



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.

WATER

Michigan is bound by 4 of the 5 Great Lakes

Michigan has 3,126 miles of Great Lakes Shoreline
(MDOT).

Michigan has the longest freshwater coastline of any
political subdivision in the world (Wikipedia).

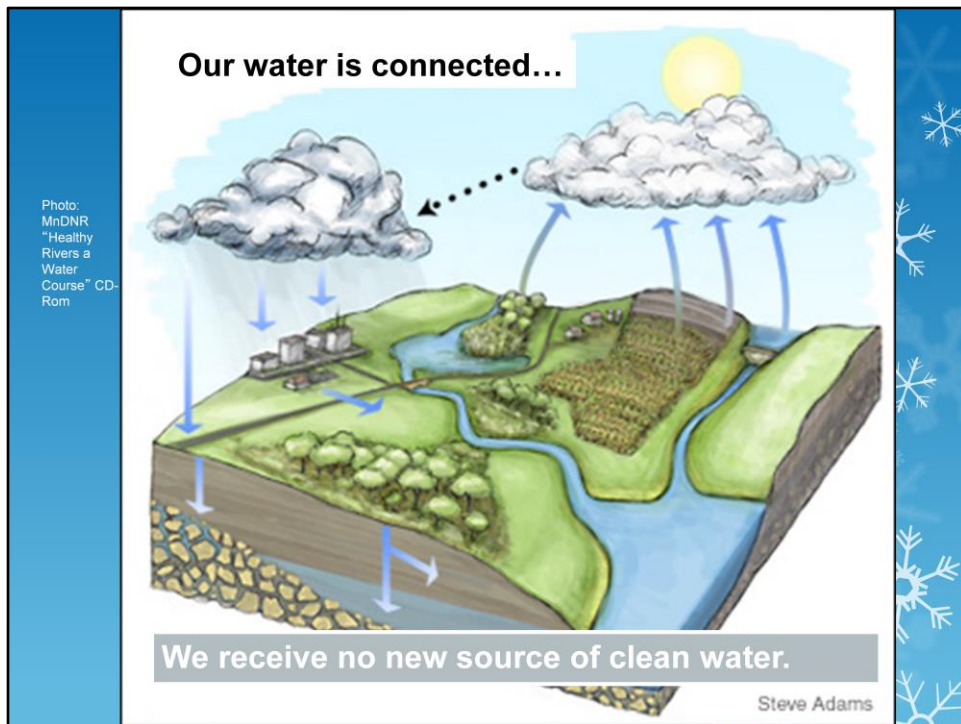
Michigan has 11,000 inland lakes and 36,000 miles of
streams (MDOT).

Photo: Jo Latimore, MSU.

In Michigan, you are never more than 6 miles from a
water body and 85 miles from a Great Lake

40 of Michigan's 83 counties touch a Great Lake (MDOT).

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 water on our planet is salt water

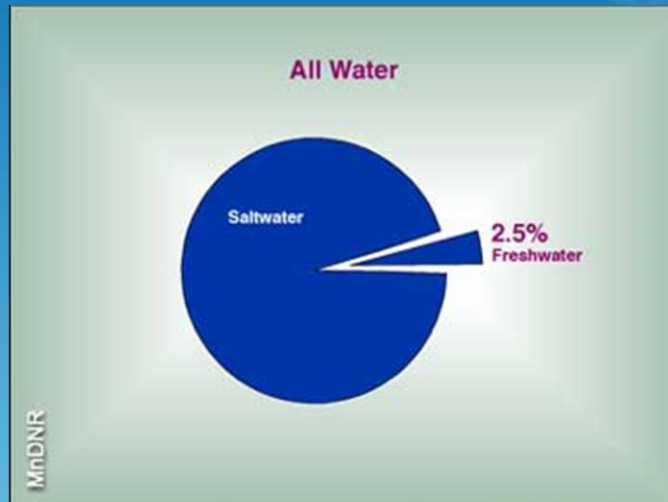


Photo: MnDNR
"Healthy Rivers a
Water Course" CD-
Rom

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.

How are Michigan Lakes and Rivers doing?



| | |
|------------------|--|
| Albrow Creek | Bass River |
| Bass River | Bean Creek |
| Bear Creek | Bear Creek |
| Bear Lake | Belle River and North Branch Belle River |
| Belleville Lake | Berry Drain |
| Black Creek | Black River |
| Brighton Lake | Blakely Drain/Marsh Creek |
| Brownstown Creek | Buck Creek |
| Burdick Drain | C.S. Mott Lake |
| Carrier Creek | Cass River |
| Cedar River | Clinton River |
| Coldwater River | Coon Creek (East Branch) |

Photo: James Fountain

Michigan list of impaired waters:

www.michigan.gov/documents/deq/wb-swastmdl-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 they are not being tested, or submitted or possibly not polluted.

