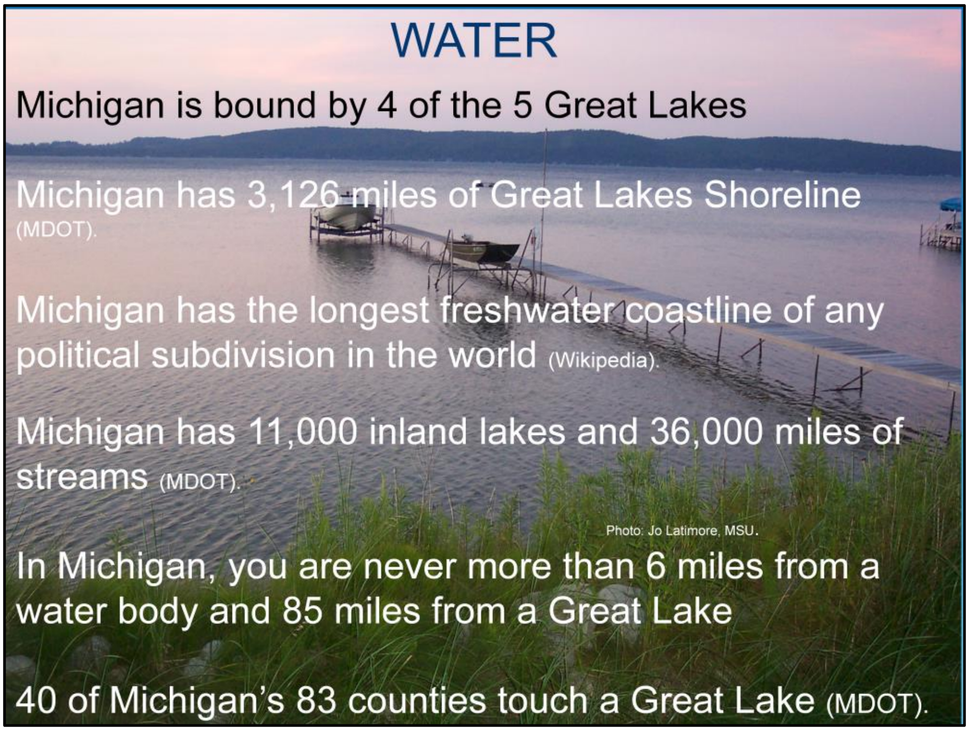
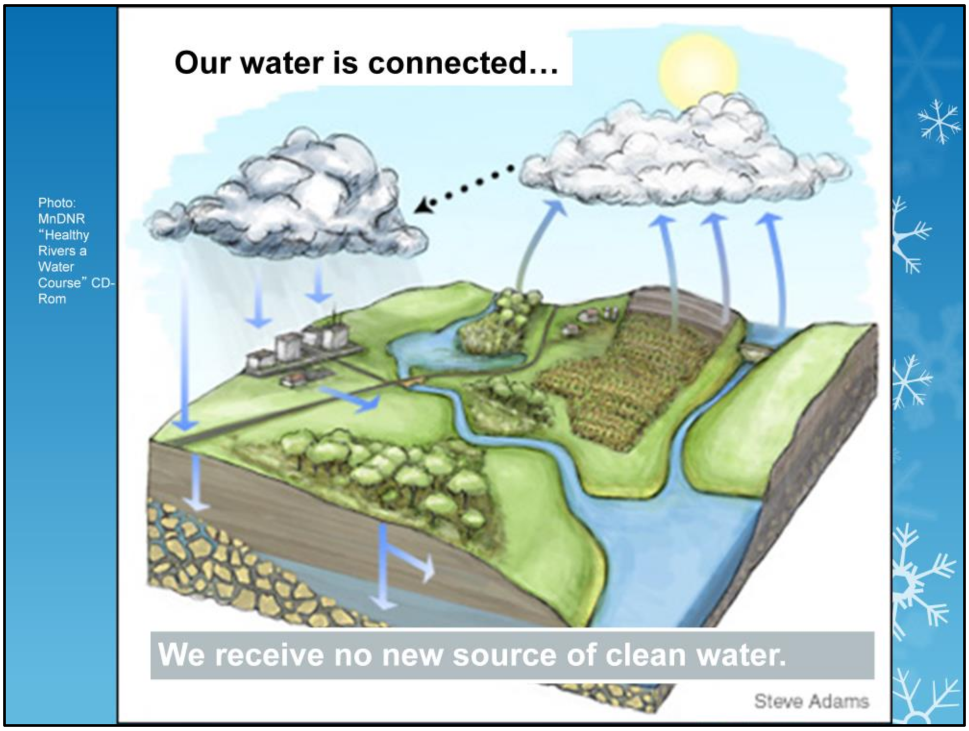
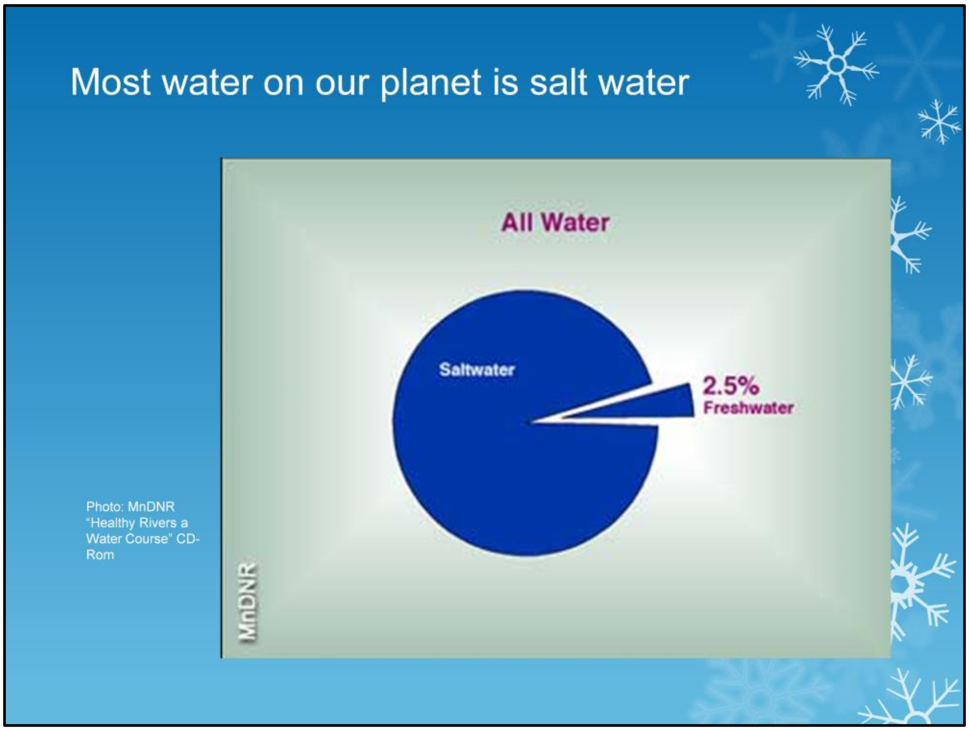
This section should set the stage for why we need to change the way we do winter maintenance. The tone should be positive and encouraging and not blaming.



