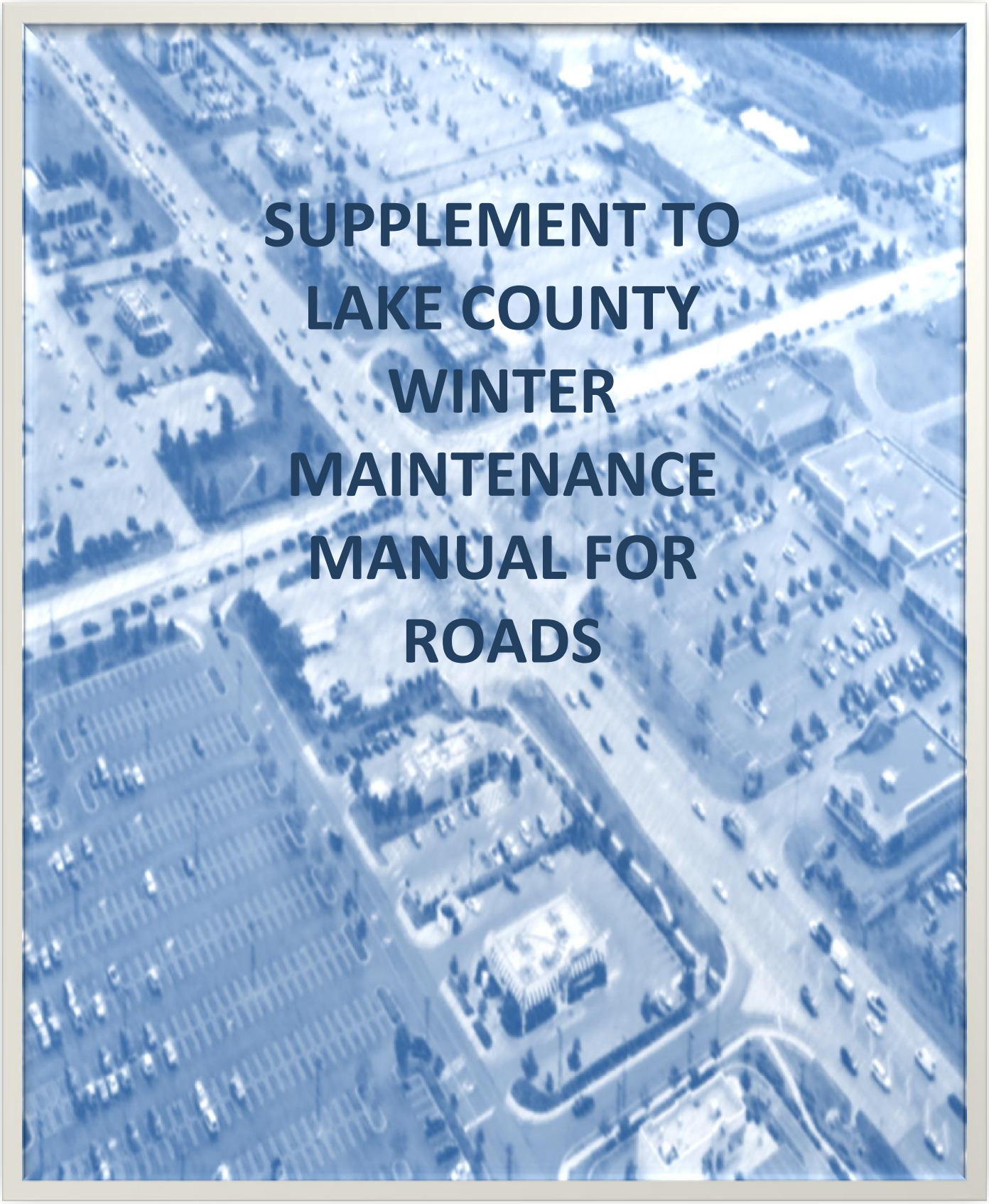


SUPPLEMENT TO LAKE COUNTY WINTER MAINTENANCE MANUAL FOR ROADS

Lake County Deicing Numbers

There are 3,910 road miles in Lake County totaling 22.8 square miles, and 8,640 acres totaling 13.5 square miles of parking lots. Salt (primarily sodium chloride) is commonly used for winter maintenance to remove snow and ice from these roads and parking lots. Figure 1 reflects the amount of salt purchased by Lake County government jurisdictions via the state contract price from 2009-2013.