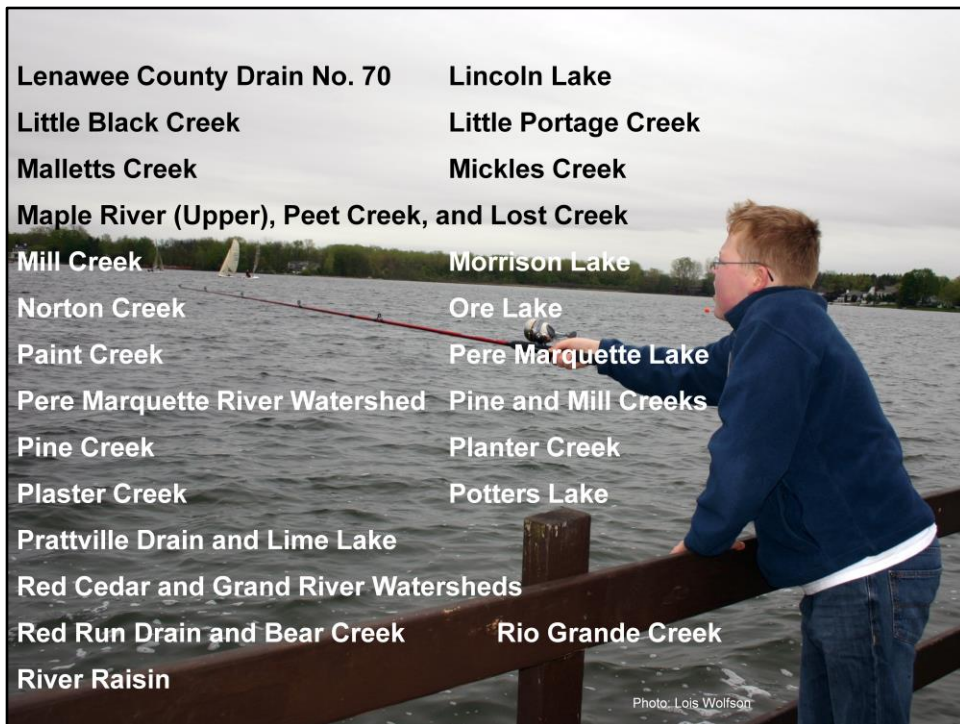


| | |
|--|--|
| Crapaud Creek | Deer Creek |
| Detroit River | Duff Creek |
| East Pond Creek | Eau Claire Village Drain and Farmers Creek |
| Ecorse River | Ford Lake |
| Ford Lake/Belleville Lake | Frank and Poet Drain |
| Galien River | Geddes Pond |
| Goose Lake | Grand River |
| Great Bear Lake Proper | Hammell Creek |
| Honey Creek | Johnson Creek |
| Kawkawlin River Bay | Kawkawlin River (North Branch) Kent Lake |
| Kintz Creek and Hunter's Creek | |
| Lake Allegan (Kalamazoo River Impoundment) | |
| Lake Erie/Luna Pier Beach | Lake Macatawa |
| Lake St. Clair Lapointe Drain | |

From DEQ website 2013

Michigan list of impaired waters:

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From DEQ website 2013

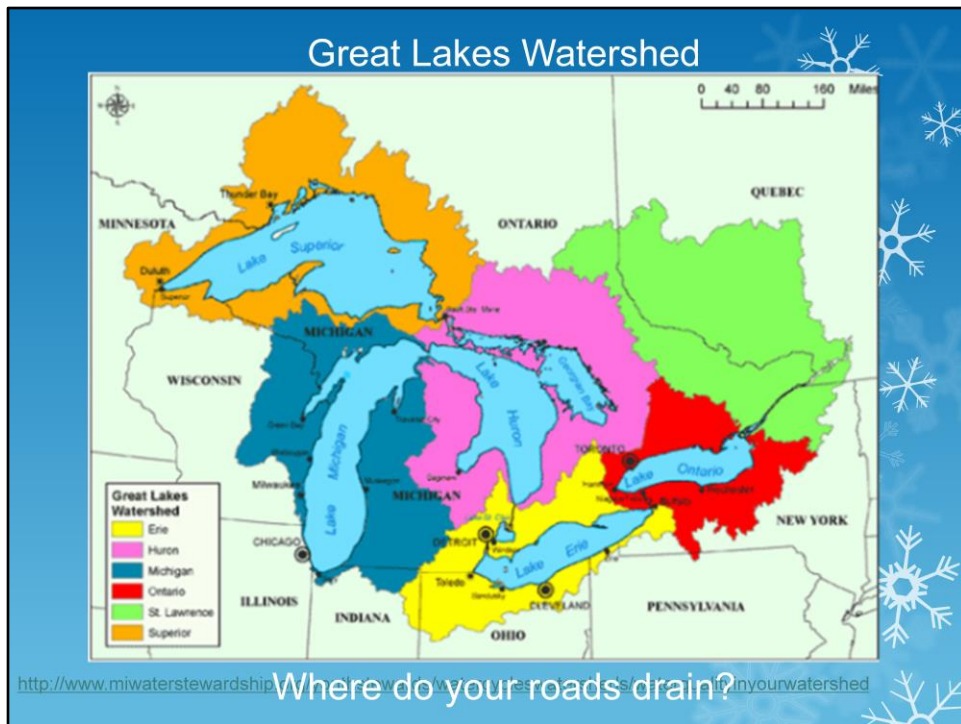
Michigan list of impaired waters:

