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Publications

Environmental Impact of Road Salt and Deicers

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by Christine A. Fazio and Ethan I. Strell

Since snow has been on everyone's mind this winter, it seemed fitting to write this month's column about snow. Central Park recorded 56.2 inches of snow through January, making this the snowiest winter through January since 1869, when the National Weather Service started keeping track.[1] In addition to plowing and shoveling, keeping New York's roads and walkways passable also involves tons of road salt and other deicing chemicals.

Common salt, sodium chloride, is the primary deicing chemical used, with up to 12 million tons used in the United States each year. The New York State Department of Transportation (NYSDOT) reports that it uses an average of 950,000 tons of salt annually.[2] New York City alone has used over 300,000 tons so far this winter. In a survey of 22 states, New York State ranked as the largest user of road salt.[3]

Although road salt is popular among states and municipalities because it is relatively cheap, readily available, and effective, its use also causes environmental harm, much of it unregulated and unmonitored. Melting snow dissolves salt into charged sodium and chloride ions which can lead to elevated levels of sodium and chloride in soil and water. Road salt is a major culprit for elevated chloride levels in ground and surface waters of the northern United States and in many urban streams.

Environmental Impacts

According to the United States Geological Survey, many streams have chloride levels toxic to aquatic life and that also exceed the chronic water-quality criteria recommended by the U.S. Environmental Protection Agency (EPA).[4] Exposure to high levels of chloride in water, especially for an extended term, affects abundance and reproduction of fish and other aquatic organisms.[5] In addition to the direct effects of chloride, salty water is denser than fresh water, so it sinks to the bottom of water bodies, impairing complete circulation of water, which in turn can deplete oxygen levels and affect the survival of fish and invertebrates.[6]

Road salt runoff also enters drinking water supplies. While chloride in drinking water is not considered harmful to human health, it affects the taste of water and is listed as a secondary standard under the federal Safe Drinking Water Act. In addition, elevated sodium levels in drinking water may be a concern for people on restricted-sodium diets, although dietary sources of sodium are far greater than water.

Roadside plants and vegetation are damaged by road salt runoff and spray. Polluted runoff causes plant dehydration, nutrient imbalance, and even toxicity.[7] Salt spray from roads accumulates on foliage and causes "leaf burn" and tissue desiccation.[8] Interestingly, road salt also serves as artificial salt licks, attracting moose and other sodium-deficient animals to roadways, which can cause increased traffic accidents and road kills.

In addition to the salt itself, additives, like ferrocyanide, are used to prevent caking in large salt supplies. Ferrocyanide can release cyanide ions into the environment, and the EPA has determined that ferrocyanide is one of the "cyanides" in its list of toxic pollutants under section 307(a) of the Clean Water Act (CWA).

Alternative Deicers

Alternatives to rock salt are available, and some of these alternative deicers are currently being used either alone or together with road salt in varying ratios. Although alternative deicers may perform as well as, or better than, ordinary road salt under certain conditions, they have their own disadvantages.

The first group of commonly used alternative deicers are other chloride-based salts such as calcium chloride, potassium chloride, and magnesium chloride. However, using these salts entails environmental impacts similar to road salt, since they all release chloride when dissolved. These chemicals also are corrosive and are generally too costly for widespread implementation.[9]

The second group of alternative deicing agents are organic-based deicers such as acetate-based deicers and agricultural byproducts. The most commonly used acetate-based deicers are potassium acetate, commonly used for deicing in the airline industry, and calcium magnesium acetate, which is used for deicing in more environmentally sensitive areas and on bridges or other structures sensitive to salt corrosion.[10] These acetate-based chemicals are reported to be more environmentally-friendly than chloride-based salts, but cost more and may mobilize heavy metals in soil. Their decomposition also consumes oxygen, resulting in lower oxygen levels in water.[11]

