

# Chemicals & How they Work

## TODAYS TOPICS

- Salt
- BENEFITS OF LIQUIDS
- MAKING AND STORING LIQUIDS
- BLENDING OF LIQUIDS
- APPLYING LIQUIDS AND EQUIPMENT NEEDED
- LIQUID ONLY ROUTES CASE STUDIES – WHO IS ALREADY DOING THIS
- WRAP UP

## Plow First!! Plowing Is Still The Best Method Of Removing Snow



Do Not Try To Burn Off Snow With Chemicals

*IT TAKES 4 TIMES MORE MATERIAL TO REMOVE ICE THAN PREVENT IT*

## Chemicals

Chemicals applied to prevent or break the bond between ice and snow to the road surface

We remove snow & ice with the plow  
– we make it easier to remove with the chemicals

## Material Information Sheet

Salt is the most common and cost-effective material we use

<b>Material and Quality Control</b> <b>Chemical and Description</b>	<b>Lowest Practical Melting Temp (°F)</b>	<b>Eutectic Temp. (°F)</b>	<b>Optimal Concentration</b>
<b>NaCl (Sodium Chloride)</b> Delivered as solid rock salt, also can be made into a brine. The basis of most deicing materials. Very corrosive. Inexpensive. Very available. Rarely has a corrosion inhibitor added.	15	-6	23%
<b>MgCl<sub>2</sub> (Magnesium Chloride)</b> Delivered as a liquid. Often used to wet NaCl crystals to increase adherence to surface and reduce melting points. Corrosive. Higher cost. Often has a corrosion inhibitor added.	-10	-28	27-30%
<b>CaCl<sub>2</sub> (Calcium Chloride)</b> Delivered as flakes, pellets, or liquid. Powerful deicer but extremely corrosive. Sometimes used incorrectly to open storm drains. Higher cost. Often has a corrosion inhibitor added.	-20	-60	30%
<b>CMA (Calcium Magnesium Acetate)</b> Delivered as a powder, crystals, pellets, or liquid. Liquid CMA is used mainly on automated bridge deicing systems. Noncorrosive, biodegradable. Sometimes added to sodium chloride as a corrosion inhibitor. Alternative for areas where chloride use must be limited. Often higher cost.	20	-18	32%
<b>KAc (Potassium Acetate)</b> Delivered as a liquid. Often used on automated bridge deicing systems and airports. Use for anti-icing, deicing, and prewetting. Non-corrosive, biodegradable. Alternative for areas where chloride use must be limited. Higher cost.	-15	-76	50%
<b>Blends</b> Both chlorides and acetates exist in blends. Talk to your supplier and determine the lowest practical melting temperature, the optimal concentration and the basic components in the blend. Most blends are centered on rock salt since it is cheap.	Varies	Varies	Varies
<b>Winter Sand/Abrasives</b> Winter sand has some salt mixed in it to keep it from freezing. Abrasives should be used for cold temperatures when deicers are not effective. They provide temporary traction but only work when they are on top of the ice.	Never melts; provides traction only		