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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.

How does sand affect the water?

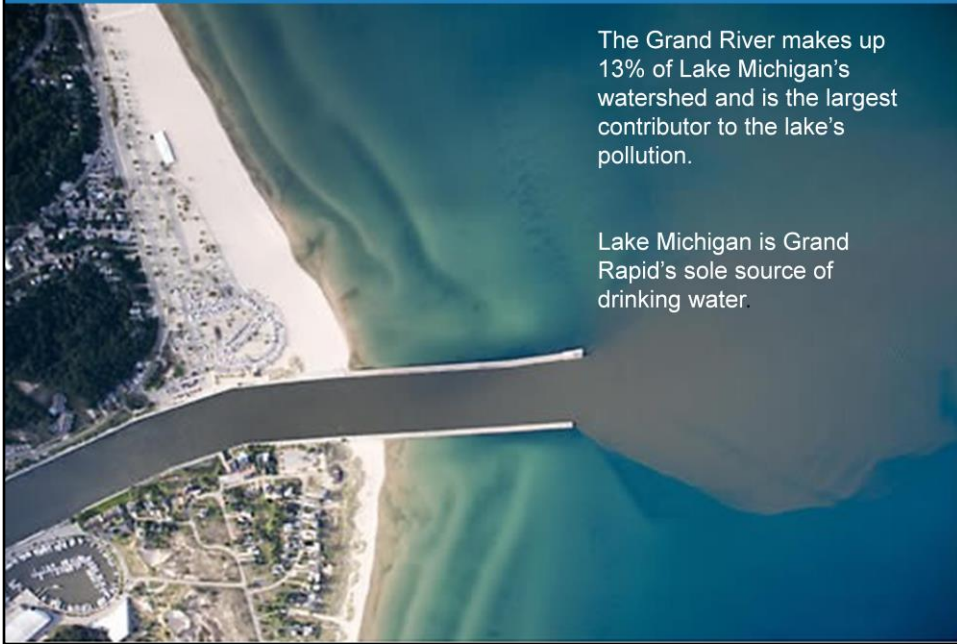


Sand was more popular in the past than it is today. Mostly because we the traveling public demand a higher level of service than sand can provide.



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.

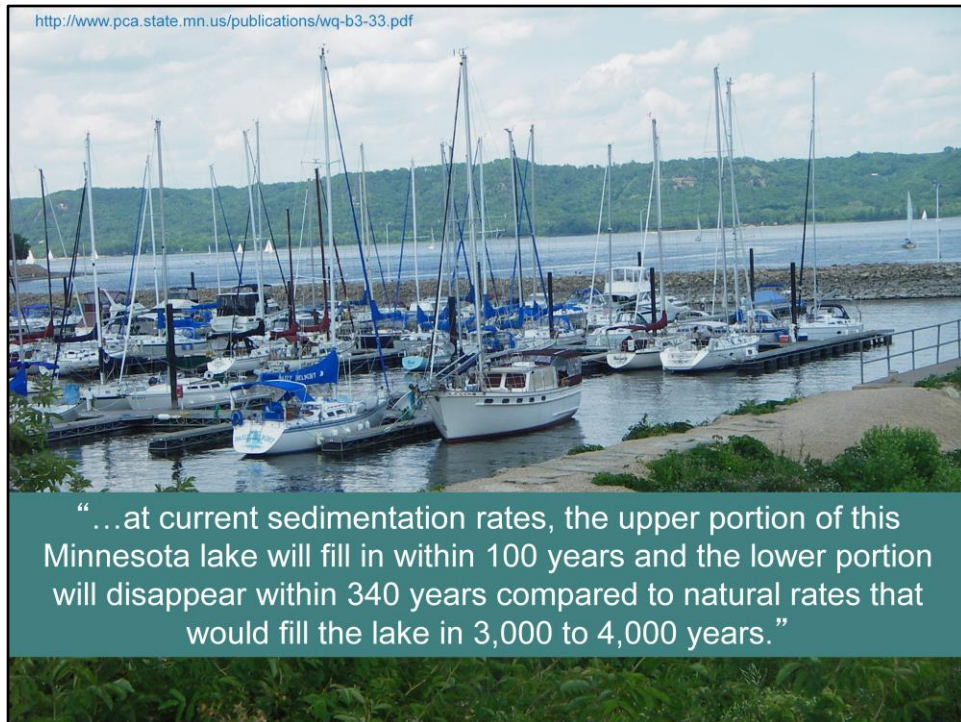
To our lakes and rivers



The Grand River makes up 13% of Lake Michigan's watershed and is the largest contributor to the lake's pollution.

