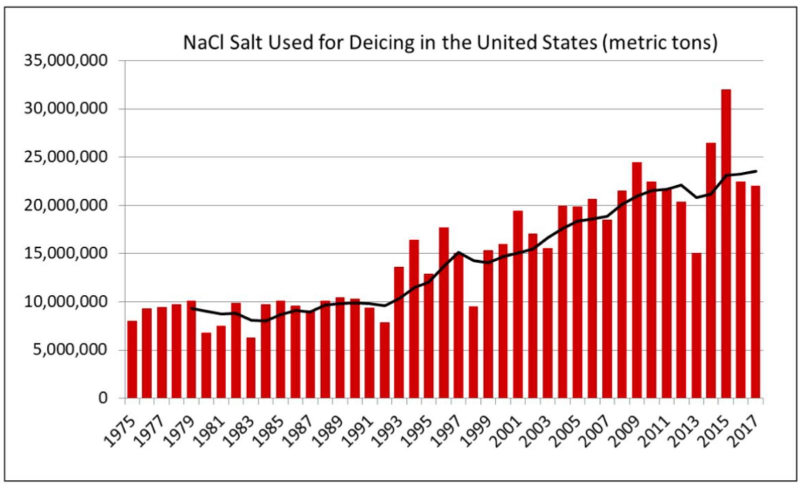
November 2024

Summary of Chloride Contamination in Vermont

Goal: Limit the impacts of sodium chloride ("road salt") through a reduction in salt use on roads and other impervious surfaces to protect water quality and reduce corrosion of state infrastructure and motor vehicles while continuing to ensure public safety. This is achievable through 'sensible salting,' the implementation of best management practices, and the use of salt alternatives.

Increased Use of Road Salt

According to the USGS, the use of road salt, primarily sodium chloride, has tripled nationwide since 1970 to over 20 million metric tons. Chloride remains in the environment as it does not biodegrade, evaporate, precipitate to form a solid, or adhere to other minerals.



(US Geological Survey, 2017, Salt statistics, in Kelly, T.D., and Matos, G.R., comps., Historical statistics for mineral and material commodities in the United States: US Geological Survey Data Series 140, available online at http://pubs.usgs.gov/ds/2005/140/)

The Cary Institute of Ecosystem Studies

Sources

The largest source of chloride is road salt and other deicing products, but salt solutions are also used on dirt roads in the summer to reduce dust. There are also some industrial sources of chloride. While studies have been conducted on road salt use and its environmental and infrastructure impacts, fewer studies have been conducted on the use of brine on dirt roads in the summer, so this is harder to quantify.

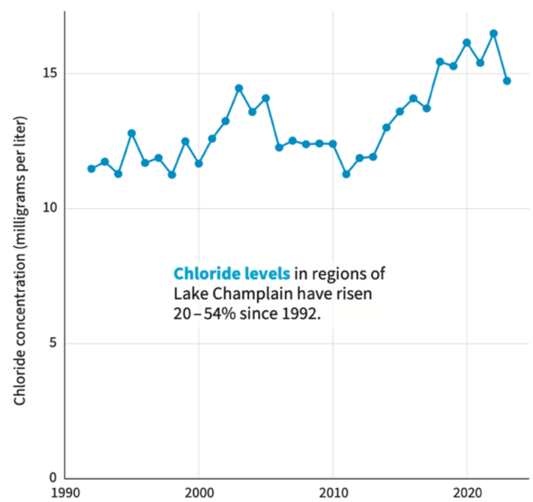
Due to their smaller sizes, headwaters and streams are more suspectable to chloride contamination impacts. With streams and rivers, there is also an initial spike during spring snowmelt. But, if chloride permeates area groundwater, low water events due to drought will cause those streams and rivers to draw in chloride contaminated groundwater. This can lead to further stressors on aquatic biota already impacted by low water and higher temperatures from the drought.

Impacts on Water Quality

Surface and grounds waters are becoming increasingly salinized from sodium chloride, largely due the de-icing practice of salt application, with smaller tributaries and some ground water sources seeing more acute loading of chloride, while larger water bodies are showing more gradual increases.