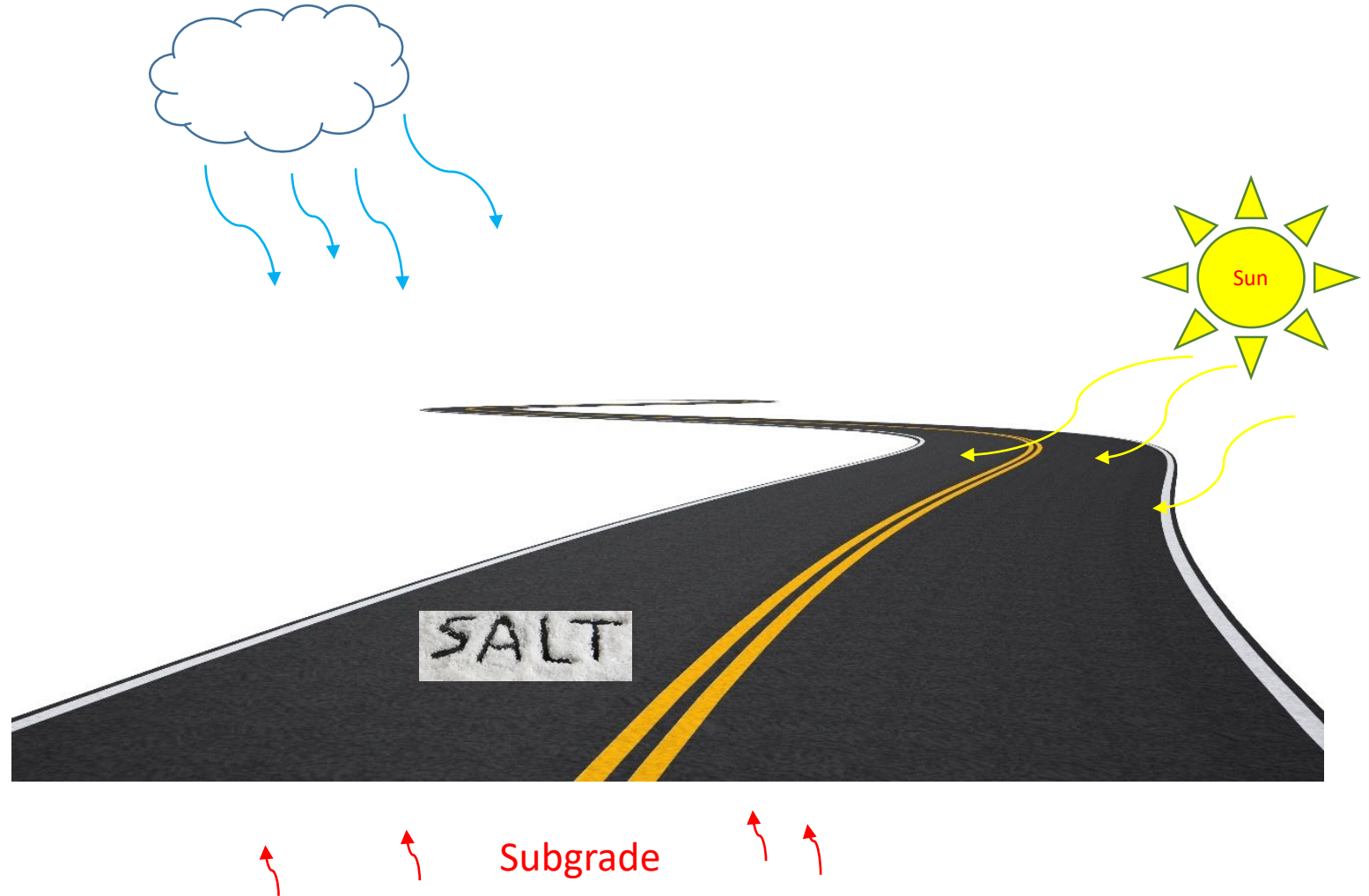
- Salt
  - Salt = Sodium Chloride = NaCl
    - Doesn't work well under 15deg pavement temperature
- Below 15 deg pavement temperature
  - Calcium Chloride CaCl<sub>2</sub>
  - Magnesium Chloride MgCl<sub>2</sub>
    - Work better in lower temperatures

## Pounds of Ice Melted Per Pound of Salt

Pavement Temp. °F	One Pound of Salt (NaCl) melts	Melt Times
30	46.3 lbs of ice	5 min.
25	14.4 lbs of ice	10 min.
20	8.6 lbs of ice	20 min.
15	6.3 lbs of ice	1 hour
10	4.9 lbs of ice	Dry salt is ineffective and will blow away before it melts anything.
5	4.1 lbs of ice	
0	3.7 lbs of ice	
-6	3.2 lbs of ice	

It is not cost-efficient to apply salt (sodium chloride) at pavement temperatures less than 15° F.