Lake Michigan is Grand Rapids's sole source of drinking water.

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

2009 – Minnesota Erosion Control Association Study funded by Great Lakes Coastal Grant

About 25% of winter sand was recovered in 2009. Unrecovered sand in small Lake Superior drainage area would fill metrodome every 19 years

What % of your
sand do you
recover?

4

Interstates
US Highways
State Highways
County Roads



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

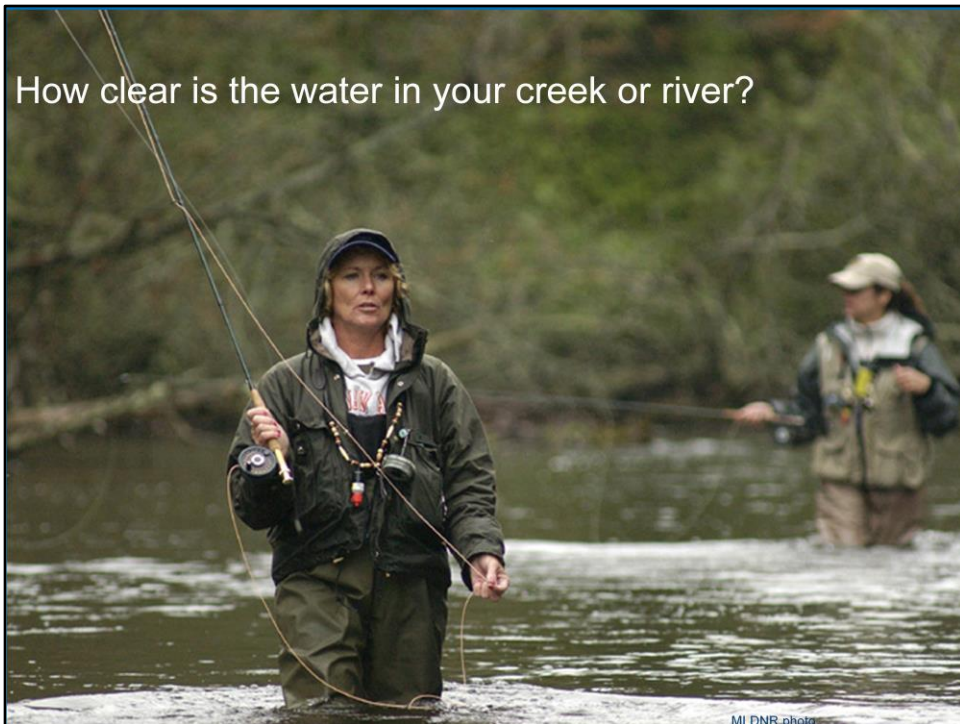
Michigan does not have a numeric suspended solids or turbidity water quality standard. "We use a narrative standard that says suspended solids and turbidity cannot be in unnatural quantities that are or may cause injury." Quote from Michigan DEQ 2011



For comparison: Minnesota's turbidity standard is 25 NTU's
(Nephelometric Turbidity Units)

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.

How does salt affect the water?



Photo: Fortin Consulting

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.

1940 Detroit became the first major city to use rock salt for snow and ice control



Salt has been used for over 70 years on MI roads

<http://michpics.wordpress.com/2008/12/10/michigan-road-salt-the-detroit-salt-mine>

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.

Where does the salt go after we apply it?



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.

Salt dissolves and runs downhill to the nearest lake, river or wetland.

It does not biodegrade, breakdown or disappear.