When chloride from road salt leaches into groundwater, it risks contamination of drinking water sources. This not only causes salinization of the drinking water, but the presence of chloride above certain levels causes corrosion of drinking water systems, which can result in increased levels of lead, copper, and iron in the system. Researchers have linked the high lead contamination in Flint, MI, drinking water to high chloride levels.

Chloride Contamination in Vermont

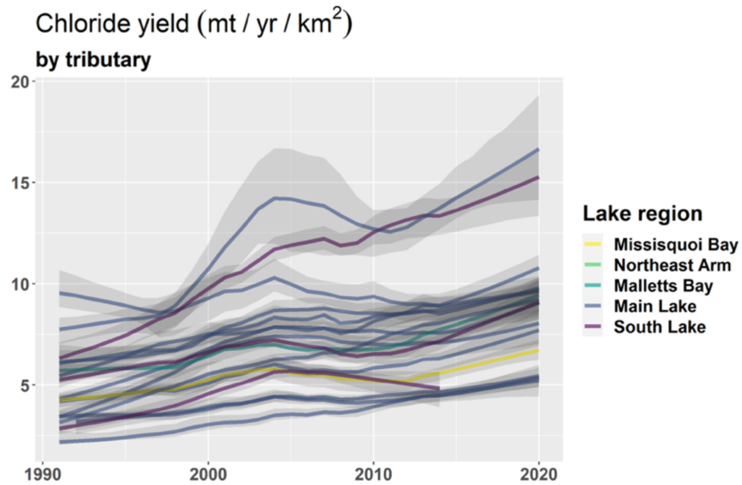


DATA SOURCE: Lake Champlain Long-Term Monitoring Program (LCBP, VTANR, NYSDEC)

Lake Champlain Basin Program, 2024 State of the Lake, pg. 17

"Road salt is a recognized contaminant in the Lake Champlain basin, which spans 21,401 square kilometers (8263 square miles) across portions of Vermont and New York in the United States and Quebec in Canada. Increasing chloride concentrations have been observed in the main lake, its tributaries, and smaller lakes within the basin over the past 50 years. Seven tributaries to Lake Champlain are impaired by chloride …."[1]

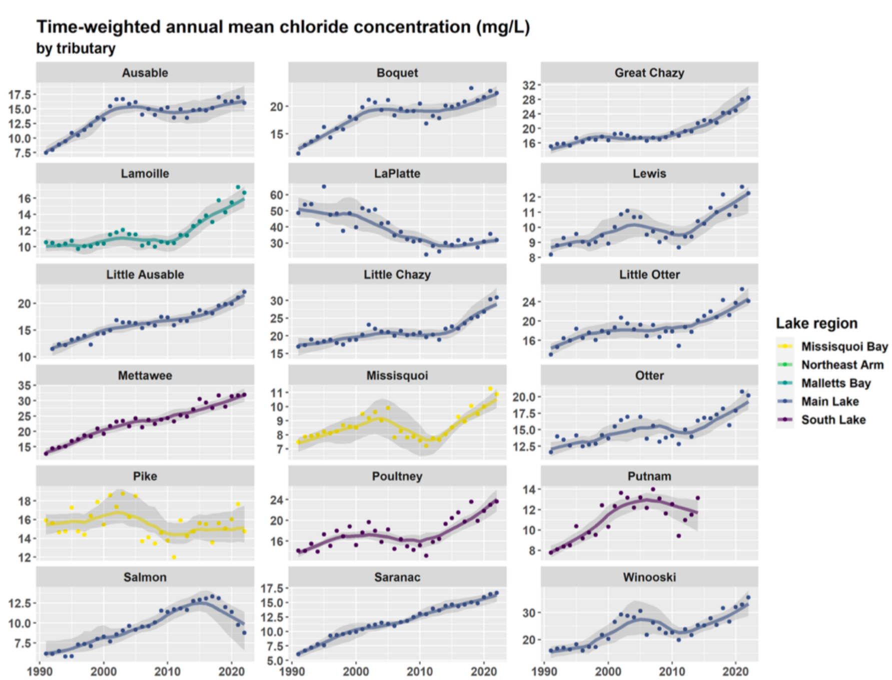
[1] Sparacino, Holden, Kristine Stepenuck and Stephanie E. Hurley, *Understanding reduced salt practices used by commercial snow removal businesses in the Lake Champlain Basin: A mixed methods analysis*, Journal of Environmental Management 351 (2024) 119957.