Chemicals in their solid form must change from the solid state to a liquid state to work. To do this they need heat and moisture. Heat comes from the pavement and moisture from the event or applied by our equipment





## Solid Thoughts

- If it is solid it isn't working!
- Best practice – should be applied pre-wet or using treated salt
- Almost all solids are sodium chloride
- Snow pack and freezing rain really need solids
- Will take longer to dilute than liquids, so good if you have long route times

## Pre-treating and Pre-wetting



Treated salt

## Using Abrasives

# Why Isn't It Melting?

# Benefit- Traction

Must be spread ON TOP OF residual snow/ice

Sand has no melting power!!!



## Sand: Advantages

- Relatively inexpensive (initial material cost)
- Easy to apply
- Some Skid resistance
- Visible sign of your presence
- Instant Effectiveness
- Suitable for unpaved roads



# Want Your Material To Work?

## Get It Wet!

## Liquid Thoughts

- Live fast and die young!
- Excellent for pre-treatments, especially for frost management
  - But very little value if dealing with freezing rain
- Be very careful using on snow pack or ice
- Appropriate equipment selection (e.g. trailers) allows for easy liquid pre-treatment and solid in-storm application
- Blending can allow enormous versatility

## Liquid Management

- The “basic” liquid is salt brine
- Easily made, easily stored, easily handled, easily used
- Also possibilities with blending using other chemicals



# Why and the Benefits of Liquids

## You Are Already Using Liquids

Salt Doesn't Melt Anything

Until It's In  
Solution



## Typical Liquid Products

- Natural Occurring Salts
  - Sodium Chloride – 23% solution
  - Calcium Chloride – 32% solution
  - Magnesium Chloride – 28% solution
  - Potassium Chloride
- Other Chemicals
  - Urea
  - Calcium Magnesium Acetate
  - Agricultural Products – Both by-products and engineered products
  - Various Additives

## Why do we use liquids?

- Reduce salt usage
  - ✓ Prevent or break the bond
  - ✓ Reduce bounce and scatter
  - ✓ Activate salt quicker
  - ✓ Save money
  - ✓ Reduce environmental impacts

## Pre-wetting: Is Done as Material is Applied to the Roadway



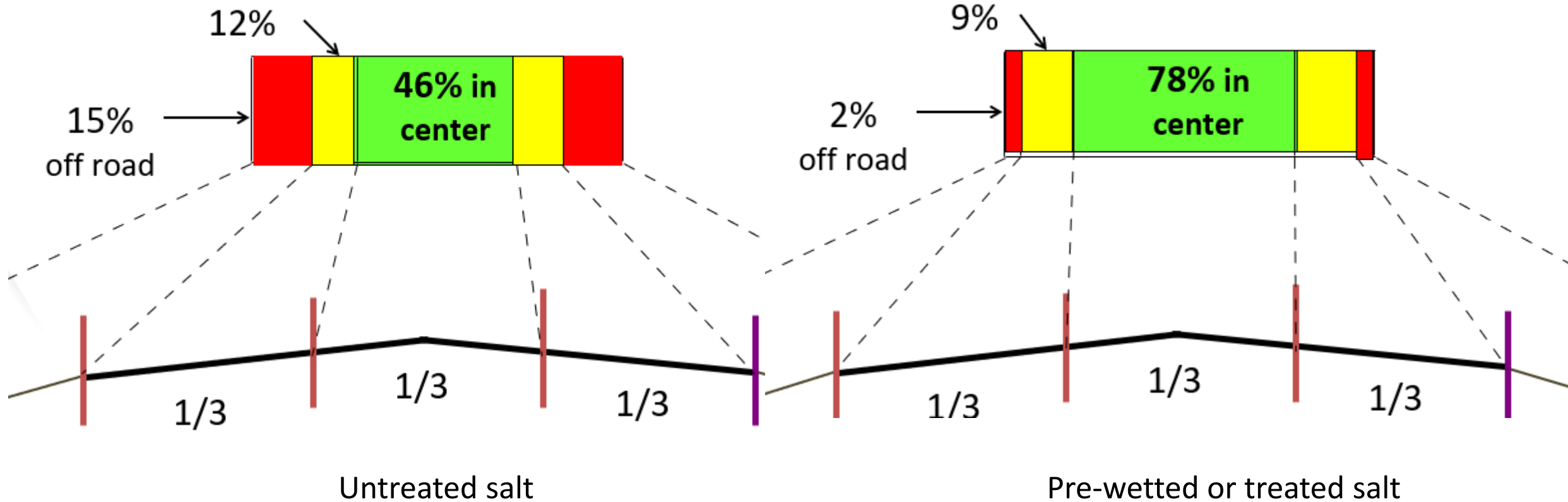
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**Liquid application rates vary and are often dependent on the equipment installed on the vehicle.**