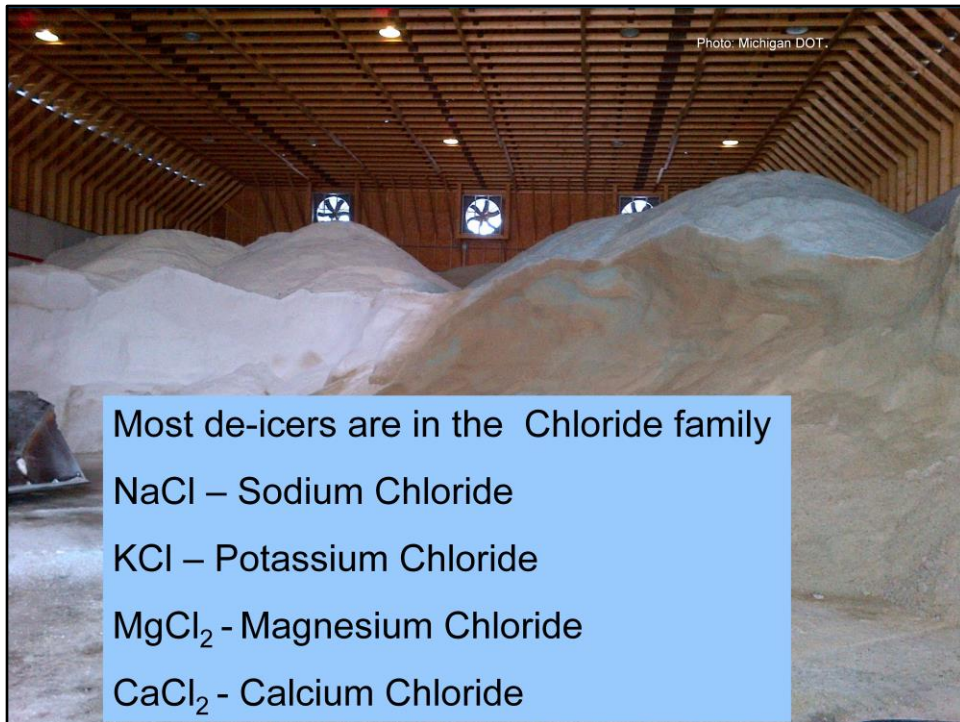
Over time it accumulates.

We are unaware because we cannot see it.



Photo: Pat Soranno, MSU.

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.



Most de-icers are in the Chloride family

NaCl – Sodium Chloride

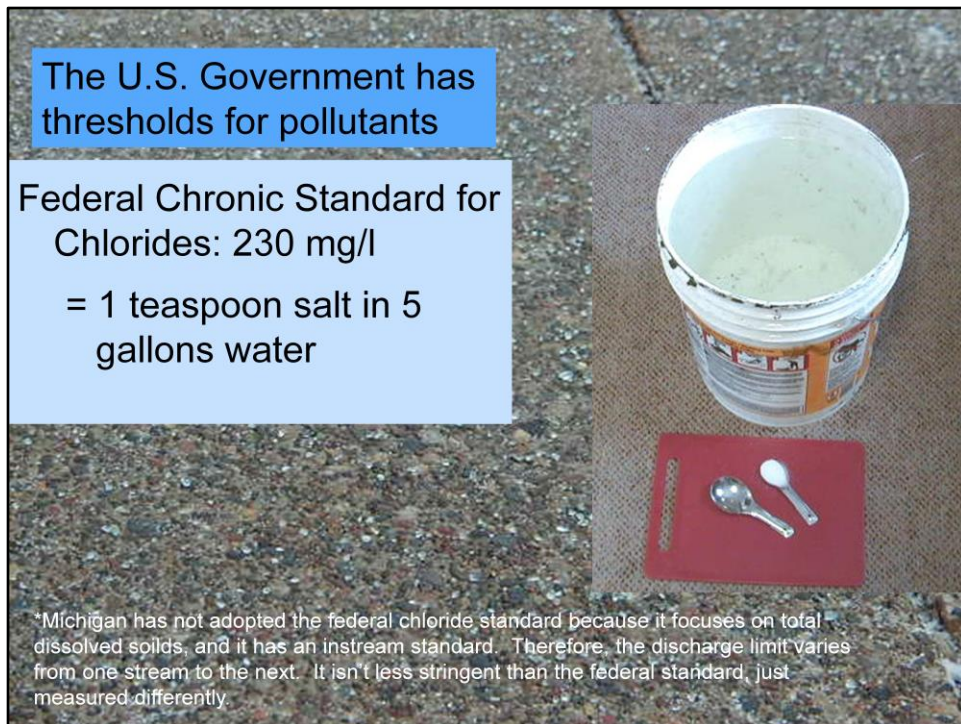
KCl – Potassium Chloride

MgCl₂ - Magnesium Chloride

CaCl₂ - Calcium Chloride

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"

How much
water would
it take to
dilute 50 lbs
of salt to a
level of
safety?