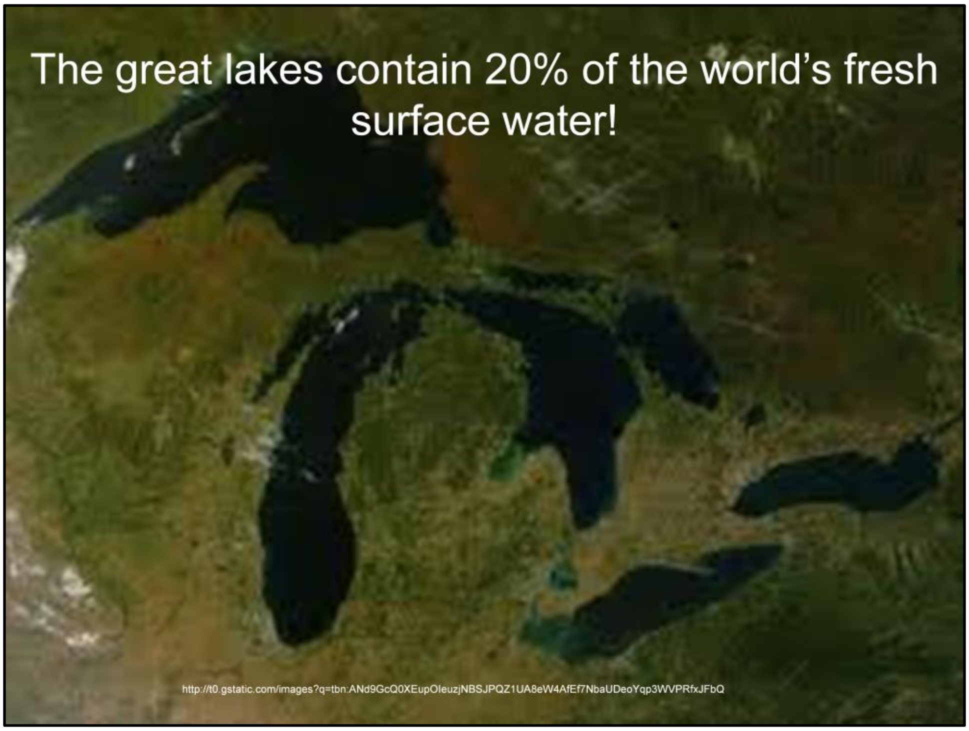
Michigan is a state filled with wonderful water resources. It is easy for us to assume that the water will always be there for us. But we need to understand some of the invisible changes that are taking place in our freshwater systems.



Our water cycle is a closed loop system. No new water is available for planet earth. We just keep reusing the water, over and over and over again, that is on this planet.



Most of planet earths water is salt water. Very small percent is freshwater. We need to try to keep our freshwater from becoming saline.



20% of the entire planets freshwater is found in the great lakes. It is very important for Michigan to protect this water for the entire planet.

Michigan list of impaired waters:
www.michigan.gov/documents/deq/wb-swas-tmdl-approvedlist_212987_7.pdf

None of these waters are listed for chloride pollution. Very few if any are listed for sediment. This is not the same as saying the lakes and rivers of michigan are NOT polluted by chloride and sediment. It is only saying the are not being tested, or submitted or possibly not polluted.

From DEQ website 2013
Michigan list of impaired waters:
www.michigan.gov/documents/deq/wb-swas-tmdl-approvedlist_212987_7.pdf

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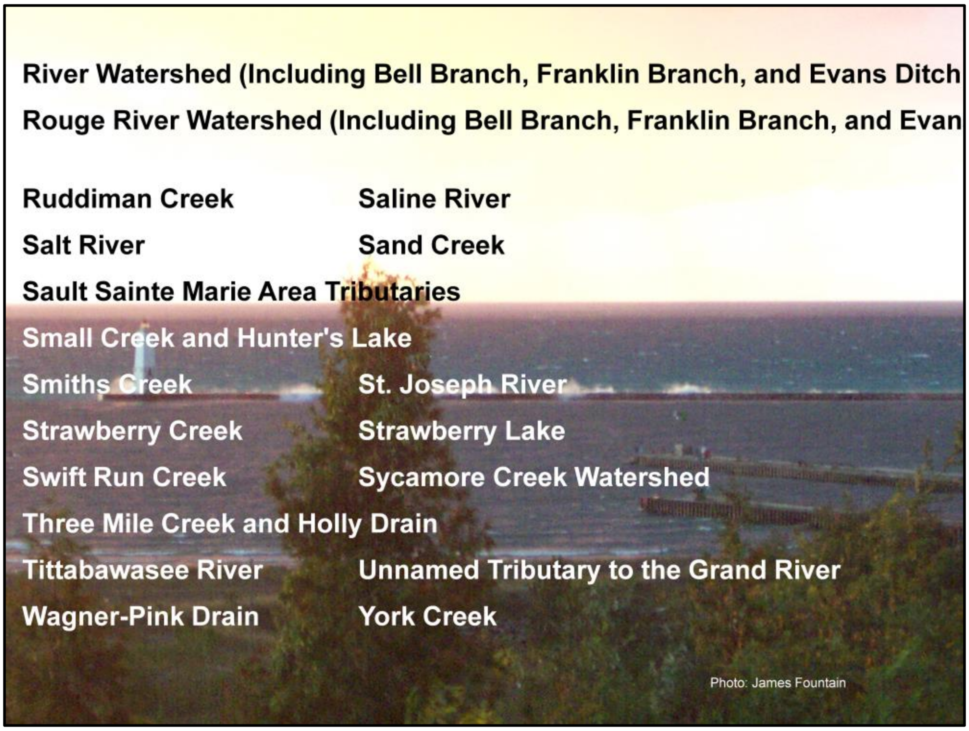
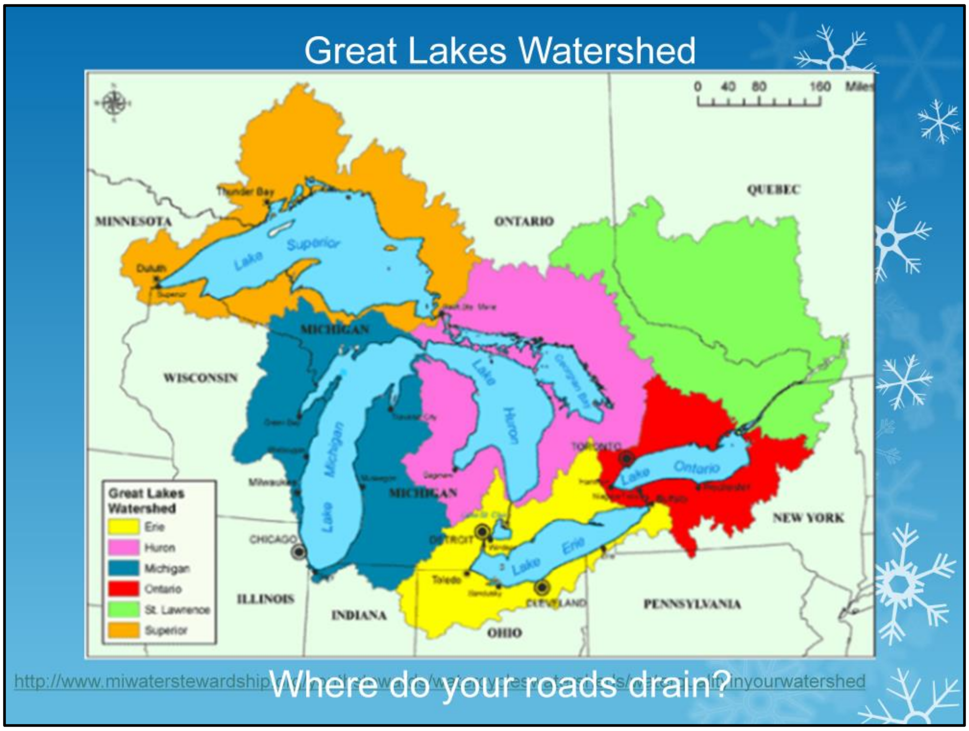


From DEQ website 2013
Michigan list of impaired waters:
www.michigan.gov/documents/deq/wb-swas-tmdl-approvedlist_212987_7.pdf

The people in the best position to protect our water are those that work on the land. Winter maintenance professionals are perfectly placed to do a world of good as far as water protection.
This section will explain the link between land use and water quality related specifically to the chemicals used in winter maintenance.