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Many agencies have experienced good results with higher volume rates.

## Typical Scatter Pattern of Road Salt



## Trucks with 970 gallons of On-Board Liquid



## Two flood nozzles

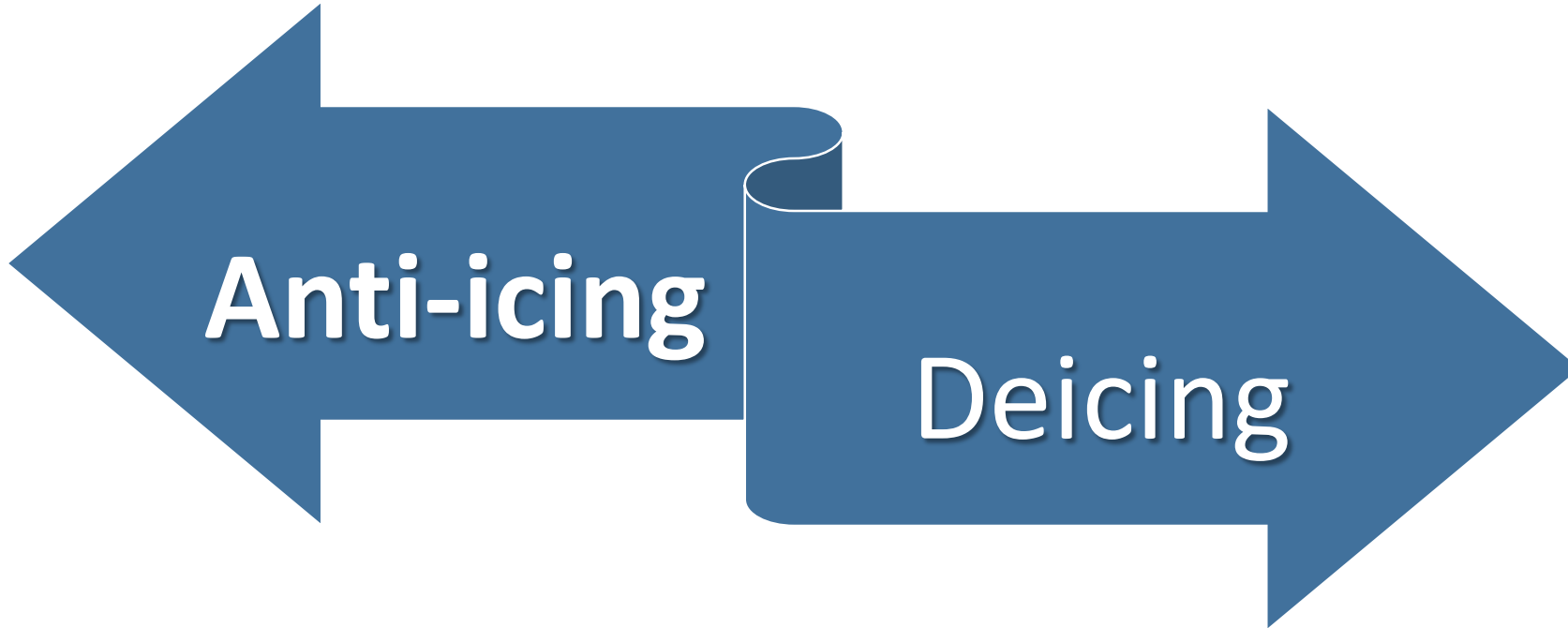


430 gallon tank installed inside the truck body





# The “Control” In Snow & Ice Control



**What's the Difference?**

## Anti-Icing

Anti-icing Prevents  
Snow from Freezing &  
Bonding to a Surface



## De-Icing

Deicing Breaks the Bond of Snow That Has Already Frozen to the Surface





Anti-icing = Preventing the Bond

***This Flow  
Chart Is  
for Salt  
Brine  
or  
Enhanced  
Salt Brine  
Only!!***



A copy of this chart is in your handout materials

## Anti-Icing: When you might NOT want to anti-Ice



## Anti-icing



- Proactive strategy accomplished by applying liquid directly to the road surface
- Generally used in advance of an event
- Focus on hills, bridges & major roads
- Benefits:
  - Better pavement conditions
  - Less chemical required
  - Applications can last for days
  - Lower costs resulting from less chemical

**Know your expectations—  
It is not meant to melt everything!**



**Treated**



**Untreated**



# It Doesn't Always Work

A Cold Storm, Dry Snow & the Anti-icing Caused the Snow to Stick.



# Making and Storing Liquids

## Brine Making is Easy & Cost Effective



## Brine Makers



## Continuous Brine Making Machine

Continuous brine making machine. Undissolved fines and solids are automatically and continuously removed during brine production. up to 6,000 GPH output or our Ultimate controls up to 10,000 GPH output.



