consideration			
	Deicing Ability	Corrosion Protection [1]				Application Rates	Spreading Equipment	Storage Requirements	Applicator Safety Equipment Requirements
Sodium Chloride			12°F/-11°C	$20-40					
Calcium Chloride			-20°F/-29°C	$200	Unavailable[4]				
Calcium Magnesium Acetate[5]			23°F/-5°C	$650-675					
CG-90 Surface Saver		 [5]	1°F/-17°C	$185					
Verglimit[6]		 [7]	25°F/-4°C	3 x cost of regular asphalt overlay	NA [8]	NA	NA	NA	NA
CMS-B[9]	—	—	-10°F/-23°C	$.40-.50/gallon	—	—	—	—	—
Sand	 [10]		NA	$5	 [11]	NA [12]	NA [13]	NA	

SOURCE: Pacific Sector Consultants, Inc. NA = Not available.

[1] Costs to society due to corrosion caused by deicing materials are inversely proportional to the amount of corrosion protection offered by each deicer.

[2] Many of these temperatures are based on laboratory tests and do not account for variables in field conditions. For example, the minimum effective temperature of sodium chloride is 12°F, but it can be used at lower temperatures in sunny conditions.

[3] Based on estimates derived in chapter 4.

[4] Calcium chloride can be used in liquid or pellet form. Neither storage nor spreading equipment costs is estimated for either due to lack of information. Not accounting for the storage and equipment costs, CaCl costs more than salt/sand, CG-90 Surface Saver, and salt, and less than CMA.

[5] [illegible]

[6] [illegible]

[7] Verglimit contains pellets of calcium chloride and may have the same corrosive characteristics as CaCl, but only small quantities of CaCl are released to the environment from Verglimit overlays.

[8] Because Verglimit also is a road surface, it offers more than deicing alone, therefore its costs cannot be compared to other deicers.

[9] CMS-B is a new product; its uses, limitations, and costs are not clear.

[10] Sand is not a deicer; it is an abrasive applied to provide friction and should be used in conjunction with snow plowing and/or a deicer.

[11] Costs are derived for a salt/sand mixture (2:1).

[12] Application rate comparisons have been made by identifying the amount of material necessary to achieve MDOT's bare-pavement policy; the use of sand alone will not achieve this end. Sand should be used in conjunction with snow plowing and/or a deicer; therefore, costs for those additions will be incurred.

[13] Spreading equipment costs are based on application rates, which cannot be derived without knowing what other winter maintenance methods will

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