From Vaughan, Wiltse et al, *Multi-decadal Monitoring Reveals Salinization Impacts of Road De-icing Salt Application in the Lake Champlain Watershed*, Powerpoint presentation.

In 2014, the Vermont Dept of Environmental Conservation (DEC) added chloride to the Vermont Water Quality Standards (VWQS).

- The U.S. Environmental Protection Agency (USEPA) lists chronic levels of chloride as 230 mg/L and acute levels as 860 mg/L.
- The listing of chloride in Appendix C of the VWQS is in line with for USEPA Maximum Allowable Concentration (acute criteria) of 860 and Average Allowable Concentration of (chronic criteria) of 230.
- While due to its large volume, Lake Champlain remains below acute and chronic levels, some stormwater discharge points in Burlington have been measured over 8,000 mg/L.



Matthew Vaughn PPT, Vermont Citizens Advisory Committee,
Long-term chloride trends for Lake Champlain and its Tributaries (Feb. 12, 2024).

The Vermont 303(d) Impaired Waters List for Chloride shows elevated levels of chloride due to road salt in Englesby Brook and Potash Brook in the upper Lake Champlain region, and in Centennial Brook, Muddy Brook and Sunnyside Brook in the Winooski Basin. DEC has developed a TMDL for Sunnyside Brook in Burlington to address the chronic and acute levels of chloride in the Brook.

While many waters are below USEPA and VWQS acute and chronic levels, the steady increase in chloride levels and spikes in concentration after weather events is a cause for concern and an indication that salt use needs to be reduced before more waters reach critical levels.

Impacts on Aquatic Biota

Salinization of headwaters, tributaries, and lakes can result in biological toxicity for aquatic organisms and in physical changes to a water body, such as altering water density which affects mixing and stratification cycles.

Sensitivity to chloride levels is species-specific, but studies show that exposure to periodic high concentrations is more detrimental to species than constant exposure to lower levels. While USEPA sets acute and chronic levels, some aquatic biotas are more sensitive and therefore affected by lower concentrations.

Impacts on Infrastructure

Road salt is corrosive to steel, aluminum and reinforced concrete, which causes the rusting of the underside of vehicles, as well as faster rates of deterioration of water systems, bridges, roads, and railways.

In 2020, the U.S. Environmental Protection Agency estimated that corrosive damage to cars, trucks, bridges, and roads cost $5 billion annually in repairs nationwide.

The AAA estimates that the repair of salt-related rust damages at $15.4 billion over a five-year period (2012 to 2017), at an average cost of $490 per repairs.

Road salt contaminates surface water and can leach into aquifer systems, which can lead to contamination of drinking water sources. High chloride concentrations cause the corrosion of pipes which contributes to higher lead, copper and heavy metals in waters, particularly from older pipes. This is more apparent in urban areas with higher levels of impervious surfaces, and therefore, more use of road salt.

Elevated chloride levels were found in the drinking water system of Flint, MI, and has been linked to the elevated lead concentrations in the community’s drinking water.

However, chloride in groundwater can also infiltrate private wells, causing pipe corrosion and increased level of lead, copper and other heavy metals in drinking water systems of individual residences that are not connected to surface waters or municipal drinking water systems.

Resources

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Labashosky, Sara, *The Salty Truth: Revealing the Need for Stricter Road Salt Application and Storage Regulations in the United States*, Villanova Environmental Law Journal, (9-1-15). https://digitalcommons.law.villanova.edu/cgi/viewcontent.cgi?article=1363&context=elj

Lake Champlain Sea Grant – Road Salt & Water Quality
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Pieper, Kelsey J., et al, *Impact of Road Salt on Drinking Water Quality and Infrastructure Corrosion in Private Wells*, Environmental Science & Technology, 2018, 52, 14078-14087. https://pubs.acs.org/doi/10.1021/acs.est.8b04709

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https://www.lcbp.org/publications/concentration-load-and-trend-estimates-for-nutrients-chloride-and-total-suspended-solids-in-lake-champlain-tributaries1990-2017/

Kelly, Victoria R., et al, *Road Salt: The Problem, the Solution, and How to Get There*, The Cary Institute of Ecosystem Studies (2019).
https://www.caryinstitute.org/sites/default/files/downloads/report_road_salt.pdf