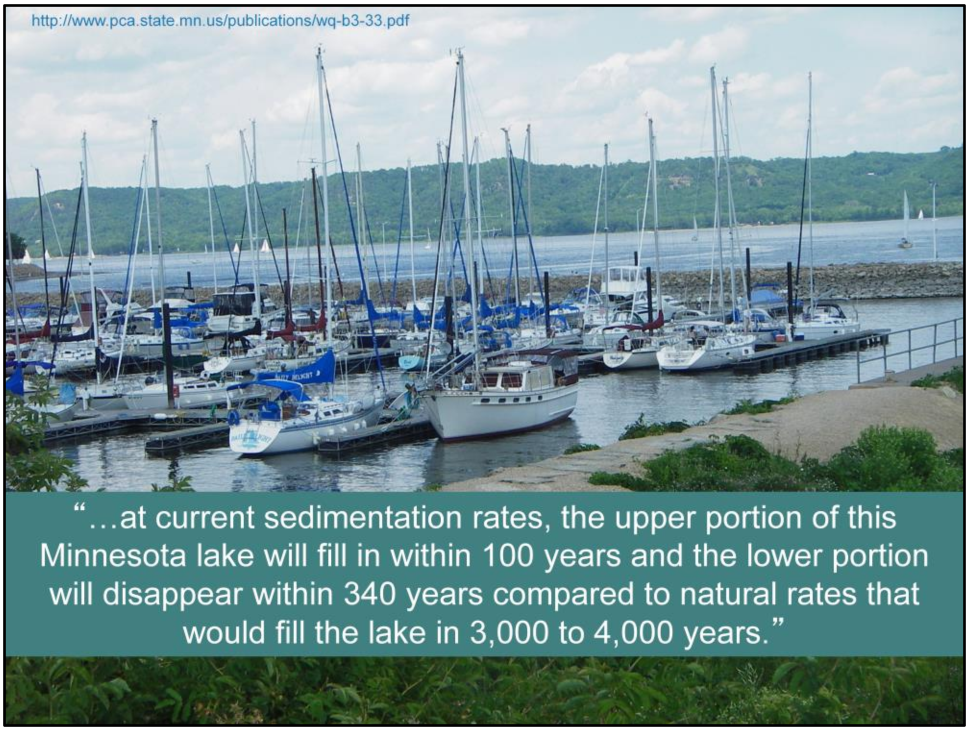


This allows you see which great lake you influence. Figure out where your roads are on this map and you can tell which lake they drain too. You might be surprised at how far away you can be and still influence the great lakes.

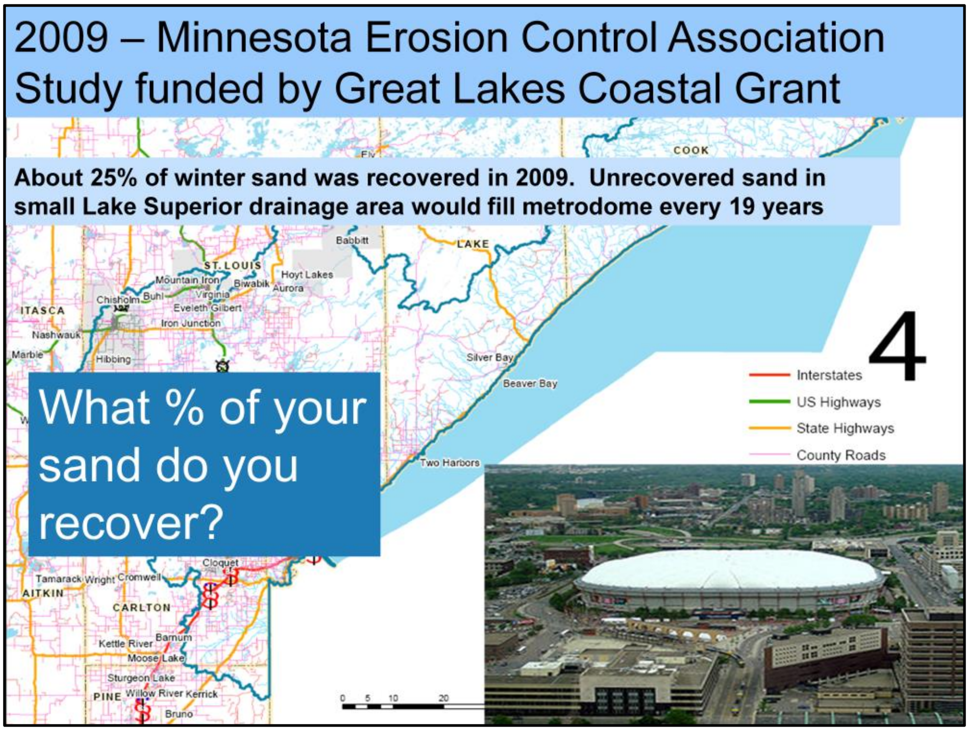
Sand was more popular in the past than it is today. Mostly because we the traveling public demand a higher level of service than sand can provide.

One of the problems with sand is it doesn’t stay put. It very quickly migrates out of the wheel paths. Once it is out of the wheel paths it never returns to the wheel path and is essentially useless.

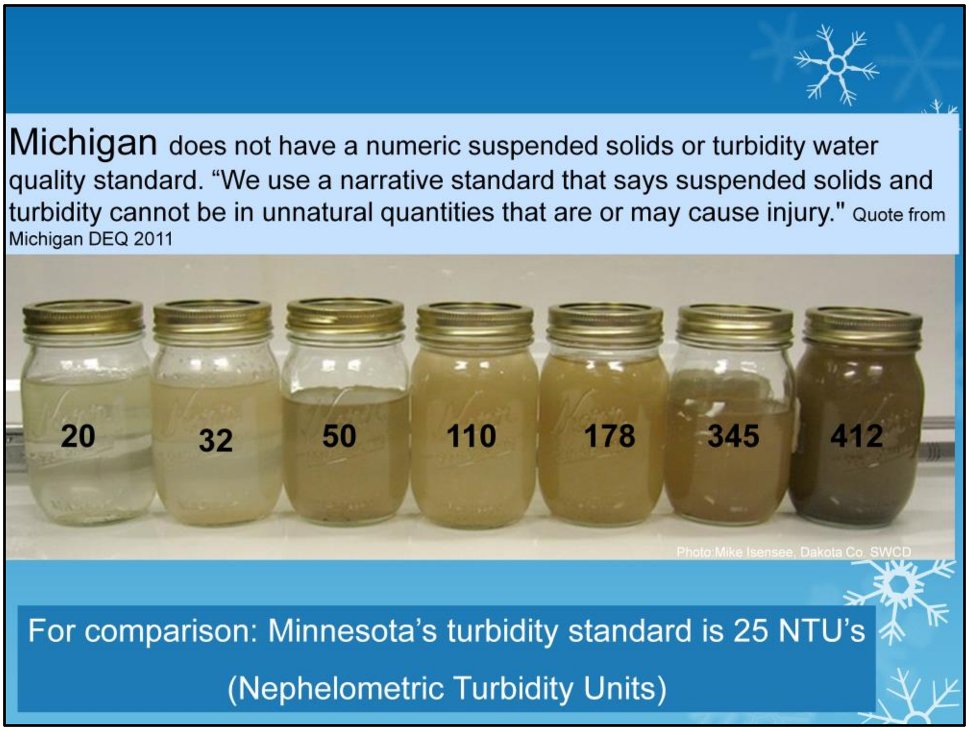
A good example of sediment transport. We rarely get a birds eye view of the problems we contribute to. But would be a great training tool if we did.



