



Salt and Brine Basics

April 13, 2022

Waukesha County Department of Public Works-
Highway Operations

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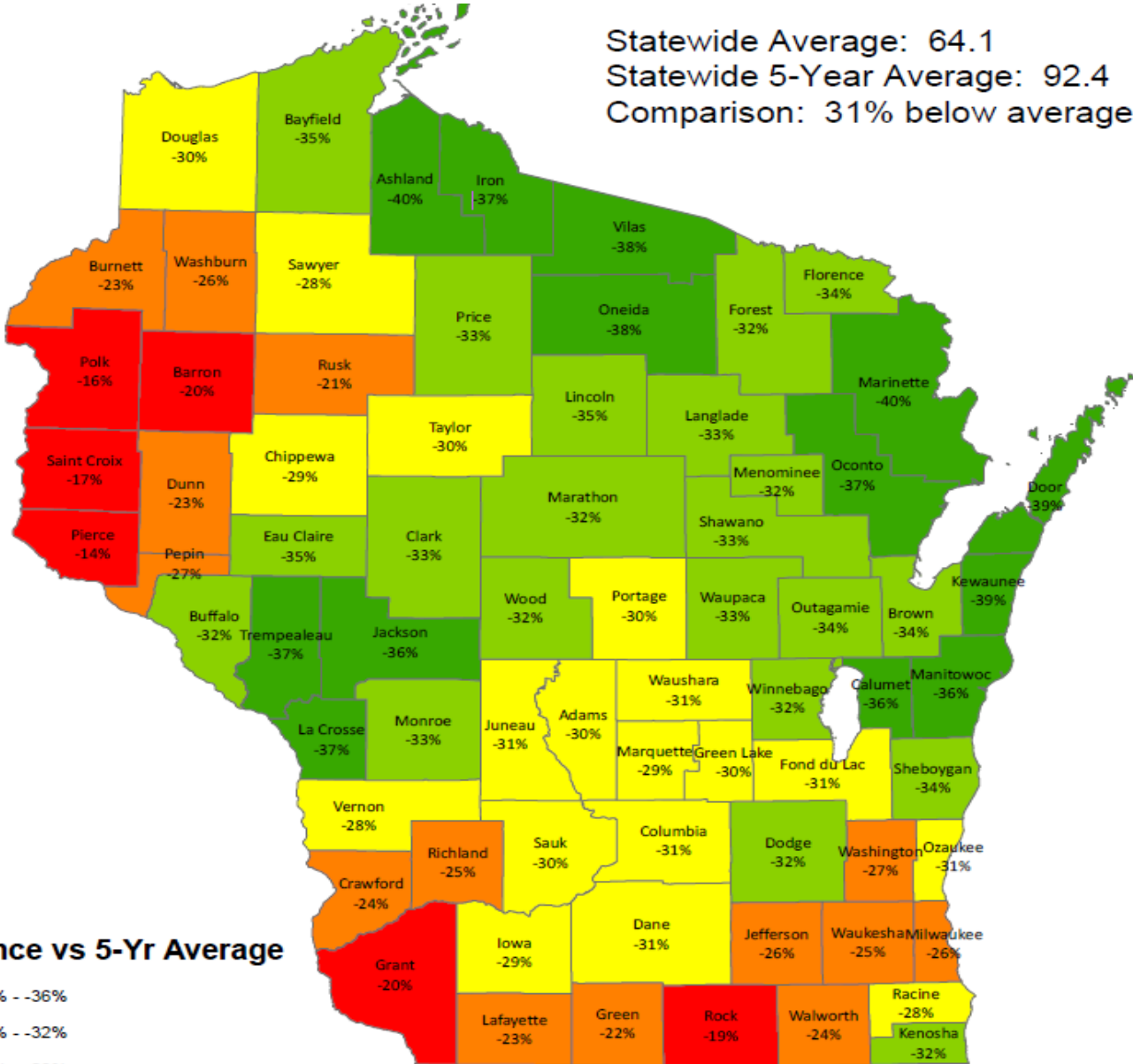
Topics For Discussion

- Wisconsin Salt Use Totals and Cost
- Salt Brine; Why Brine?
- Snow Fighting Techniques and Definitions
- Technology and Systems
- Key Strategies and Goals

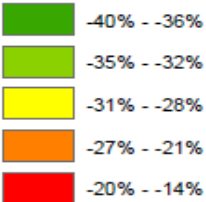


Statewide Average: 64.1
 Statewide 5-Year Average: 92.4
 Comparison: 31% below average

Winter 20/21 Severity Index vs 5-Year Avg.