A variety of agricultural byproducts derived from sources such as corn, beets, and grains can be used for slowing down the formation of ice or pre-wetting salt to make it more effective, but they are costly, are not effective alone at melting ice, and also consume oxygen by decomposition.[12]

Regulation

Road salt appears to have escaped the permitting requirements of the CWA. Even in New York City's watershed areas, road salt use is not restricted, though storage is. The city's watershed regulations instead reference the NYSDOT best management practices. Because road salt is applied to land surfaces and is washed away by snowmelt and rain, it generally is treated as non-point source pollution. We are not aware of any instance where the application of salt or other deicer required its own individual or general State Pollutant Discharge Elimination System (SPDES) permit. For treated runoff that enters a municipal stormwater system, discharge into water bodies is permitted in accordance with the applicable individual or general SPDES discharge permit for that stormwater system, which likely does not specifically address road salt.

However, an argument could be made that the application of road salt and other deicing chemicals might require a CWA permit because it could be considered a "pollutant" that is discharged from a "point source." While sodium, chloride, and additives such as ferrocyanide would likely not be considered "chemical waste" when being used for their intended purpose of melting snow and ice, these residual chemicals when washing into storm drains and water bodies could become "chemical wastes," which is included in the definition of "pollutant" under the CWA. And a truck spreading salt could be considered a "point source" under the CWA.

In an analogous situation, environmental groups brought CWA citizen suits challenging the spraying of pesticides for mosquito control above or near waterways. EPA had previously issued a rule concluding that such spraying did not require a CWA permit if the spraying was done in accordance with the pesticide's label. EPA took the position that spraying in compliance with the label was not the discharge of a "pollutant" from a "point source," because the pesticide was not a "pollutant" discharged into water at the time it was sprayed; it only became a pollutant later, after excess residual pesticide found its way into water.

In *American Cotton Council of America v. EPA*, the U.S. Court of Appeals for the Sixth Circuit invalidated the EPA's rule, holding that at some point following application, excess pesticide…finds its way into the navigable waters of the United States. Pesticides applied in this way and later affecting the water are necessarily "discarded," "superfluous," or "excess" chemical. Such chemical pesticide residuals meet the Clean Water Act's definition of "chemical waste."[13]

In a recent related case, the U.S. Court of Appeals for the Second Circuit also disagreed with the district court's conclusion that spraying pesticides from applicators attached to trucks or aircraft were not "point sources" because the spray went directly into the air, not the water. The court held that "the spray apparatus was attached to trucks and helicopters, and was the source of the discharge. The pesticides were discharged 'from' the source, and not from the air."[14]

Although the word "salt" might not conjure up the same visions of a silent spring that "pesticide" does, the CWA and relevant case law would seem to allow treating its discharge as a regulated activity. Moreover, both sodium and chloride are listed on New York's list of water quality standards and EPA lists chloride as a secondary contaminant under the Safe Drinking Water Act.

While requiring individual SPDES permits for the application of road salt would not be practical or cost-effective, the issuance of a general permit, or several general permits based on particular watersheds, might be a reasonable way to identify the particular environmental impacts of salt use and require the use of best management measures and training to minimize the amount of salt used.

In Canada, road salt use currently is not regulated. However, in a comprehensive assessment of road salt published in 2001, Canada's environmental agency, Environment Canada, concluded that deicers containing inorganic chloride salts with or without ferrocyanide have adverse impacts on the environment and are therefore toxic under the Canadian Environmental Protection Act (CEPA). Following the publication of the assessment, Environment Canada initiated the risk management process as required by the CEPA, which resulted in the Code of Practice for the Environmental Management of Road Salts.[15]

Mitigation and Management

Because chloride and sodium remain in solution in water, it is difficult to treat water after the fact. Currently, reduction in the amount of salt used is the only effective management strategy.[16]

Best management practices can reduce the negative environmental impacts of road salt without compromising public safety. Many states and municipalities have adopted best management practices. For instance, Maryland recently adopted a law requiring the development and use of a road salt management best practices guidance document for use by local and state governments to minimize the adverse environmental impacts of road salt runoff. Also, in 2011, the New Hampshire legislature introduced HB202, which would require state certification for anyone who applies salt to public and private roads and parking lots, as a means to limit the amount of deicing salt spread in New Hampshire and to enforce best management practices. New York State does not have legislation addressing this issue, but Bill S02020 was introduced in the Legislature last month, which would direct the Commissioner of Transportation to use salt substitutes near environmentally sensitive highways.