## Liquid Storage – Best Practices

- Above ground storage
- Proper containment system
- Double walled tanks
- Sufficient storage
- Blending liquids



# Blending Liquids

## Chloride Cocktails

### The Art Of Blending Liquid Deicers





## Mixtures Can Be Purchased



## Do Your Homework!

- Blending – How will the products work together?
- What am I trying to achieve?
- What am I applying to the environment?
- What is the cost/benefit ratio?
- Is this my best option?



How sugars help

## Automated Blending System



THE OPERATOR CONNECTS THE HOSE,



ENTERS HIS TRUCK NUMBER,



ENTERS AN AMOUNT



AND IT FILLS IT PRECISELY ACCORDING TO THE PREDETERMINED FORMULA



# APPLYING LIQUIDS AND EQUIPMENT NEEDED

## Anti-icing



- Streamer nozzles
- 8" – 12" spacing (2-300 Mm)
- Anti-icing – 20 gal to 50 gal per Lane-mile - for DLA ? How high does it go
- Better friction, established chemical layer and improved public perception

## Anti-Icing Equipment



Source: City of Waconia

## Anti-Icing Equipment



Source: Varitech Industries



# LIQUID ONLY ROUTES

## CASE STUDIES – WHO IS ALREADY DOING THIS

## User feedback in McHenry County



4 liquid only routes that start and terminate at the facility

## Replaced existing tanks with (10) 15,000 gallon tanks



Four tanks holding Supermix, four tanks holding brine, one tank beet juice, last tank calcium chloride.  
WTheyare running 3 liquid routes 80/20 - 80 %brine/20%beet juice. Chlorides only used in extreme temps.