Difference vs 5-Yr Average



Date created: 5/11/2021



Winter 20/21 Salt Use

- Statewide
 - Salt Use: 324,265 tons, 9.2 Tons/LM
 - Severity Index: 64.1
 - **Great News: 1st time since 1988/1989 winter under 10 Tons/LM****
- Northwest Region
 - Salt Use: 72,042 tons, 9.2 Tons/LM
 - Severity Index: 74.1
- Southwest Region
 - Salt Use: 92,009 tons, 9.5 Tons/LM
 - Severity Index: 55.7
- Southeast Region
 - Salt Use: 70,415 tons, 11.5 Tons/LM
 - Severity Index: 54.0
- North Central Region
 - Salt Use: 48,672 tons, 7.6 Tons/LM
 - Severity Index: 70.4
- Northeast Region
 - Salt Use: 41,127 tons, 8.0 Tons/LM
 - Severity Index: 53.8



WisDOT Southeast Region Salt Breakdown



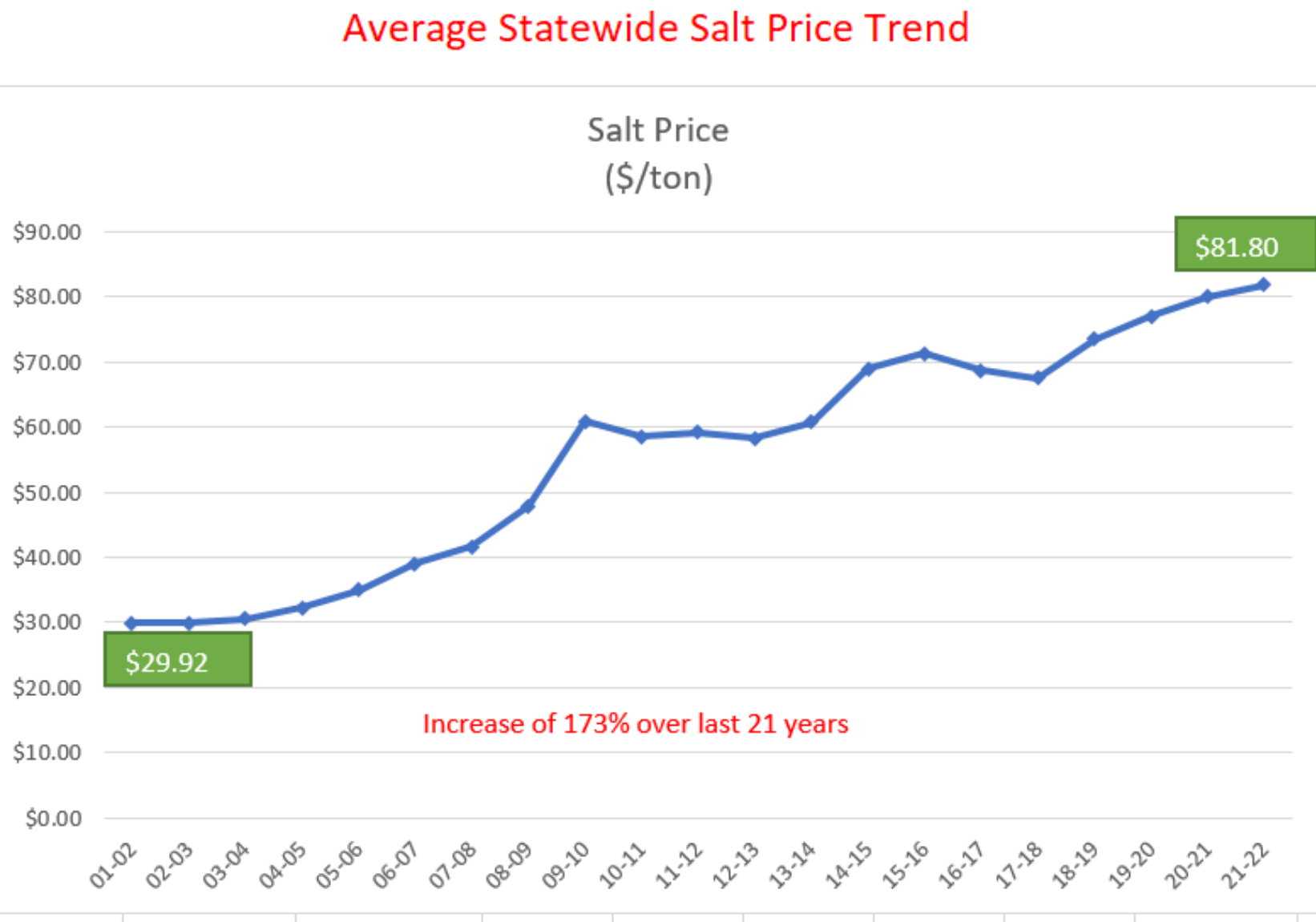
ID	County	Region	Lane Miles	Salt Used (tons)	Tons per lane mile	Severity Index
30	KENOSHA	SE	670.04	8,324	12.4	45.8
40	MILWAUKEE	SE	2005.05	21,761	10.9	53.1
45	OZAUKEE	SE	309.78	3,286	10.6	54.1
51	RACINE	SE	731.45	9,656	13.2	49.6
64	WALWORTH	SE	708.76	7,706	10.9	55.9
66	WASHINGTON	SE	607.17	6,738	11.1	62.3
67	WAUKESHA	SE	1110.54	12,944	11.7	57.2
SE Region Totals:		SE	6,142.79	70,415	11.5	54.0