**More than
10,000
gallons**

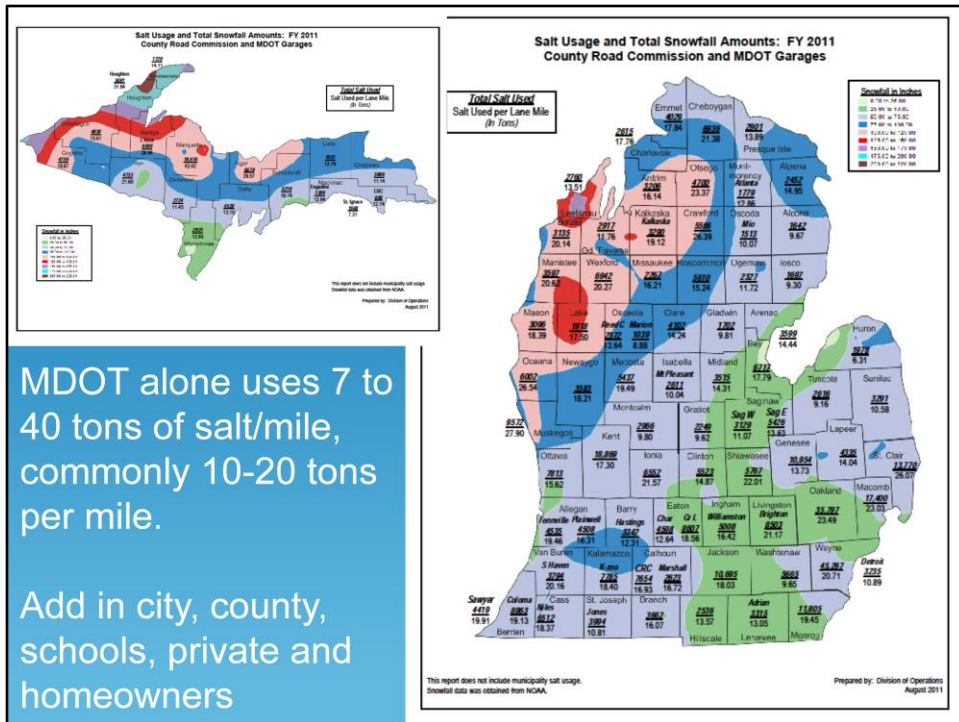


By using the crude estimate of 1 teaspoon of rock salt pollutes 5 gallons of water we have approximated that 50 pounds of rock salt pollutes 10,000 gallons of water to the federal chronic chloride standard of 230 mg/l. This is a conservative estimate.

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.

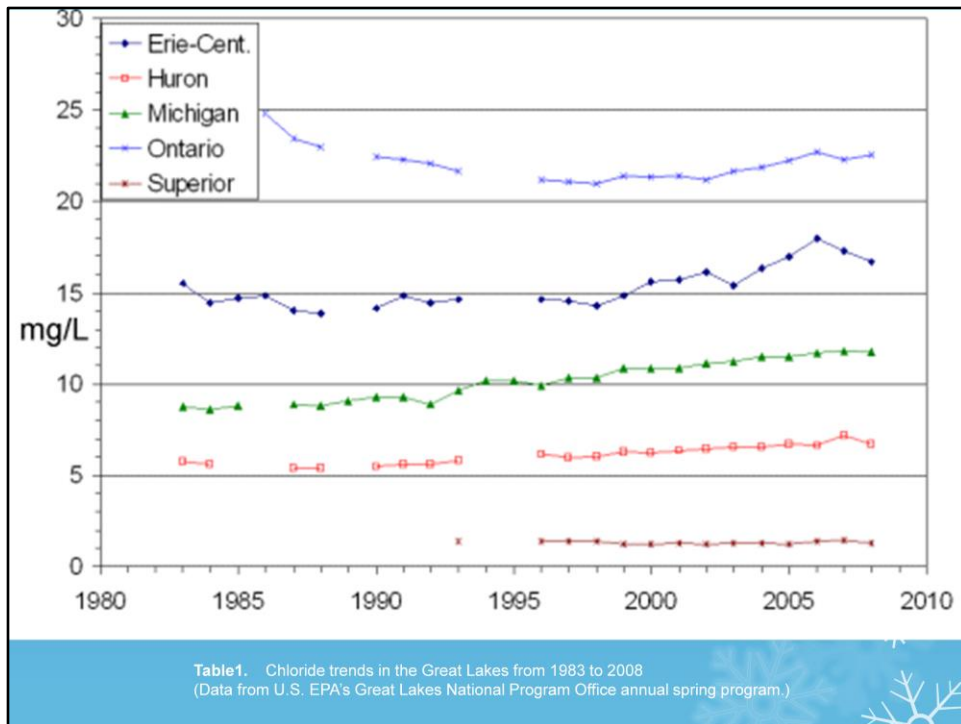


MDOT used approximately 526,450 tons of salt and 111,750 tons of sand (statewide total) from November 2010 to May 2011 for what was a relatively heavy winter. MDOT used approximately 343,150 tons of salt and 67,800 tons of sand (statewide total) from November 2011 through May 2012 for what amounted to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