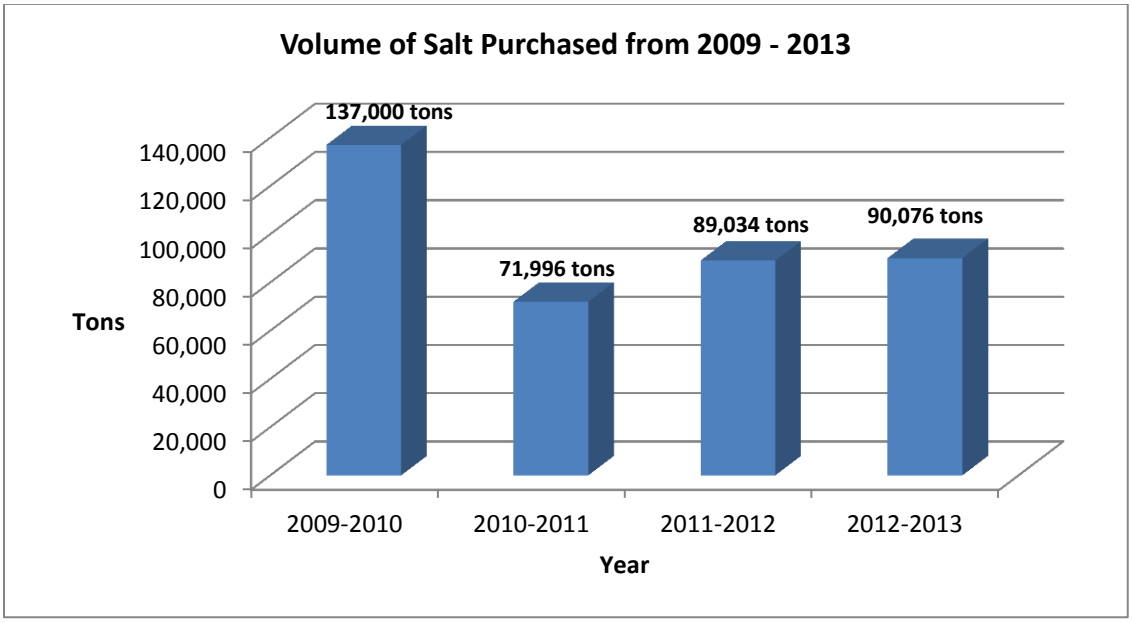


Figure 1. Changes in volume of salt purchased from 2009 to 2013.

Note: There have been several winter seasons where additional salt was purchased from other suppliers or salt just wasn't available for purchase. For instance, the volume of salt that would have been purchased had it been available in the 2013-2014 winter season is greater than the amount shown in the state contract price purchases depicted in this graph. A total of $14,262,032 was spent on salt purchases in the 3 years from 2010-2011 through 2012-2013.