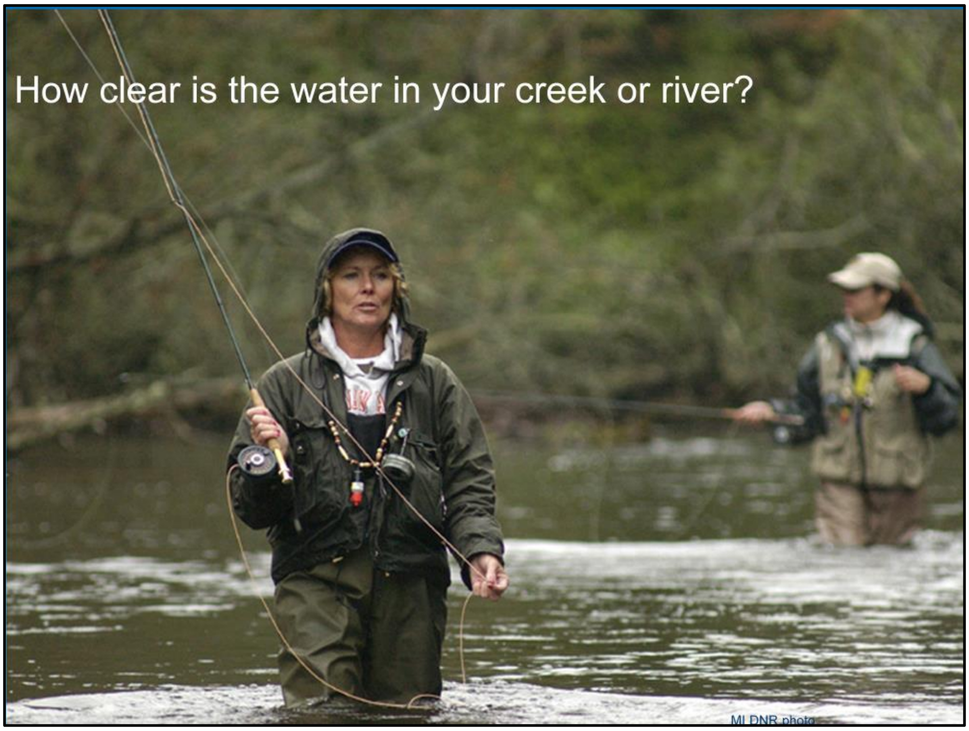
Lake Pepin in MN
Explain how lakes fill in and age. Our land use accelerates the aging and filling in process. We should work to slow down the aging process. List what contributes to increase sedimentation: poor erosion control, winter sand, agriculture, sand we bring to our beaches and so on



Northern MN sand recovery rate is about 75%. What is yours? All unrecovered sand migrates to the low point in the landscape…our waters.



According to the DEQ: impacts from suspended solids (TSS) are uncommon on the impaired waters list. However impacts from low Dissolved Oxygen (DO) and Biota are common. Those TMDLs usually look to control TSS as a method to fix DO or Biota.
Dave Drullinger DEQ – email correspondence 2013

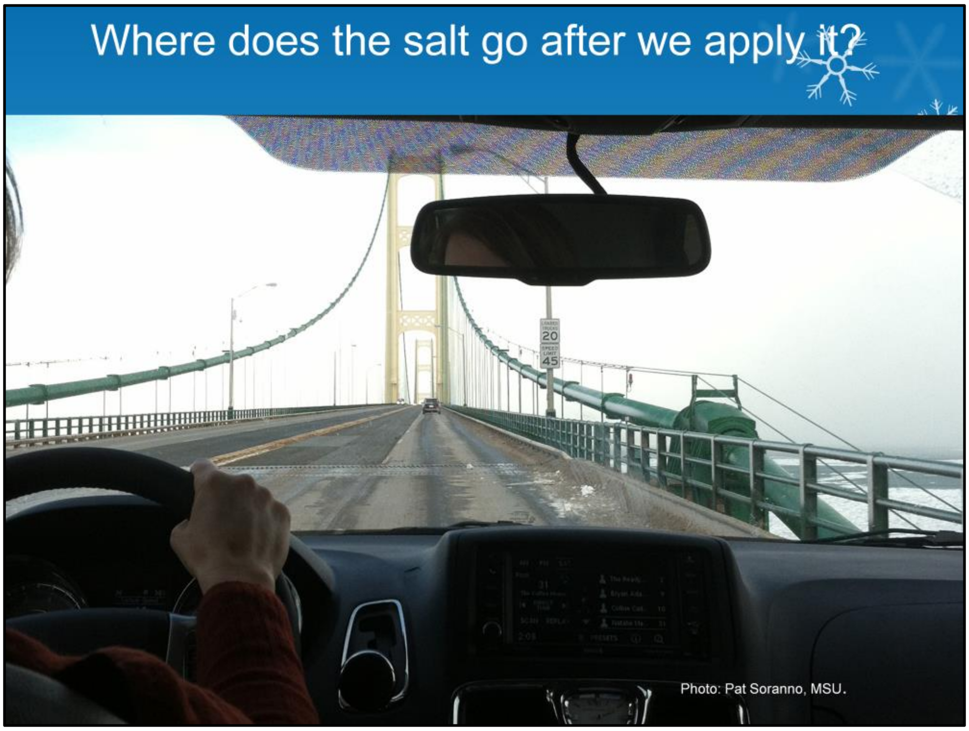


Take time to look at the creeks in your service area.   You now have a way to tell if they are healthy or struggling with sediment. A good school project for your kids is to take jars of water from several creeks and compare the clarity. It tells a story.

Salt is what we use as our primary winter maintenance tool across the country. We have been salting for over 50 years. Salt also goes to the low spot in the landscape but it not as visible as sand so it is easily ignored.

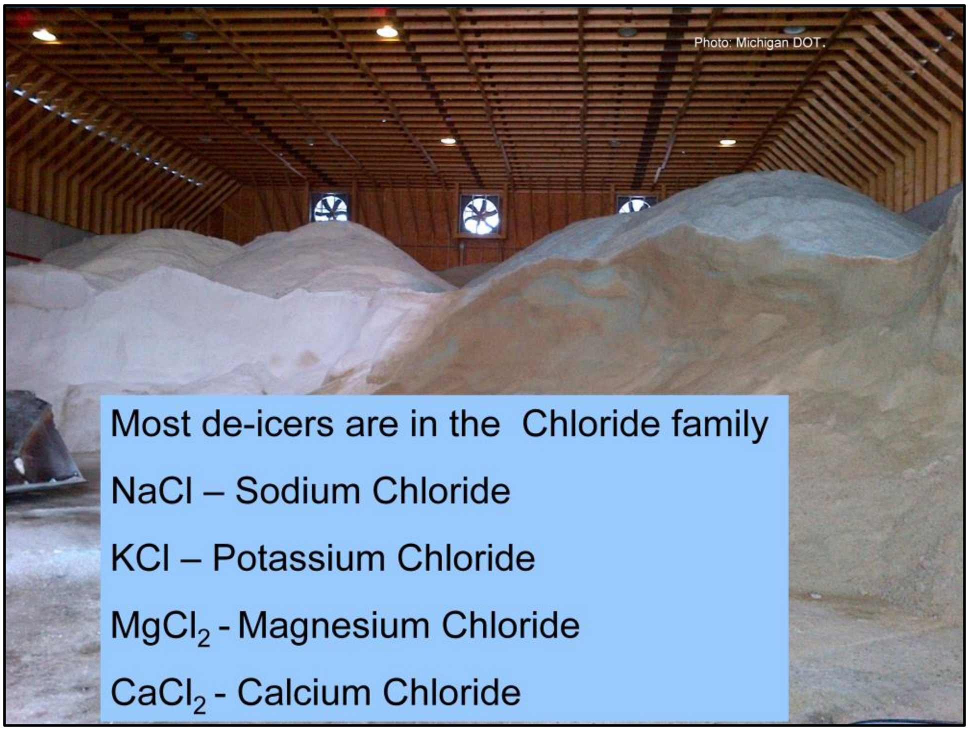
Salt gives us higher performance in the winter, it melts ice and gives us clear roads. It is a tool we are highly dependent on.

