TREE CITY USA®
BULLETIN
No. 32
Dr. James R. Fazio, Editor • $3.00

Let's Stop Salt Damage

Too much salt in the environment is just as unhealthy as too much salt in a diet. The annual use of deicing salt on streets and sidewalks is phenomenal. Before more damage is done and the results compound themselves, it is time for communities and individuals to look closely at alternative actions.

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When snow flies, public safety must be a primary goal. At the same time, ways must be found to protect the environment from too much salt.

It has been called "white death," "the silent killer," and "car eater." Its real names are sodium chloride, rock salt, or deicing salt. By whatever name, the topic of deicing salt has been called by one official in the Environmental Protection Agency, "a classic environmental problem that seeps through the cracks."

Deicing salt presents communities with a true enigma. We want — and must have — safe streets, highways and sidewalks. And when snow falls, salt certainly does the job of accident prevention. In fact, it is so effective that during an average winter more than ten million tons of rock salt are poured on our nation's streets and highways. In the forested Adirondack Mountains, as much as 30 tons per lane mile have been used during some winters. On more heavily travelled highways the figure can reach 80 tons per lane mile in a single year.

Unfortunately, salt does not stay where it is needed. And as it washes or is blown onto nearby soil and vegetation, it is far more than a pinch of salt in nature's diet! The results increasingly pose a threat to trees and shrubs in northern climes, to say nothing of structures, water resources and even human health.

Fortunately, there are ways to fight icy roads and sidewalks while at the same time spreading less salt. It is time to look seriously at the problem and to take a stand for the future. The challenge of bringing about change may well rest with those who care about trees and other natural resources. The issue of salt also serves as a good example of how community forestry must be viewed in a broad, ecological context that goes far beyond the traditional activities of planting and pruning.

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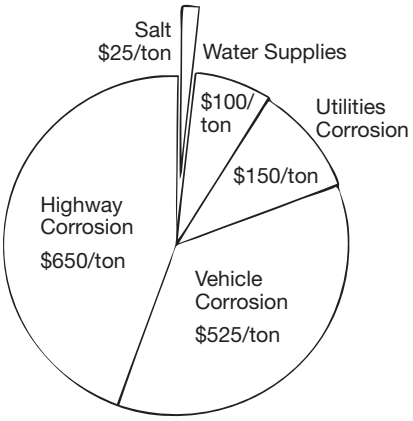
The Real Cost of Salt

Not only is rock salt effective at melting ice and snow, put simply, it is cheap! At approximately $25 to $50 per ton, it is what the National Wildlife Federation has called "America's weapon of choice for deicing some 1-1/2 million miles of Snow Belt streets and highways."

But the real cost of salt must take into account the costs of damage it causes. These are considerable.



The total economic cost of rock salt purchased at $25/ton is $1450/ton!

SOURCE: New York State Energy Research and Development Authority

In the example, which is based on a study of road salt in New York State, it can be seen that the purchase price is dwarfed by the price paid by tax dollars to repair corroded highways and bridges, and by private dollars to repair vehicle damage. The problem of polluted water sources and corroded utility equipment hits both public and private pocketbooks.

Study after study has computed the real price paid by society for its rock salt addiction. Here are some examples:

- In Massachusetts, several million dollars have been spent over the past 10 years replacing domestic water supplies that were contaminated by road salt.