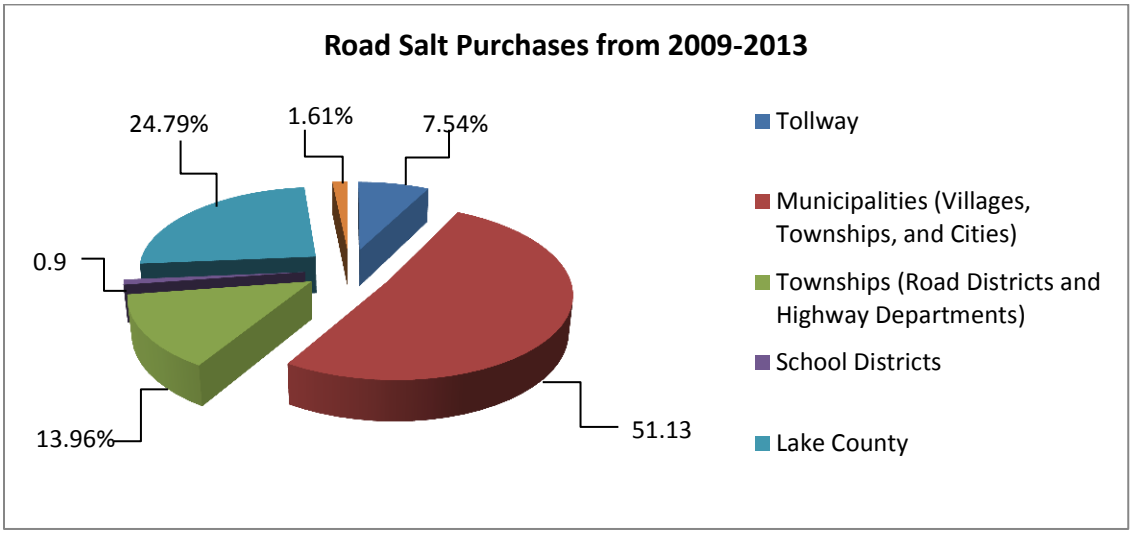
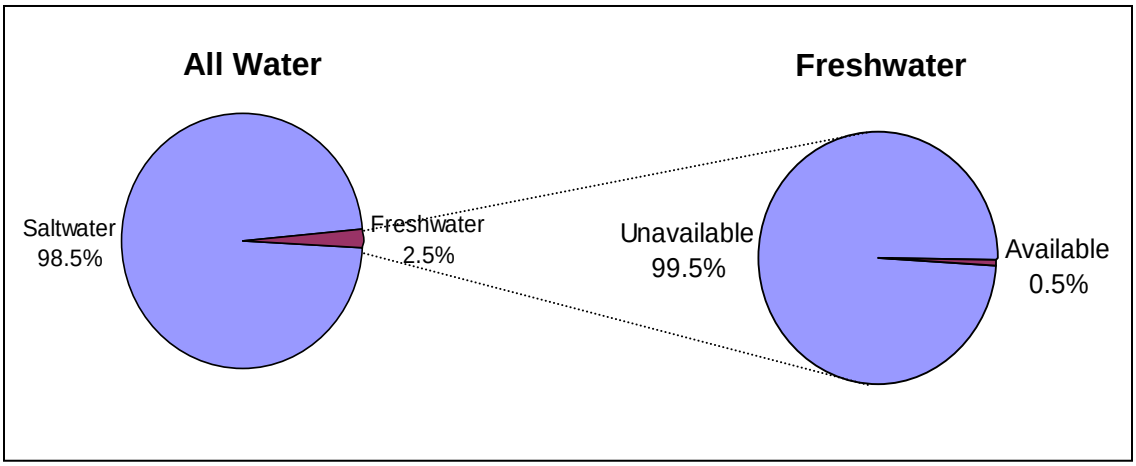


Figure 2. The distribution of road salt based purchases from 2009 to 2013.

One ton of rock salt ($65-$70) causes greater than $1,450 in corrosion damage to bridges. (Sohanghpurwala 2008)

Water and the Environmental Impacts of Deicing Materials

- Only 2.5 percent of all of the water on this planet is freshwater (not saltwater). Of that, less than 1 % is available for use. The majority of freshwater is frozen in the glaciers (*Freshwater Crisis* n.d.).