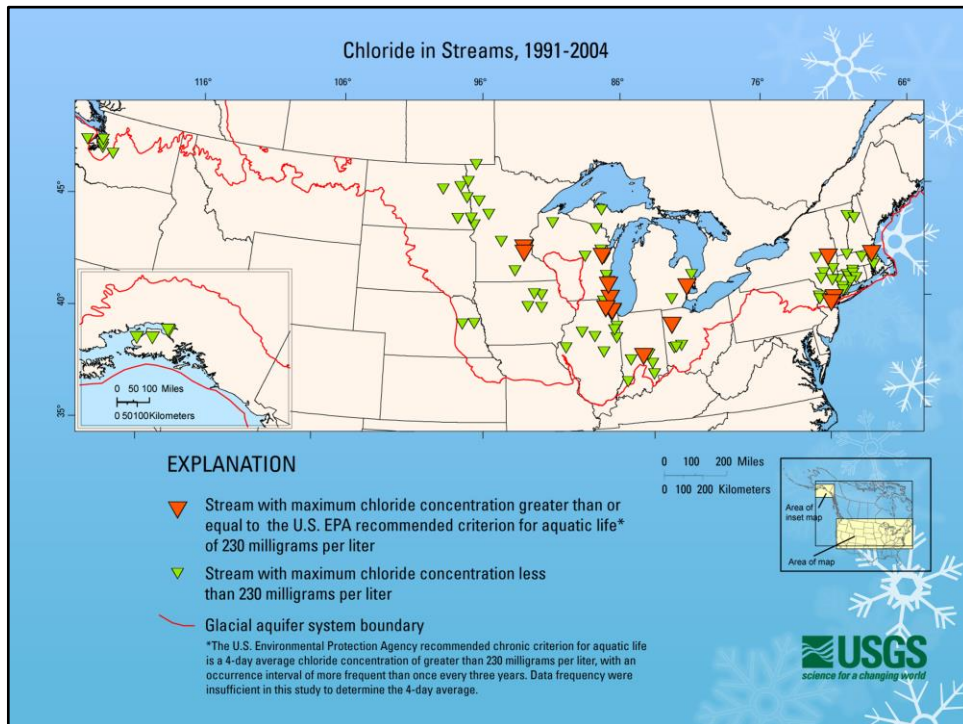


A chemo cline is formed with salt as the more dense salt water settles to the bottom. This can affect the seasonal turn over of the lake.

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

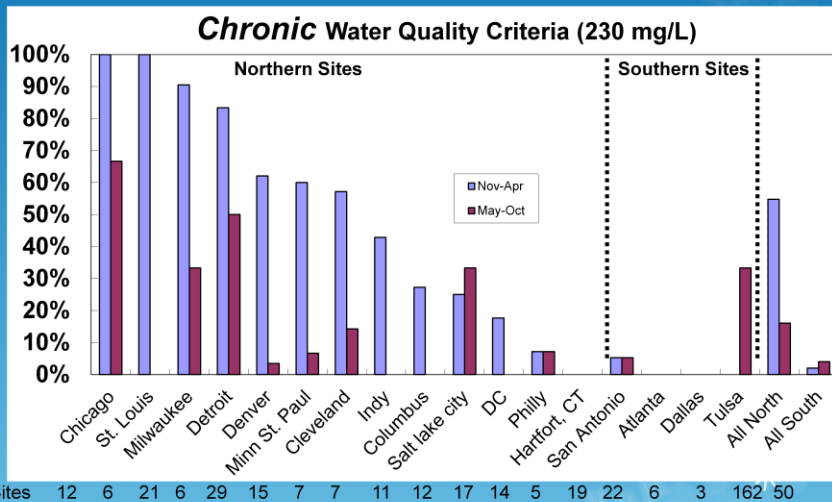


Salinity trend in the great lakes. It is astounding to think of how much salt must be received in the lakes to show an upward trend since there is so much water for dilution.



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.