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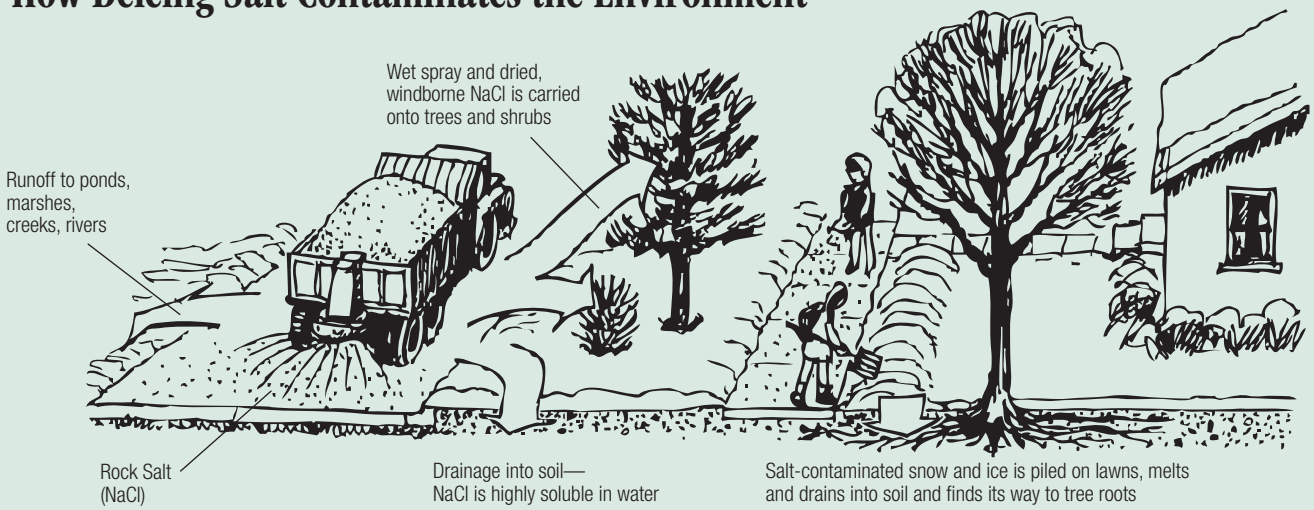
The real cost of salt must be measured not in terms of purchase price, but in terms of the long-term damage it does to bridges, road surfaces, automobiles and other property.

- Lawsuits have been brought against the Pennsylvania Turnpike Commission and the Ohio Department of Transportation for alleged road salt pollution of private water supplies.
- One half the corrosion damage to American highway structures is blamed on deicing salt.
- Brake linings deteriorate in the presence of salt, and the cost of auto body repairs and preventive coatings has been placed at $2 billion per year.
- Damage to roadside vegetation in the Adirondack Park imposes a cost to the tourism industry estimated at $3.1 million per year.

How Deicing Salt Contaminates the Environment



Chloride Ions (+)

Highly mobile; increase soil salinity and pass through soil to accumulate in groundwater.

Sodium Ions (–)

Less mobile; displace naturally ocurring calcium and magnesium cations, thereby damaging soil structure. This results in decreased soil permeability and aeration, and increased surface runoff and erosion.

Trees Suffer from Salt

The use of rock salt has been increasing over the past 40 years along with the increase in traffic and concern about public safety and preventing litigation. The results have been slow to show up in the environment, but the death and damage of roadside vegetation is a signal we should heed like a miner seeing his canary die.

Trees are affected by salt in many ways:

Water Loss

Salt in the soil is highly absorbent, depriving roots of water.

Chloride Poisoning

When sodium chloride dissolves, free chloride ions are easily absorbed by roots. The chloride ions are then carried through the sap stream to leaves where they accumulate to toxic levels.

Soil Damage

Sodium ions cause soil to lose its ability to aggregate into clumps and maintain open pores for air and water. The result is soil compaction accompanied by its many problems.

Nutrient Loss

Excessive sodium in the soil restricts a tree's uptake of magnesium and potassium. These two elements are essential in the process of photosynthesis.

Freezing

When salt sprays or splashes on twigs and buds, the salt can enter spaces between cells and weaken the resistance of some species to cold temperatures.

Reduced Vigor

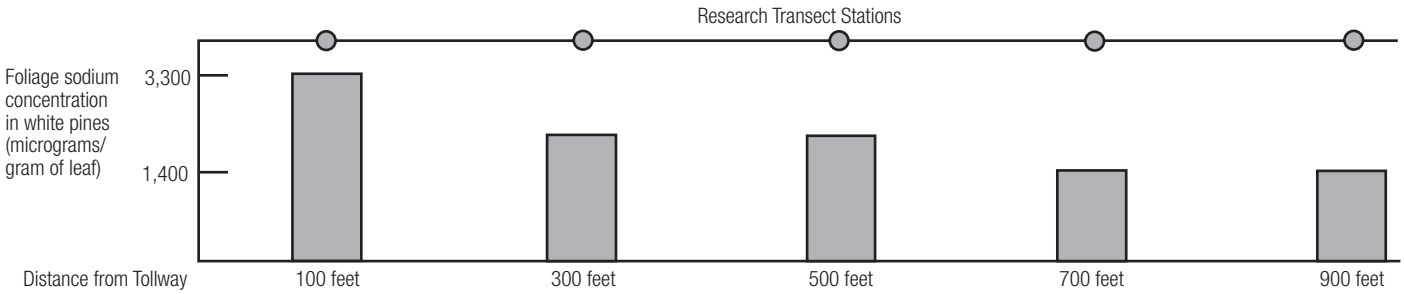
The toll of salt damage can generally reduce a tree's vigor, making it more susceptible to insects and diseases.