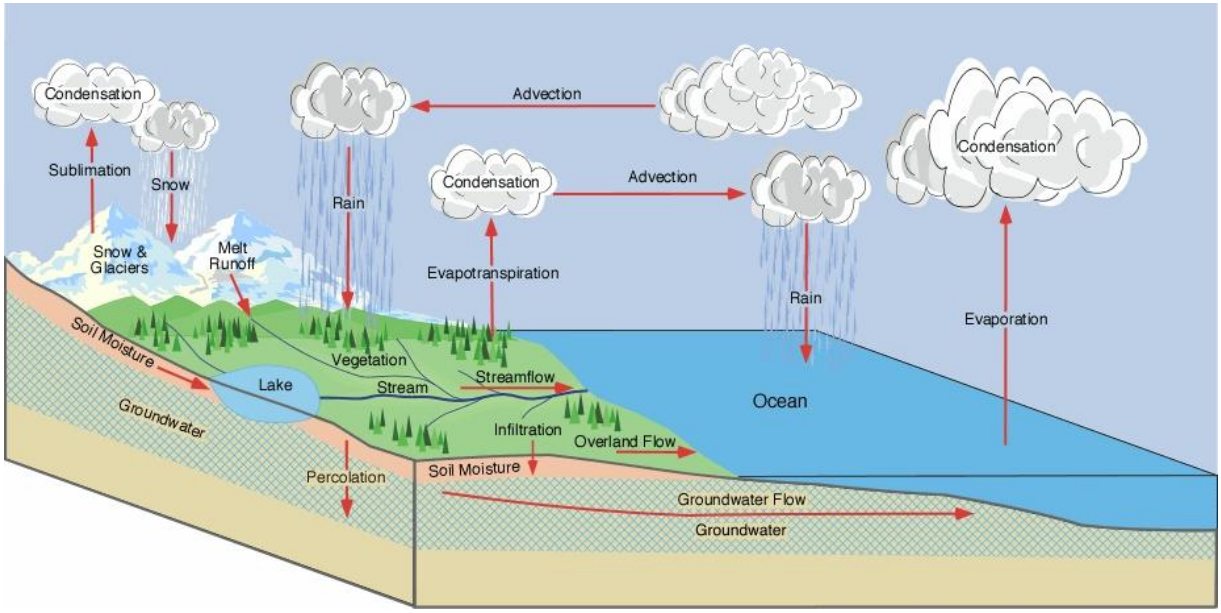


Figure 3. Available Water (*Freshwater Crisis* n.d.) and the Water Cycle (USGS hydrocycle)

- Water is recycled over long periods of time. We have a limited supply of water on this planet. Water is reused, recycled and dispersed as illustrated above.

Chloride concentrations are increasing in many surface waters in Lake County and throughout the Chicago metropolitan area.

- There are 169 lakes, river and stream segments in Lake County that are polluted enough to be on the 2012 federal list of impaired waters. The Skokie River, Middle and West Forks of the North Branch Chicago River, the Des Plaines River, Fox River, Buffalo Creek and Fiddle Creek are among the Lake County waters listed as being impaired by chloride. (For a list of Illinois' impaired waters, see http://www.epa.state.il.us/water/water-quality/index.html.)

- Lakes in Lake County have been monitored by the Lake County Health Department between April and October since the late 1980s. In general many county lakes are becoming more saline with increased road salt use. In 2013, the average concentration was 145 mg/L, with the highest concentration being measured in the first sample collected in early spring.

- Nearly 18% of water samples taken from Lake County lakes from 2005-2013 had chloride concentrations greater than the US EPA chronic standard of 230 mg/L. Maximum concentrations in Lake County exceeded 2,300 mg/L in lakes and over 8,000 mg/L in winter runoff.

- Between 2005 and 2013, chloride concentrations have dropped from the highest levels in a number of these lakes. This variation is due to the wetness of the year and the dilution that occurred in the lakes during relatively wet years.