Salt accumulates in the water. Because of this our concern is growing. We have been salting for many years and so our concentration of salt is on the rise.



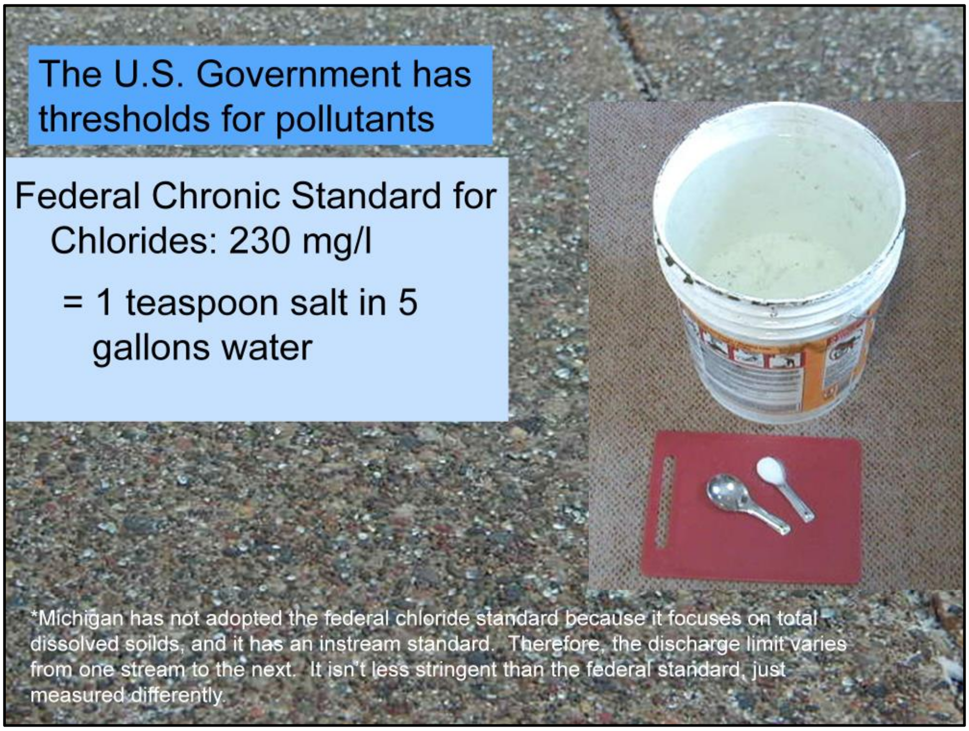
It is easy to see that salt from this bridge would end up in the water but often it is not intuitive that salt from roads ends up in the water.

If we took a glass of water and added salt to it we could not see it but we could taste it. If we covered the glass and put it into the cupboard for 20 years, then uncovered the glass and took a sip we could still taste the salt. This is a simple way to explain that salt does not biodegrade or go away.



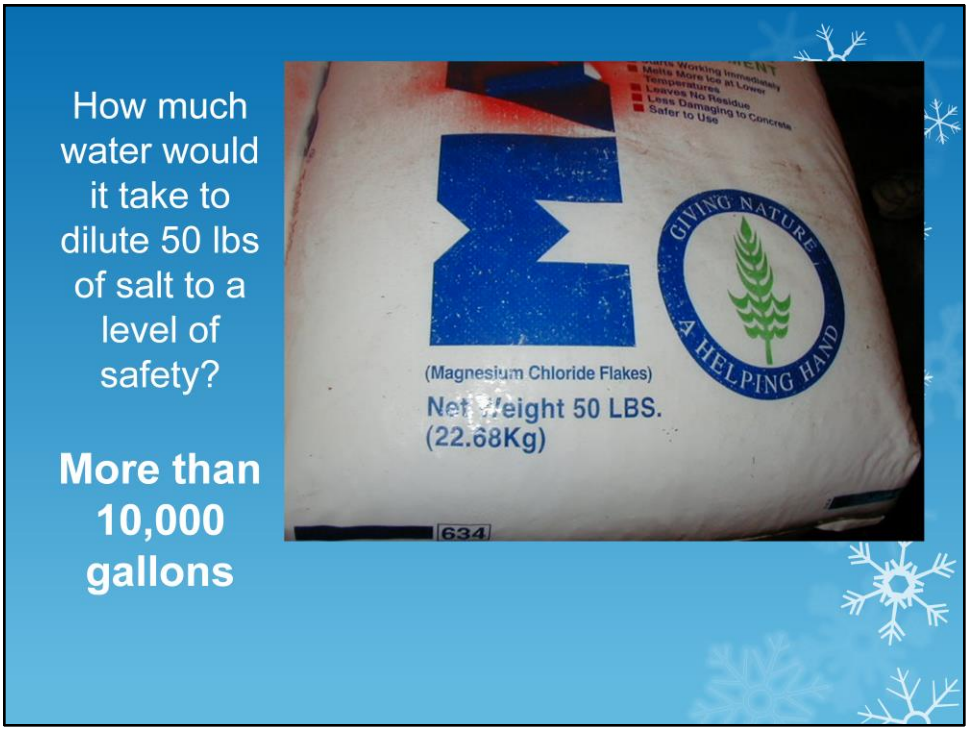
There are other chloride de-icers. All of them create an accumulation of chloride in the water. They all have different properties as de-icers which will be explained later in the ppt.

The most common ingredient in de-icers is chloride.



Michigan has not adopted the federal standard. MI standard is much more complex involving total dissolved solids. Michigan's standards vary depending on several variables:
General waters of the state not to exceed 500 mg/l monthly average (lakes, rivers)
Drinking water not to exceed 125 mg/l monthly average
Great lakes and connecting waters not to exceed 50 mg/l monthly average