Salt Injury Symptoms

- Brown needles, with needles dying from the tips back (often only on the side facing a street or road).
- Stunted, yellow foliage.
- Premature autumn leaf coloration
- Death of leaf margins (scorched appearance)
- Twig dieback

In the West, where salt use is relatively low, trees are dying in such scenic areas as Lake Tahoe. In the East, dying white birches mar the approach to the Olympic village of Lake Placid, New York. Elsewhere in the Adirondacks, roadside pines and white cedars are turning a sickly red and brown. Scientists at the Adirondack Ecological Center have also measured significant salt levels in creeks below deiced highways. This came as no surprise, but what did surprise the scientists was to find salt levels increasing throughout the summer following rain storms. The discovery confirmed one of the most serious aspects of deicing salt — its components stick around long after the salt has done its job!

The reach of salt from where it has been spread is also alarming. In the Adirondacks, salt was found in mist among the trees more than 100 yards from a lightly-used highway. In Chicago, not a tree or shrub in the entire Morton Arboretum is safe from the spray of freeway salt. Damage has been recorded as far as 413 yards from the tollways that pass the arboretum.



Transects extending from the edge of a tollway into Morton Arboretum near Chicago verified the airborne spread of salt to distances greater than previously believed. Samples of white pine needles taken at 200-foot intervals in April were used to obtain salt concentrations in foliage.

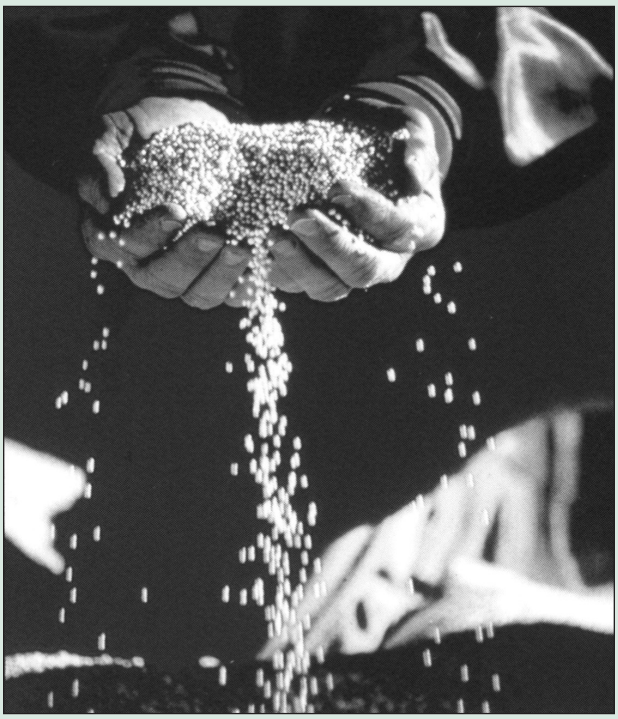
How to Prevent Damage to Trees

Adding more and more salt to the environment cannot continue indefinitely without serious consequences. For public safety, deicing will always be necessary. But the time has come to look closely at alternatives to doing business as usual. By whatever means, a community goal should be to reduce the use of sodium chloride on streets and sidewalks as quickly as possible.

CMA: The Environmentally Friendly Alternative

CMA, or calcium magnesium acetate, is a small, pellet-like substance manufactured from dolomitic lime and acetic acid, the main ingredient of household vinegar. It is an effective deicing material that biodegrades quickly in the soil, and when used in reasonable quantities, it does not contaminate water supplies, and does not harm plants or cause significant corrosion. The product was introduced commercially in the mid-1980's and is now available across North America. Almost any highway expert will agree — CMA is the answer to the dilemma of public safety vs. the environment.