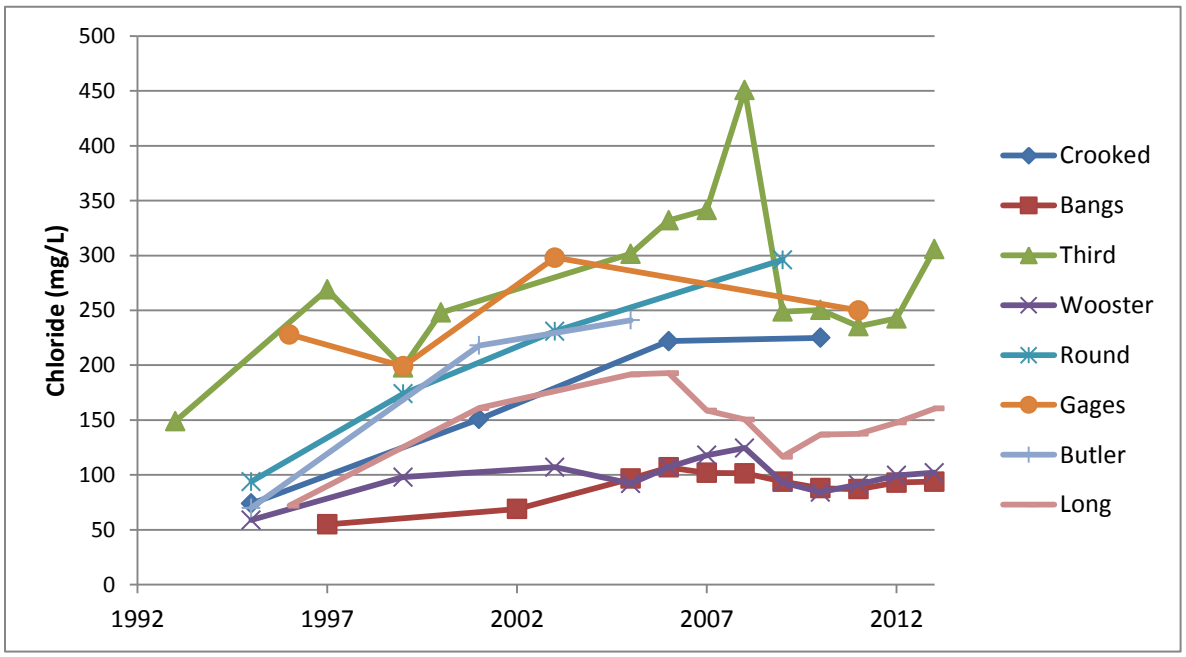
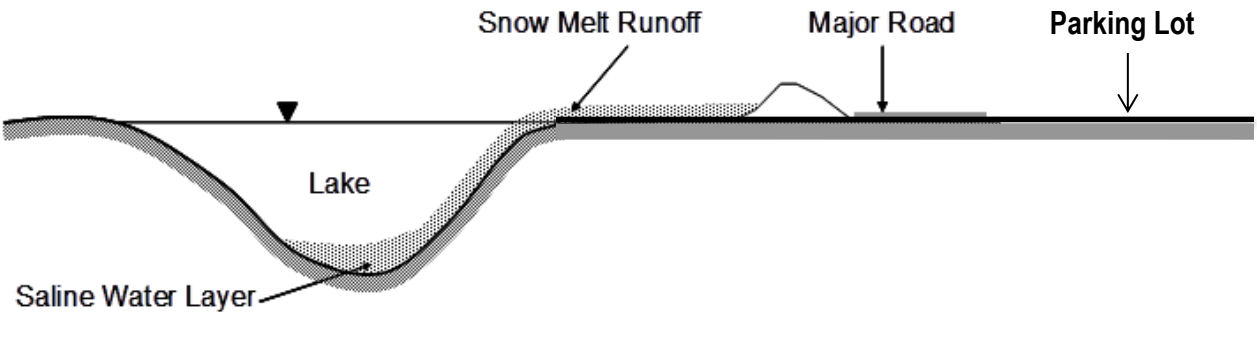


Figure 4. Trends of chloride concentrations in deep water samples on a subset of lakes in Lake County Illinois.

Fathead Minnows will die if exposed to chloride concentrations of 443 mg/l for more than 30 days (http://duluthstreams.org/understanding/impact_salt_2.html)

- Chloride is virtually a permanent pollutant that does not degrade and cannot be removed from surface waters. Once in the water, it continues to accumulate in the environment over time. Salt from paved surfaces dissolves flowing into the nearest storm drain with stormwater and snowmelt runoff or moves downhill to the nearest lake, river or pond.

- The concentration of chloride is increasing in our surface waters and groundwater. Salt water is heavier than freshwater and sinks to the bottom of the lakes. This may cause chemical stratification of the lake and loss of or changes in lake turn over (Stefan et al. 2008). The consequences of this can lead to a change in species and nutrient composition that could have devastating effects on the entire lake ecosystem.



Modified from Sander et al. 2008

Figure 5. Schematic of a saline water intrusion into a lake

Reduced road salt use = reduced salt in lakes and streams.