On the local level, a bill was recently introduced in the New York City Council recognizing the environmental impacts of road salt on water and plants and the costs of salt-related corrosion on cars, roads, and bridges. If enacted, the bill would create a task force to study salt use and issue recommendations for alternative methods of melting snow and ice.[17]

A principal best management practice to enhance the effectiveness of road salt, thus reducing the overall amount of road salt needed, is to pre-wet the salt by mixing salt with a liquid deicing chemical before applying it to the road. The dissolved salt begins working sooner and results in faster deicing. The New Hampshire Department of Environmental Services found that pre-wetting road salt reduced salt application by 20 percent. Moreover, pre-wetted salt adheres to the pavement better than solid salt, reducing the amount of salt bouncing off the roads.

"Anti-icing" is a proactive snow and ice control strategy of preventing the hard-packing of snow and ice by applying chemical freezing-point depressant prior to or very early into snowfall, rather than trying to "de-ice" the compacted snow and ice that have already adhered to the pavement. Anti-icing lowers the freezing temperature before the snow or ice accumulates on the ground and facilitates plowing and can reduce the amount of chemical to less than one third of the amount needed for deicing.[18]

Another strategy is using advanced technologies to analyze current and expected weather events, temperatures, and traffic levels, therefore helping managers select the most effective deicing strategy. Networked road weather-information systems (RWIS) provide real-time information on road and weather conditions, and the data from RWIS can be used to determine where and when anti-icing and de-icing should take place.

As part of the road salt reduction initiative, New Hampshire Department of Transportation varies its application mixtures for ice and snow control materials on a per mile basis depending on traffic and weather conditions. Several other states reported successful cost savings from investing in advanced technologies like the RWIS.

Other recommended best management practices include investing and calibrating equipment for precise application and providing worker training. The Salt Management Plan (SMP) that began in Toronto and is now in use nationwide in Canada, effectively implemented the best management practices. The City of Toronto reported 35 percent-50 percent decrease in salt spread on local roads within a few years since its introduction.

In addition to the environmental benefits, implementing best management practices is fiscally prudent, as it requires less spending on deicing materials, equipment, and labor, as well as the indirect costs due to salt-related corrosion of roads, bridges, vehicles, and other infrastructure. For instance, Colorado reported that implementing anti-icing reduced the total annual cost of winter operations from $5,200 per lane mile to $2,500 per lane mile and Toronto saved nearly $1.9 million in one year in decreased salt use alone after the SMP.

Christine A. Fazio *is a partner and* **Ethan I. Strell** *an associate in the environmental practice group at Carter Ledyard & Milburn.* **Jayun Koo**, an associate at the firm, assisted in the preparation of this column.

Endnotes

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[11] Norwegian Public Roads Administration (2010).

[12] New Hampshire Department of Environmental Services (2011); Norwegian Public Roads Administration (2010).

[13] 553 F.3d 927, 936-7 (6th Cir. 2009).

[14] Peconic Baykeeper v. Suffolk County, 600 F.3d 180, 188 (2d Cir. 2010).

[15] "Road Salts" http://www.ec.gc.ca/nopp/roadsalt/en/index.cfm.

[16] USGS 2010.

[17] A Local Law to amend the administrative code of the city of New York, in relation to the creation of a Road Salt Task Force, File no. Int 0469-2001.

[18] Transportation Research Board (2007); Kelting and Corey (2010); The Connecticut Department of Transportation (2006).