The problem with this alternative? Cost! While rock salt is abundant and easy to mine, the process necessary to produce acetic acid, or acetate, is expensive. Current research is seeking ways to lower the cost by using waste products such as sewage sludge or cheese whey, and results for at least some price reduction are encouraging. But currently, the purchase price of salt is only $30 to $50 per ton compared to about $900 per ton for CMA. Scientists and economists argue, however, that the real cost of salt is much higher than CMA. Economist Donald Vitaliano of Rensselaer Polytechnic Institute points out that in New York salt actually costs the public $830 per ton, not even including its impacts on the environment. Other studies have reported salt's true cost at $1,500 per ton!



Cryotech Deicing Technology

	CMA	Rock Salt
Soil:	• Biodegradable. • Increases soil permeability.	• May accumulate in soil. • Breaks down soil structure, causing compaction and erosion.
Trees/Shrubs:	• Little or no adverse effect.	• Can damage foliage, reduce vigor and result in death.
Groundwater:	• Little mobility in soil; unlikely to reach groundwater.	• Highly dissolvable and readily reaches groundwater. Increases alkalinity and can affect private and public wells.
Surface Water:	• Some potential for oxygen depletion at high concentrations in closed systems. • Decomposes rapidly.	• In lakes and ponds, affects density, stratification, and reoxygenation. • Increases runoff of heavy metals, nutrients and soil through increased erosion.
Corrosion:	• 20 to 40 times less damage to concrete. • Can actually slow salt-induced corrosion.	• Degrades concrete. Corrodes reinforcement bars, car bodies, cables, etc.

Adopted from: "Calcium Magnesium Acetate Deicer" by Carl J. Fritzche. *Water, Environment & Technology*, January, 1992. Used with permission.

What Street Maintenance and Institutions Can Do

✔ Substitute safer deicing chemicals for rock salt. When not possible for general use, a product such as CMA should be used in areas of high landscape value, including landscaped interchanges, tree-lined parking lots and streets with planted median strips.

NOTE: In the 1991 Highway Act, Congress included a provision for 80 percent reimbursement to States using CMA on bridges, overpasses and their approaches.

✔ Develop a plan based on weather conditions, grade, intersections and similar considerations in an effort to identify opportunities to reduce salt usage.

✔ When possible, substitute abrasives (sand, cinders, gravel) for salt, with a maintenance strategy that includes prompt clean-up to prevent dust and clogged sewers. Even by mixing sand with salt, salt use can be significantly reduced. Sand is about 1/4 as expensive as salt, so there is also an immediate savings to the budget that can compensate for clean-up costs or help pay for substituting CMA for salt.

✔ Monitor salt spreading equipment and its operators carefully. Adopt strict policies that eliminate spreading salt beyond the actual path of traffic. The performance of spreading equipment is affected by type of salt, grain sizes and moisture content. Use only equipment with spread-pattern control and calibrate each machine for the salt actually being used.

✔ For areas such as narrow streets, parks and parking lots, use the smallest size truck possible. This is another way to control exactly where salt is applied.

✔ Store salt in a covered building with an impermeable floor. Prevent overloading trucks, and promptly clean up any spills. Storage and loading areas should be located away from ponds, marshes or other environmentally sensitive areas.

✔ Pre-wet abrasives and salt to increase performance at low temperatures, reduce the amount needed, and help prevent "bounce" to roadside areas. Acetate-based liquid deicers are safest, but liquid calcium chloride is better than using rock salt without a pre-wetting agent.

✔ Use mounds on median strips to facilitate runoff of salt-laden water, away from planted trees.

✔ Plant salt-tolerant tree species or cultivars in areas where salt spray or runoff is unavoidable.

✔ Encourage research that continues to develop safe, cost-effective deicing substances.

Vermont Uses Surface Heat Sensors

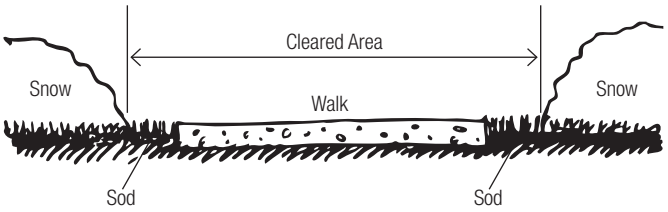
To reduce the use of road salt through better timing, the Vermont Agency of Transportation has installed high-tech sensors on their trucks. The devices measure the temperature of the road's surface rather than air temperature, since it is where tires meet the pavement that is the critical factor in determining when to de-ice. According to *Governing* magazine, the agency hopes that "smart salting" will save as much as $642,000 annually in de-icing costs, not to mention reducing environmental impacts.