- Chloride concentrations exceed the state standard in some lakes and ponds. Several Lake County golf course and landscape ponds once used for irrigation can no longer be used because high chloride concentrations are killing plants. This necessitates finding expensive alternatives for irrigation.

- Chloride is also beginning to contaminate groundwater drinking sources in some locations. In a recent report published by the United States Geological Survey (USGS, 2009), 20 of 797 groundwater wells were discovered to have chloride concentrations greater than the concentration limit of 250 mg/L for drinking water (United States Environmental Protection Agency (USEPA, 1992)).

- Road salt runoff has reduced plant diversity in wetlands of Northern Illinois. Very high chloride concentrations have produced wetlands that can only support cattails and other halophilic (salt tolerant) vegetation.

- Reverse osmosis treatment is the only way to remove salt from water. This treatment is very expensive and not practical for our lakes, rivers, groundwater and wetlands. Therefore pollution prevention is important.

Deicers can be very damaging to both soil and vegetation. Efforts to keep salt off vegetation are needed: drive slower when applying deicers, turn down spinner speed to reduce spread pattern, use drop spreaders on sidewalks, store snow piles on hard surfaces, and reduce application rates. Sources of information about salt-tolerant plants include the Plant Selector Tool from Minnesota Department of Transportation http://www.mda.state.mn.us/plants/pestmanagement/eab/eabmanual/dotplantselector.aspx or University of

Wisconsin Extension Cooperative Extension publication *Winter Salt Injury and Salt-Tolerant Landscape Plants,* https://pdf.countyofdane.com/myfairlakes/A3877.pdf .

Salt spray damages budding and branching of trees.

Figure 6: "Witch's broom" branching from salt spray

Impacts of Materials

Abrasives and deicers cause problems to infrastructure, drainage, water, vegetation, and soils when used in large quantities.

Abrasives: Winter Sand

- Runs off parking lots with water to the nearest storm drain entering lakes, wetlands, streams, and rivers.
- Fills in surface water bodies, accelerating the aging process.
- Covers habitat and disrupts the food chain.
- Irritates the gills of fish.
- Sand can carry with it other pollutants and nutrients that can have other negative effects on our lakes.
- Sand also tends to clog roadway drainage systems, which can cause flooding if not cleared.

Deicers are not "environmentally safe," regardless of what the bag says.

About one teaspoon of salt can pollute five gallons of water. This applies to all chloride containing deicers.

Chlorides: commonly used for deicing are Sodium Chloride (road salt), Magnesium Chloride, Calcium Chloride, and Potassium Chloride.

- Road salt is the least expensive and most widely used deicer.
- Salt is corrosive to steel.
- Some products have corrosion inhibitors and anti-caking agents added that are often toxic.
- Chlorides frequently damage plants through contact or by interfering with soil properties.
- Salt can cause soil to lose its ability to retain water, leading to soil erosion.

- Excess salt can make soil more alkaline and compact, and less permeable, making it more difficult to store nutrients that plants need to grow.
- Chlorides cannot be removed by stormwater ponds, bioswales, rain gardens or other best management practices (BMPs) used to absorb and filter stormwater runoff.
- Chlorides cannot be removed from lakes, wetlands and rivers, and are persistent pollutants that will not break down over time.

Acetates can have a high biological oxygen demand (BOD), and can contribute to oxygen depletion in soil and water. Use carefully.

Acetates:

- Are non-chloride compounds.
- Are an organic substance.
- When added to water, compete with aquatic life for oxygen.
- Contribute nutrients which promote algal blooms in lakes and ponds.
- Most of the problems they cause in the water are relatively short term, but severe.
- Are usually safer for vegetation.
- Are less corrosive than salts.
- Have the potential to be treated by stormwater BMPs.

One lb. of phosphorus encourages growth of up to 500 lbs. of algae. Phosphorus is in plant-based products.

Plant-based additives (beet, corn, molasses)**:**

- These additives do not contribute chloride to water but contribute nutrients (fertilizer).
- Cause an increase aquatic plant and algae growth.
- Use up oxygen in the lake or water body as they decompose.
- Have serious impacts, but not as long-lasting as chloride.