Ranges from 10.6 tons/LM to 13.2 tons/LM



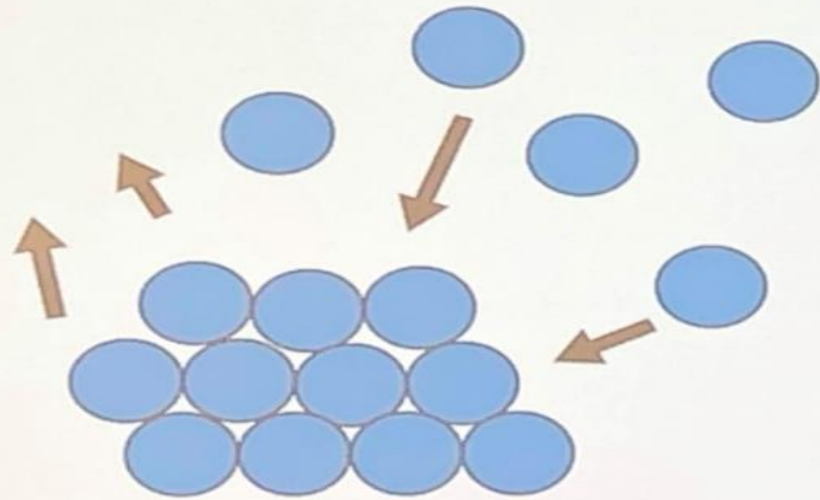
Average Statewide Salt Price Trend

Year	Statewide (\$/ton)
01-02	\$29.92
02-03	\$29.96
03-04	\$30.57
04-05	\$32.21
05-06	\$34.98
06-07	\$39.03
07-08	\$41.69
08-09	\$47.91
09-10	\$60.92
10-11	\$58.55
11-12	\$59.18
12-13	\$58.34
13-14	\$60.78
14-15	\$69.01
15-16	\$71.35
16-17	\$68.74
17-18	\$67.60
18-19	\$73.51
19-20	\$77.10
20-21	\$80.09
21-22	\$81.80

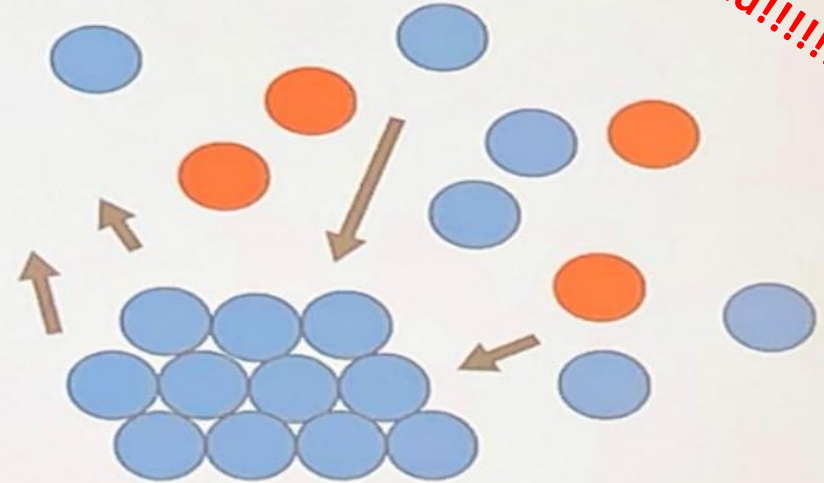


Why Salt Brine? How does it work?