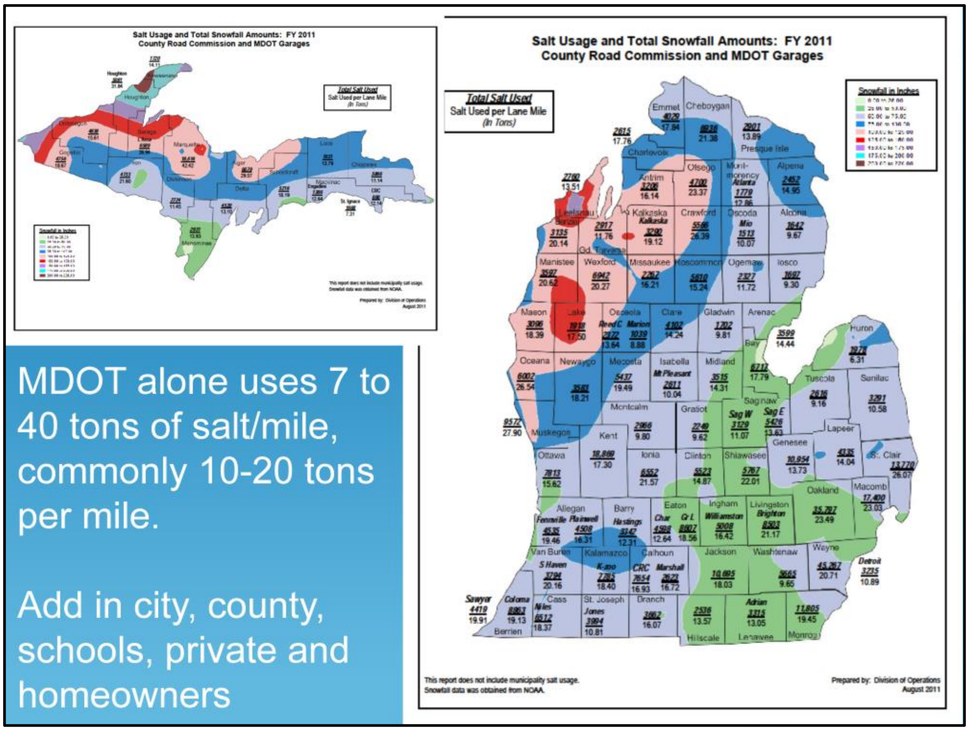
See R 323.1051 from Michigans Part 4 Rules (Water Quality Standards) Dissolved Solids for more information and current information.
However in discussions with Dave Drullinger DEQ "the 1 teaspoon in 5 gallons of water is imprecise enough that it approximates both the federal and state standards so go ahead and use it"



By using the crude estimate of 1 teaspoon of rock salt pollutes 5 gallons of water we have approximated that 50 pounds of rock salt pollutes 10,000 gallons of water to the federal chronic chloride standard of 230 mg/l. This is a conservative estimate.

1 tandem load of salt can easily contaminate
8 million gallons of water…YIKES!

By using the crude estimate of 1 teaspoon of rock salt pollutes 5 gallons of water we have approximated that a ten yard load of rock salt pollutes 8 million gallons of water to the federal chronic chloride standard of 230 mg/l.



MDOT used approximately <u>526,450 tons of salt</u> and 111,750 tons of sand (statewide total) from November 2010 to May 2011 for what was a relatively heavy winter. MDOT used approximately <u>343,150 tons of salt</u> and 67,800 tons of sand (statewide total) from November 2011 through May 2012 for what amounted to a relatively light winter. (Source: MDOT Website)

A chemo cline is formed with salt as the more dense salt water settles to the bottom.   This can affect the seasonal turn over of the lake.

When monitoring for salt make sure to monitor in the winter and at the bottom of the lake.

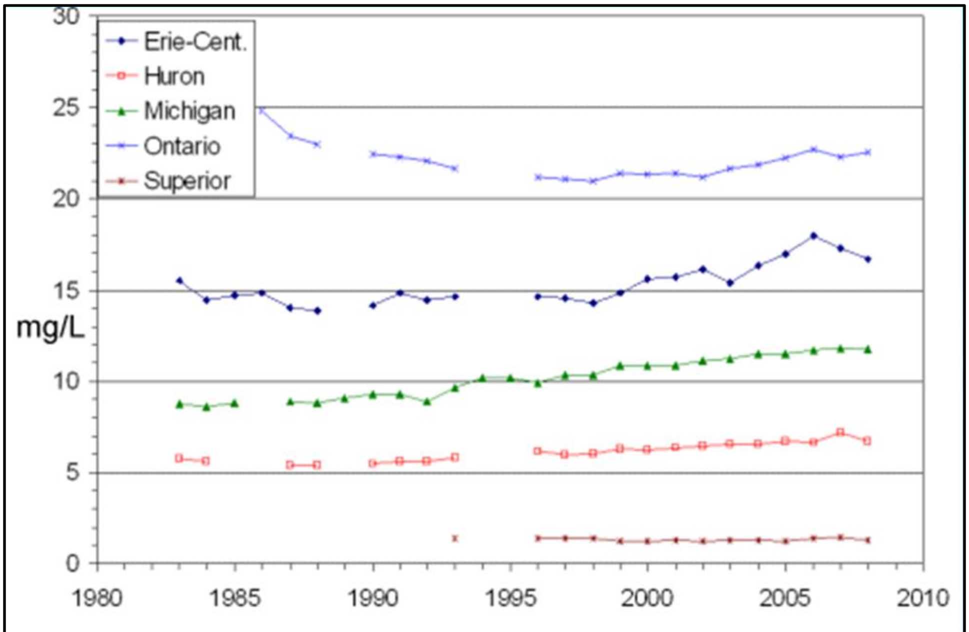
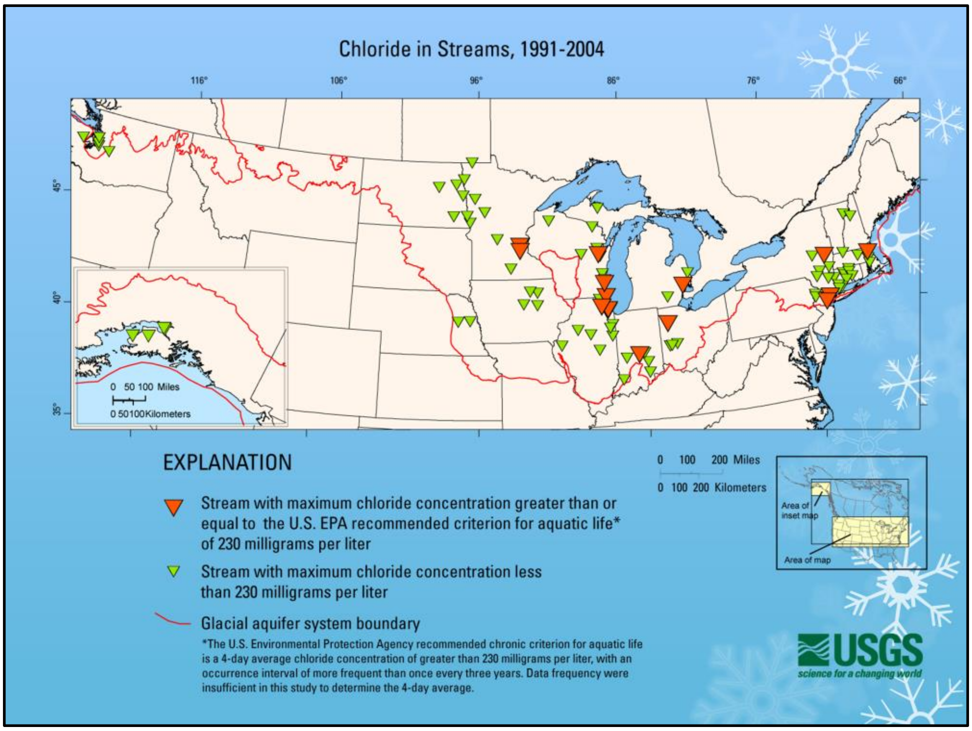
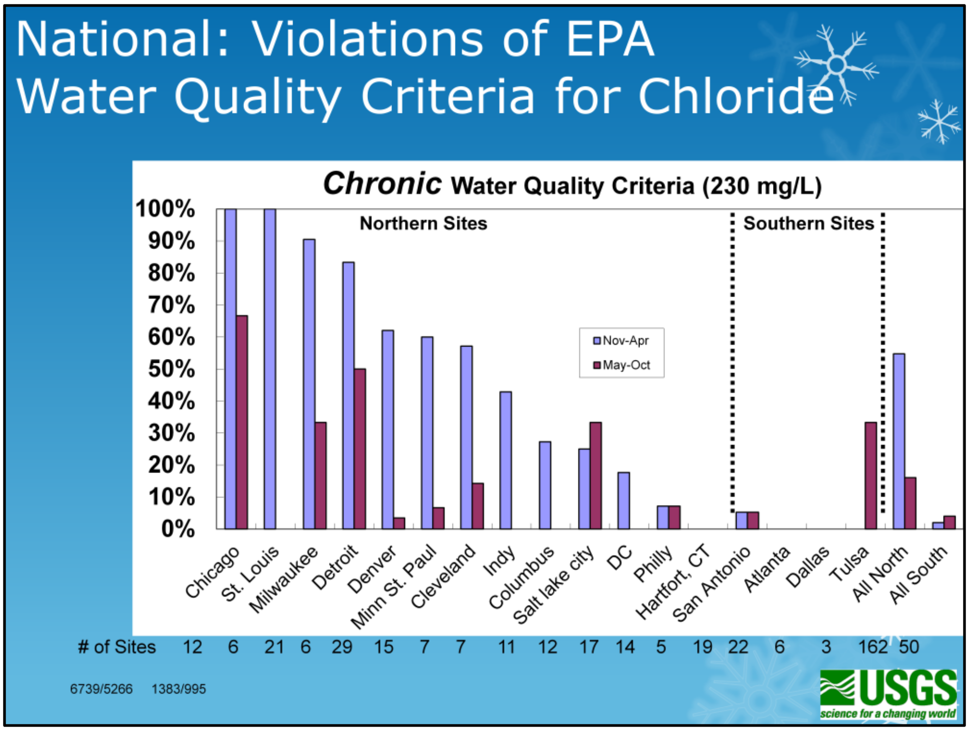