## Ohio DOT



Liquid only routes are used throughout the winter and on all ramps to the expressways

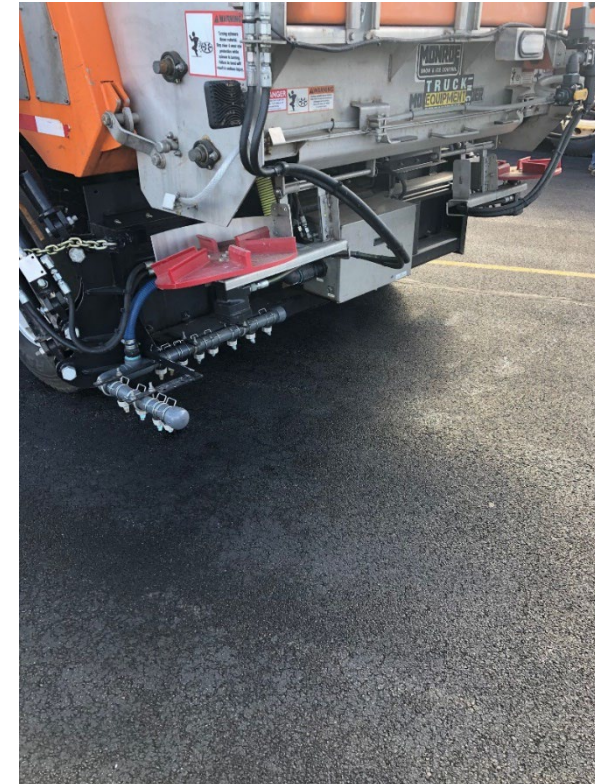


# LIQUID ONLY ROUTES IN WISCONSIN

**STATE DRIVEN BUT IMPLEMENTED BY THE COUNTIES**

## Wisconsin modified unit – the L Bar

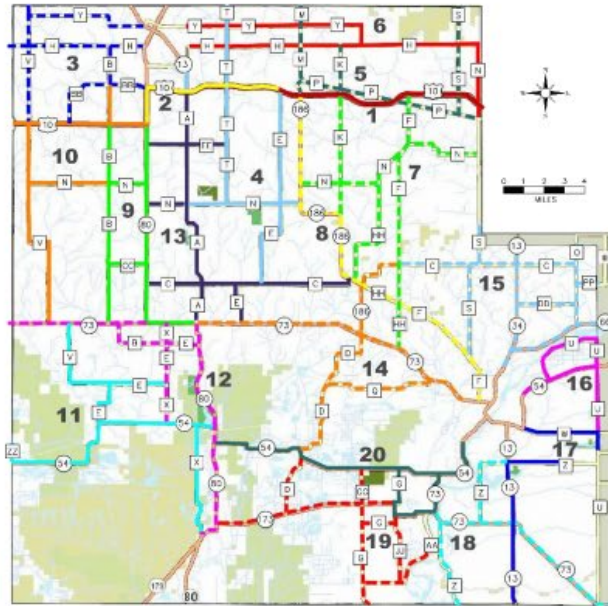
Concentrates the liquid at the middle of the road. This is a direct liquid application modification. The taper of the road allows the liquid to work its way across the pavement