National: Violations of EPA Water Quality Criteria for Chloride



6739/5266 1383/995



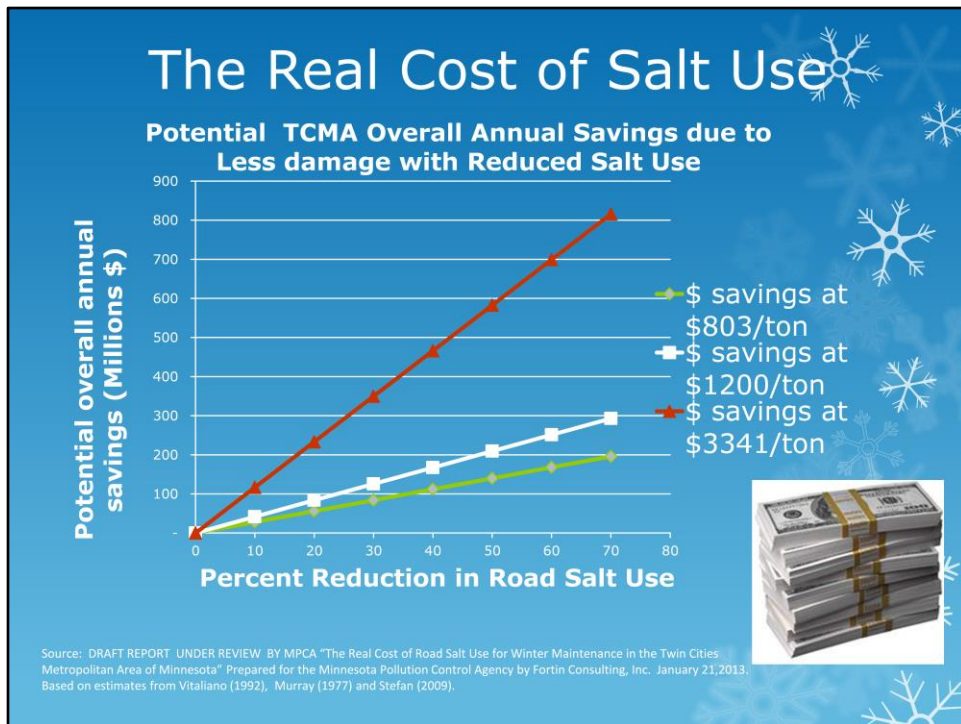
USGS study by Steve Corsi 2010

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, restaurants, 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: ¹MDOT (2013), ²MDOT(2013) ³Vitaliano (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

Can rain gardens or holding ponds help?



Infiltration areas could be a bigger threat, it directs the salt into groundwater

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.

There is no good way to get chloride
out of the water!



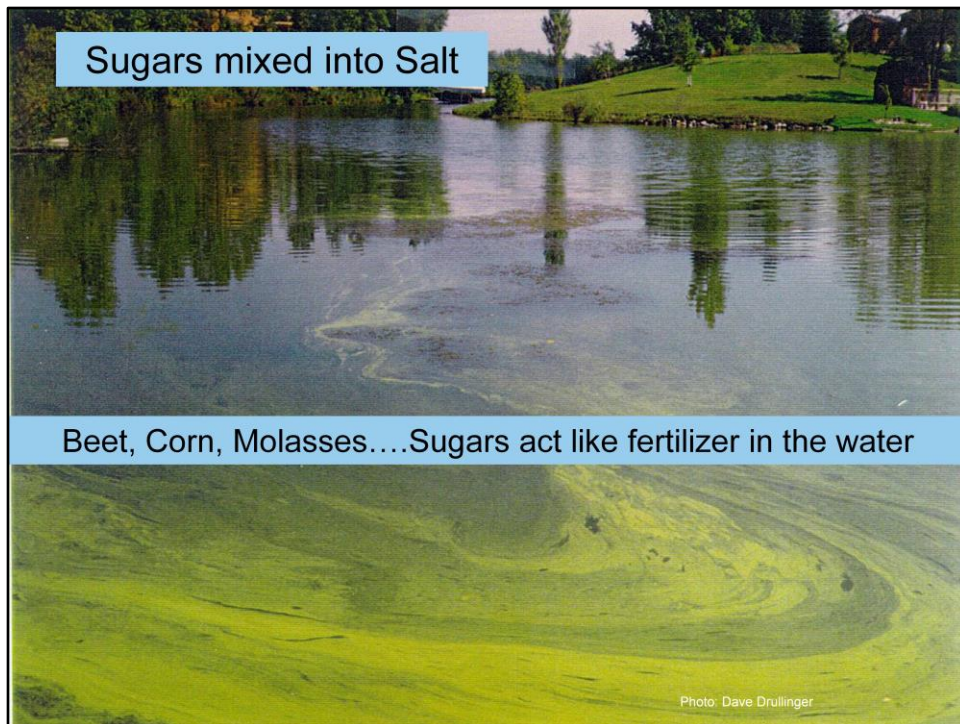
Since we have no practical tools for removing salt from freshwater ecosystems. Our best approach is source reduction. That is why this training class is so important.



**Most of the salt we have applied
is now in the water**

Photo: Michigan DOT.

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”

Non-chloride de-icers

- Have no chlorides, but have different impacts
- The threats to our water vary depending on the ingredients
- **Often compete with fish for oxygen in the water and fertilize the water**
- Impacts are typically not as long term as chlorides but may be have serious short term impacts
- Corrosion inhibitors are often very toxic additives

See

www.clearroads.org

For study on short term toxicity of the 10 most common de-icers

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.

If your salt states it is environmentally safe, this is not true... unless you leave it in the bag



Environmentally safe!

They all have
environmental
impacts

Picture from: <http://www.gardeners.com/on/demandware.static/Sites-Gardeners-Site/Sites-Gardeners/default/Products/34-829.jpg>

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.