Table1. Chloride trends in the Great Lakes from 1983 to 2008
(Data from U.S. EPA's Great Lakes National Program Office annual spring program.)

Salinity trend in the great lakes. It is astounding to think of how much salt must be received in the lakes to show an upward trend since there is so much water for dilution.



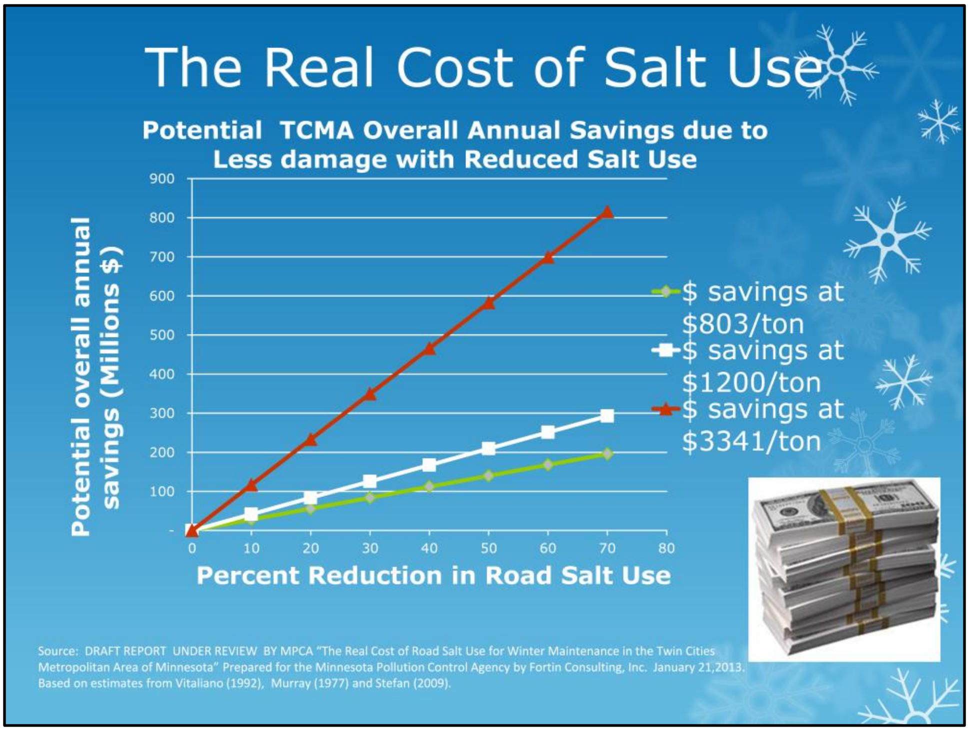
This is an older USGS study on chloride exceedences across the US. Next chart is more recent but this is a good chart to visualize what is happening.



USGS study by Steve Corsi 2010
Blue lines winter sampling, purple lines summer sampling.

To illustrate the extent of the problem we use a MN creek. This creek flows through 5 or 6 suburbs of Minneapolis. There is nothing highly industrialized just an area of urban sprawl with houses, apartments, shopping malls, resturaunts, parks, schools and so on. The analysis shows a 71 % reduction of salt use is needed in the watershed to reduce the levels in the creek to meet federal standards.

If this creek were in your service area what changes would you make to reduce your salt use 71%? Would you or would you not figure out a way to make the reductions? It wouldn't be easy.



Source: DRAFT REPORT UNDER REVIEW BY MPCA "The Real Cost of Road Salt Use for Winter Maintenance in the Twin Cities Metropolitan Area of Minnesota" Prepared for the Minnesota Pollution Control Agency by Fortin Consulting, Inc. January 21,2013. Based on estimates from Vitaliano (1992), Murray (1977) and Stefan (2009).

The bottom line : Vitaliano estimated additional costs of $803 per ton of salt for repair and maintenance of roads and bridges, vehicle corrosion cost, and loss of aesthetic value due to roadside tree damage (1992).
Middle line: Stefan took these estimates and adjusted them for inflation to 2008 dollars and came up with a value of $1200 per ton of salt (2009).
Top line: Estimates of damage to water supplies and health, vegetation, highway structures, vehicles, and utilities due to road salt were completed based on an extensive literature search and several surveys (Murray et. al 1977). The researchers concluded that the national cost of salt-related damage approaches $3 billion which was about 15 times the cost of the salt and its application. The researchers found that the highest direct costs were from vehicle damage, but the most serious damage was to water supplies and potential impact on health. Using the figure of damage at 15 times the cost of salt and its application, for the TCMA, this would result in damage estimates of $3341/ton (based on weighted average cost of $72.77/ton for salt and $150/ton for application (Stefan 2009).

Road salt is expensive- Add it Up

Item	Cost
Material (salt) \$55/ton[1]	\$55/ton
Labor and Equipment to apply salt[2]	\$100/ton
Damage from use of salt[3]	\$800 - \$3300/ton
Total cost:	**\$1000 - \$3500/ton**

Sources: [1]MDOT (2013), [2]MDOT(2013) [3]Vitaliano (1977) and Murray et. al (1992)

This is another way to look at the cost involved in using salt. It may be easier to look at this way because we can see the $ per ton to purchase salt, the $ per ton to apply salt and the $ per ton to fix problems.