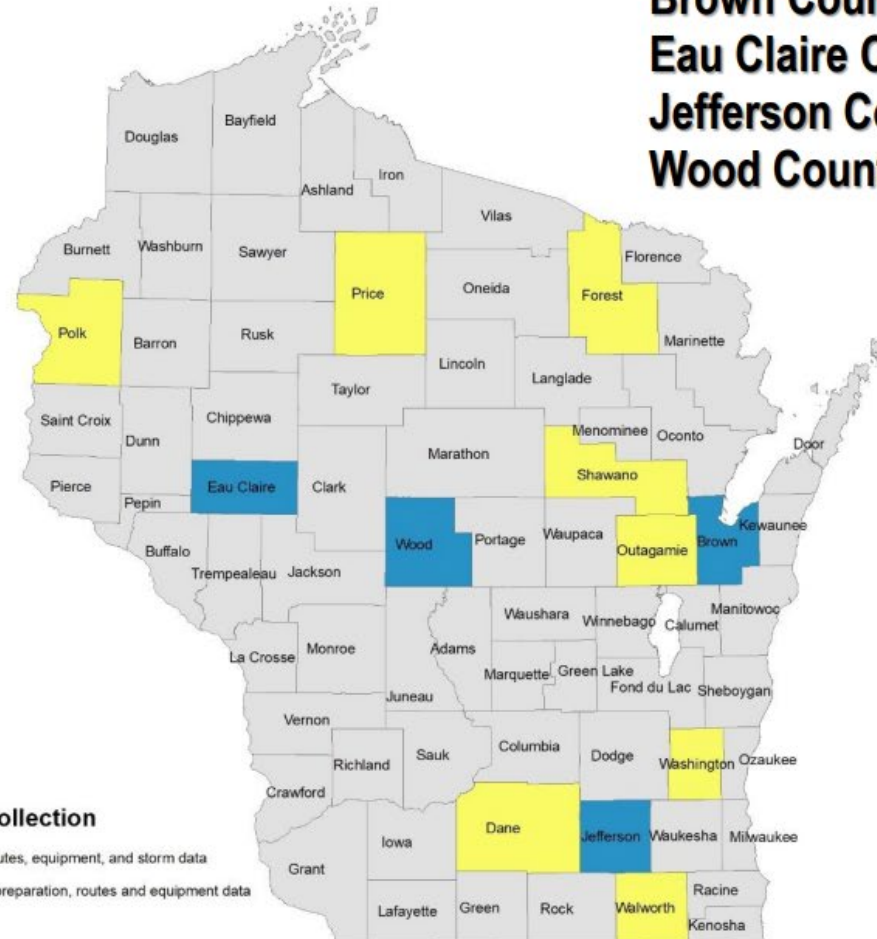
## Methodology

### Data Collection

#### Wood County Winter Maintenance Routes



#### Brown County Eau Claire County Jefferson County Wood County



## Results Comparison Group Analysis

### Wood County

Description	Study	Control	Comparison	p-value
Salt usage (lb/ln-mi)	155	298	-143 -48%	0.019
Cost w/ salt brine \$0.08/gal (\$/ln-mi)	\$8.6	\$16.5	-\$7.9 -48%	0.019
Cost w/ salt brine \$0.14/gal (\$/ln-mi)	\$14.3	\$16.6	-\$2.3 -14%	0.519
Time to Bare/Wet (hr)	9.8	12.5	-2.7 -22%	0.001

### Jefferson County (two control routes)

Description	Study	Control	Comparison	p-value
Salt usage (lb/ln-mi)	965	\$1,471	-622 -36%	0.001
		\$1,097	-180 -14%	0.239
Cost w/ salt brine \$0.08/gal (\$/ln-mi)	\$42.0	\$63.9	-\$22 -46%	0.001
		\$47.7	-\$6 -12%	0.300
Cost w/ salt brine \$0.14/gal (\$/ln-mi)	\$47.9	\$63.9	-\$16 -34%	0.007
		\$47.7	+\$0.2 +0.4%	0.969
Time to Bare/Wet (hr)	9.7	16.8	-7.1 -42%	0.001



## Wrap Up

## So, Liquids Are Always the Answer, Then?

- No, not always – here are times not to use them
- When a storm starts with rain...
- When the temperature is too low for the liquid to be effective – what is the temperature? Depends on the liquid...
- When wind speeds during the storm will be high enough to cause drifting (above 15-20 mph)



## Sometimes nothing is the best option



Tue Jan 8 2019 03:27:28 PM



205567 1 Lat: 47.8323 Lon: -96.1427 Time: 2019-01-08 14:42:15



205567 1 Lat: 47.9452 Lon: -96.2209 Time: 2019-01-08 15:07:17  
MARCoux TO TRF

## So, If I can't Use Liquids, What Then?

- First thing to note is that not every storm precludes the use of liquids
- But, if some of your storms do not allow liquids then you will not get all the benefits of using liquids
- It may still be advantageous to make use of them when conditions allow



# THANKS, SNOW MUCH

# QUESTIONS ?

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