Highway Equipment Co., Cedar Rapids, Iowa

The use of a small truck helps place salt exactly where it is needed rather than in adjoining areas of grass, trees, and shrubs.

What Property Owners, Landscapers and Grounds Workers Can Do

Individuals who are responsible for keeping walking space safe during winter have numerous alternatives to the use of salt. There are also some ways to counter the effects of salt contamination.

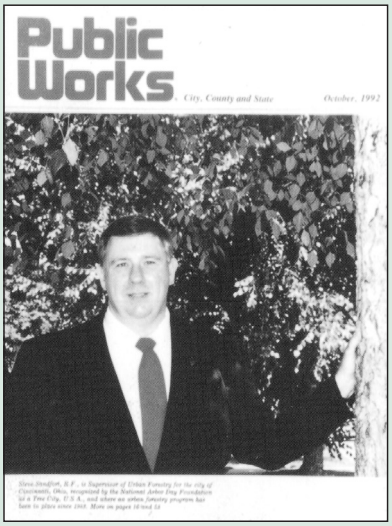


- ✔ When possible, clear snow by shovel, blower or blade before it becomes compacted and icy. By clearing several inches beyond the walk, later melting is more likely to penetrate into the soil rather than running onto the walk and freezing.
- ✔ Use alternatives to salt such as gravel, coarse sand, cat box litter, or chemicals such as CMA, urea or other products containing no sodium or chlorine. (NOTE: Use urea with care. It is a nitrogen compound that can over-fertilize vegetation and "burn" plants and tree roots.) If not available, ask your store manager to buy and promote safe products. If necessary to choose between rock salt (sodium chloride) and calcium chloride or potassium chloride, the latter two will have less toxic effects on trees and shrubs.
- ✔ Prevent salt-contaminated snow from being piled over the root zones of trees.
- ✔ Where salt splash or spray from a nearby street or highway is a problem, erect a solid barrier to protect shrubs, or wrap them in burlap for the winter. Also, avoid planting trees in "dishes," or water basins, where salt contaminated water can accumulate. Plant flush with surrounding soil.

istockphoto.com / sleddogtwo

Many options are available to end the use of deicing salt on sidewalks and plazas.

- ✔ To desalinate soil in problem spots such as planters, containers, or where young trees have received heavy salt runoff, "flush" thoroughly with water in early spring. Spreading gypsum ($CaSO_4$) first will help even more. Arboriculture expert Richard Harris recommends 4 to 8 inches of irrigation water for each 4 inches of medium-textured soil.


Public Works
City, County and State
October, 1992

Cooperation Is the Key

The late Steve Sandfort, a long-time Friend of Tree City USA, was a strong believer that the interests of urban forestry can be better served through working with the street and highway maintenance people rather than condemning them for the problems created by deicing salt. Steve was supervisor of urban forestry for the City of Cincinnati. In 1992 he had the honor of being featured on the cover of Public Works, a popular trade journal for city engineers and highway maintenance personnel.

Steve used to say that public safety and budget constraints have made it necessary to purchase salt instead of the more costly but environmentally safe products. However, through cooperation, the city now uses smaller trucks to better control the spread of deicing salt on streets with planted median strips. The city has also agreed to landscape interchanges with salt-resistant species.

Cooperation and adequate funding are the keys to reducing the amount of rock salt for now and finding safe, more inexpensive alternatives for the future.

Salt Tolerant Trees

Where it is not possible to keep salt away from areas where trees will be planted, select species that are more likely to survive on the site. Here is a list of commonly planted trees adapted from a more complete list developed by the Morton Arboretum.

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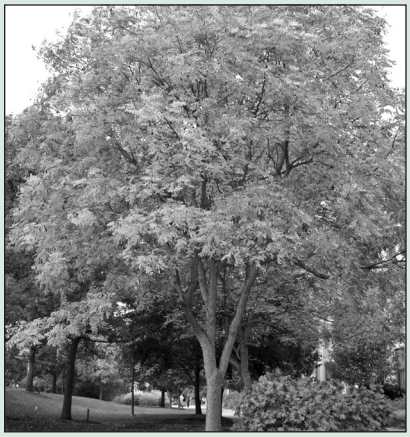
The Colorado Blue Spruce is tolerant of salt.