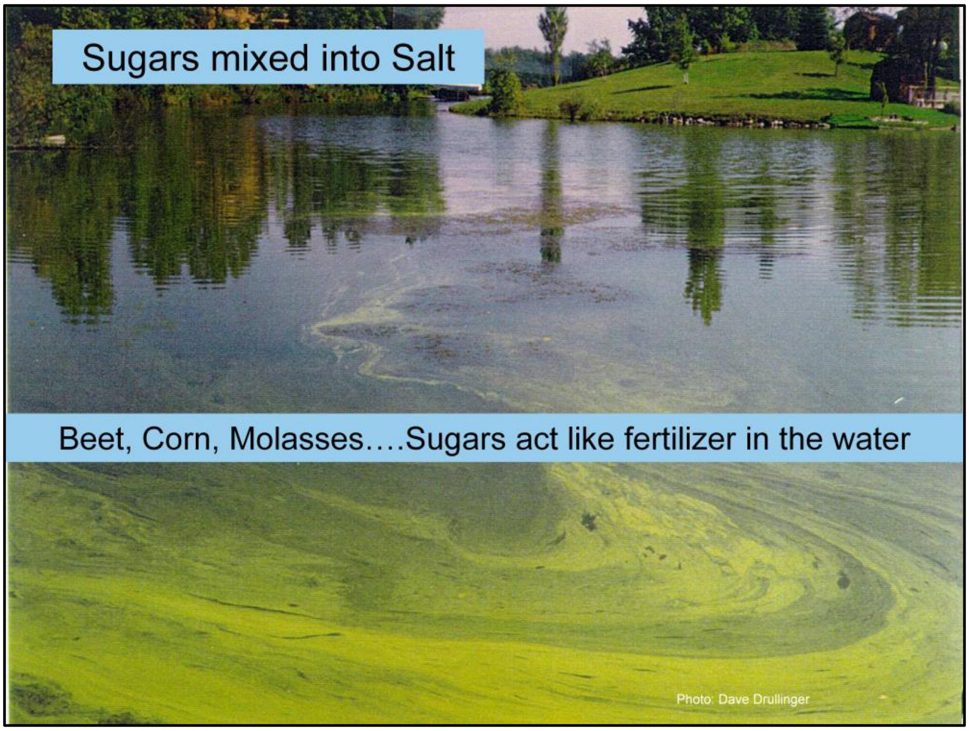
Is this accurate for your operation? Maybe not but you can make your own chart keep track of $ per ton to buy salt and other de-icers, The $ per ton to apply it and then keep track of the maintenance and repairs you have to make to your vehicles, bridges, roads, guard rail, signs, vegetation, leather boots….and so on. You probably wont be able to figure in the cost to fix the water but know that is the biggest cost of all.

By keeping track of this information you have more ammunition to fight for $ to upgrade equipment and better de-icers that are more efficient, more effective and require less salt overall. You might even have money left over to heat some bridges, put permeable pavement in critical areas and invest in other salt free or reduced salt innovations.
MDOT figures by Tim Croze, 2013

Retention ponds are not useful for dissolved pollutants like salt. Infiltration areas which is one of our main tools in lake and river protection can be a bigger threat to our ground water supply as it encourages the downward movement of the salt.

Since we have no practical tools for removing salt from freshwater ecosystems. Our best approach is source reduction. That is why this training class is so important.

We already have a lot of salt in the water. Lets slow down the rate of accumulation.   That is all that we have within our control.



https://michigan.gov/documents/deq/deq-ess-faq-water-wb-deicers_255906_7.pdf

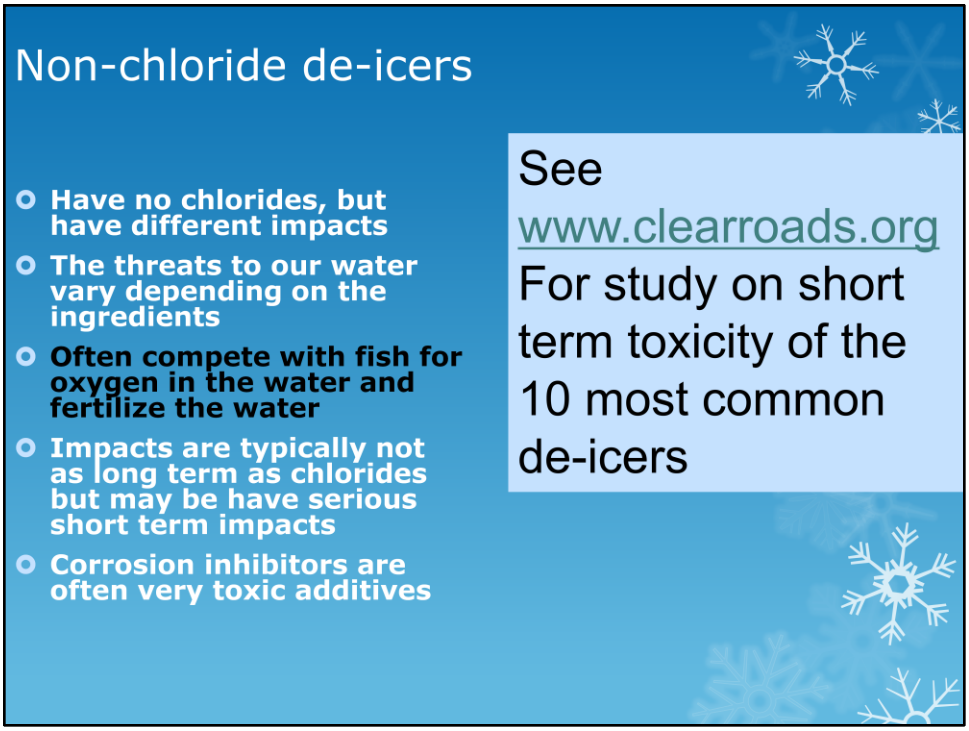
"Deicing products derived from ABPs have the potential to adversely affect water quality if allowed to enter surface waters. These products often contain high levels of organic materials which exert a high biochemical oxygen demand (BOD) when broken down by microorganisms in an aquatic environment. This results in reduced in-stream levels of dissolved oxygen (DO), which is necessary for the survival of aquatic life. Fish kills, impaired biological communities, and noxious growths of bacterial slimes can result from elevated BOD and reduced levels of DO in streams and lakes.

Some ABP deicers have the potential to greatly impact DO concentrations in surface waters, as they may contain many times the amount of BOD found in strong wastes like raw sewage. To illustrate, one organic deicer contains 210,000 mg/l of BOD (as measured through a five-day test called BOD5) according to its manufacturer, whereas strong untreated domestic waste typically contains about 400 mg/l of BOD5. Unpolluted ambient surface waters contain around 2 to 3 mg/l of BOD5.

The effect that BOD from deicers may have on a given stream's DO concentrations depends on the chemical and physical characteristics of the water body. Many of Michigan's rivers and streams have relatively low slopes and low velocities, which makes them especially susceptible to DO impacts from elevated BOD. Deicers may have different degradation rates so may affect DO levels to varying degrees.

ABP deicers may also contain nutrients that can harm water quality. Increased concentrations of pollutants like phosphorus can cause noxious plant growths and contribute to low levels of DO. ABP deicers can contain heavy metals that may be toxic to aquatic life at sufficient concentrations. Solids in the deicing materials may negatively affect aquatic life habitat if they enter a surface water.

Adverse impacts on aquatic resources can occur if deicers enter water bodies. Responsible handling of deicers is necessary to prevent the entry of the deicing materials into surface waters"



All deicers have negative environmental impacts. The impacts are varied. We should understand the working properties of the de-icers and we should understand the environmental threats of the de-icers. With this knowledge we can make the best choice.

Don't believe the label, there are no laws regulating what it can or cannot say. It may say this de-icer makes the walleyes bite, tulips bloom or melt to 900 below zero.

You are the buyer and buyer beware! Take the time to do your research.

Our goal is not to change the level of service but to become informed. If we are informed we can better judge what the right amount of salt is, and not over apply.

Winter maintenance professionals are the key to change. The key to a better future for our lakes, rivers and groundwater.

The generations before us did not know of the problem. We are the first generation to understand the problem. It is up to our generation to fix it and not pass the problem on to the next generation.

Change is difficult but necessary. The best changes can be made within your organization. You understand your equipment, your routes, your plow drivers and your customers. Challenge yourself to come up with new and better ways.

Amazing positive changes have been made in this industry over the past 10 years. It is very encouraging.