The Kentucky Coffeetree has intermediate tolerance to salt.

Growth Award Opportunity

A workshop on ways to reduce salt would qualify for 6 points toward a Tree City USA Growth Award under category D7, "Special Program to Eliminate Destructive Practices." Ten points are needed in one year to win this community-wide honor. The workshop might be for public and institutional employees who are responsible for winter sidewalk and road clearance, or for the public at large. For a complete list of requirements and qualifying activities, contact the Arbor Day Foundation or your state forester's office.

Tolerant of Salt

- Ash
- Baldcypress
- Birch, Paper
- Buckthorn, Common
- Butternut
- Elm, Siberian
- Honeylocust
- Horsechestnut
- Larch, European
- Locust, Black
- Maple, Norway
- Maple, Silver
- Mountainash, Showy
- Mulberries
- Oak, English
- Oak, White
- Poplars
- Russian-Olive
- Tree of Heaven
- Walnut, Black
- Willows
- **Evergreens**
  - Junipers
  - Pine, Austrian
  - Pine, Jack
  - Spruce, Blue

Intermediate

- Ash, Blue
- Birch, European
- Birch, River
- Birch, Yellow
- Boxelder
- Buckeyes
- Catalpas
- Cherry, Choke
- Cherry, Pin
- Coffeetree, Kentucky
- Corktree, Amur
- Dogwood, Flowering
- Dogwood, Pagoda
- Elm, American
- Elm, Chinese
- Elm, Red
- Ginkgo
- Hickory, Bitternut
- Hickory, Shagbark
- Ironwood
- Magnolia, Cucumbertree
- Maple, Amur
- Maple, Japanese
- Maple, Paperbark
- Mountainash, American
- Mountainash, European
- Oak, Black
- Oak, Bur
- Oak, Chinkapin
- Oak, Post
- Osage-Orange
- Pear, Callery
- Pecan
- Persimmon, Common
- Plum, Wild
- Yellowwood
- **Evergreens**
  - Douglasfir
  - Fir, White
  - Pine, Ponderosa
  - Spruce, White

Intolerant

- Alders
- Beeches
- Cherry, Black
- Dogwood, Corneliancherry
- Filberts
- Hackberries
- Hawthorns
- Hornbeams
- Larch, American
- Lindens
- Maple, Black
- Maple, Red
- Maple, Sugar
- Oak, Pin
- Oak, Red
- Oak, Scarlet
- Oak, Swamp White
- **Evergreens**
  - Arborvitae
  - Hemlock
  - Pine, White
  - Pine, Red
  - Pine, Scots
  - Spruce, Norway

NOTE: Crabapples vary by cultivar.

How Wildlife is Being Affected by Salt

Numerous research studies have documented the negative effects of road salt on trees and aquatic ecosystems. With salt levels rising in surface and well waters in many parts of the country, the findings might also be viewed as a warning about human health.

One example of the effects of salt in lakes, ponds and marshes can be seen in New York's Adirondack Park. Some 85 percent of the rising sodium chloride levels in Adirondack lakes can be traced to road salt – ironically, in a land area set aside in 1885 by the state legislature to maintain a pure water source for downstream cities. In a study by scientists at Syracuse University, it was found that populations of spotted salamanders and wood frogs decreased with proximity to roads. Further experiments demonstrated the sensitivity of the creatures' eggs and larval stages to salt, leading the scientists to recommend reduced road salt applications near wetlands.

A study at Saint Mary's University in Nova Scotia arrived at much the same conclusion, but found that American toads were little affected by salt and green frogs and spring peepers showed intermediate sensitivities. The scientists pointed out that community structure in roadside wetlands can therefore be altered by excluding salt intolerant species. On a wider scale, elevated levels of salt contribute to algal blooms and damage to fish and native aquatic plants while at the same time encouraging the spread of salt-tolerant invasive species like Eurasian water milfoil.

istockphoto.com/Mark Kostich

The spotted salamander might be the 'miner's canary' of aquatic life.

For More Information

Publications and sources of more research about de-icing salt can be found at **arborday.org/bulletins.**

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