All deicers work the same way – the “colligative effect”



Pure Water

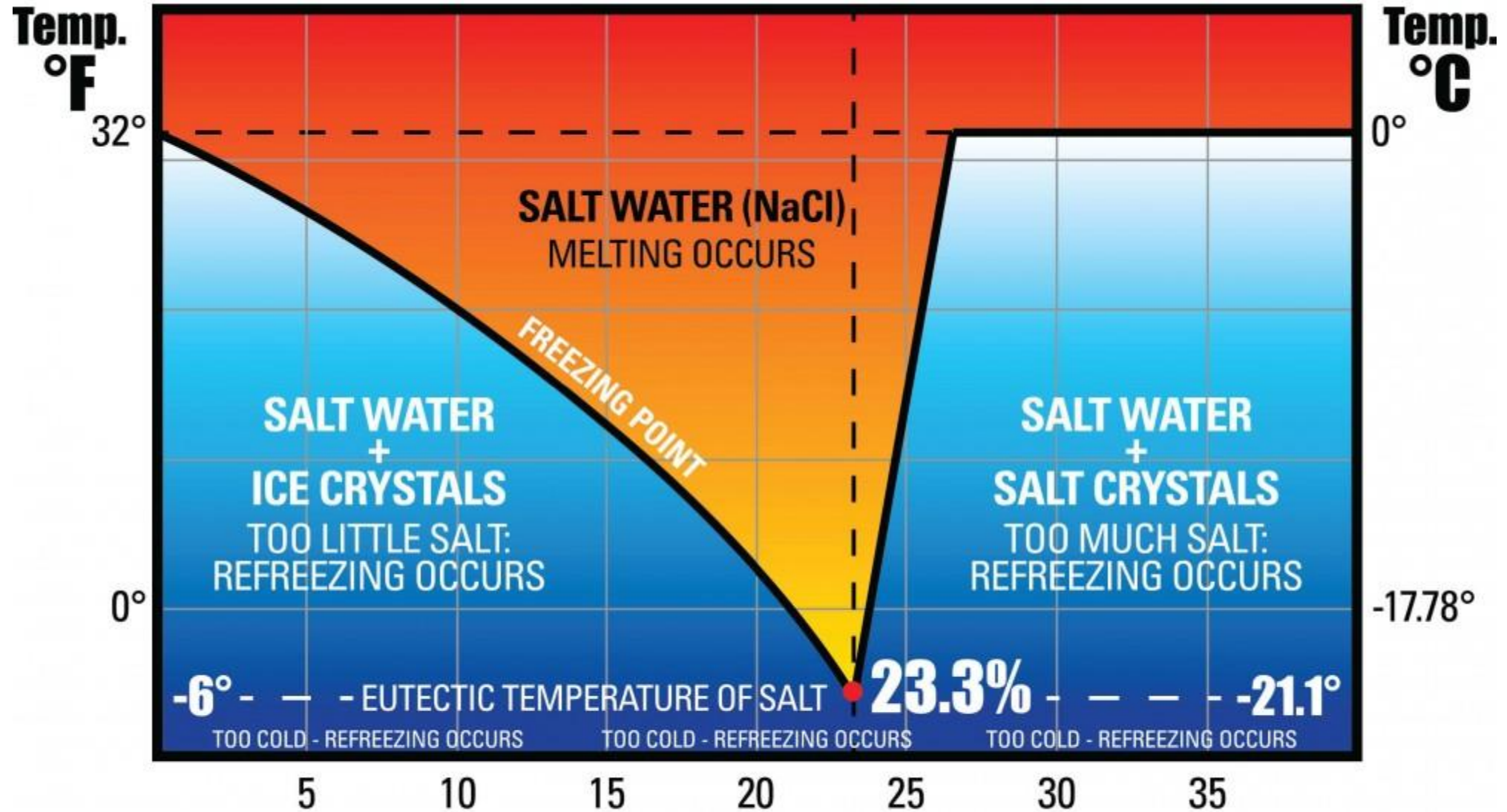


Salt Water Solution

STOP the Bond!!!!!!!!!!!!

The more “foreign particles” the lower the freezing point

SALT BRINE - PHASE DIAGRAM



Salt Concentration (% by weight)

Data courtesy of the Federal Highway Administration (FHWA)

SAFE HIGHWAYS — LESS SALT

Efficiency for Wisconsin Winter Maintenance

It's a **BIG JOB**

WisDOT works with 72 counties to clear 35,000 highway miles

Every year, Wisconsin averages...

31
snow events

72
inches snow

11
freezing rain events

Rising costs

Wisconsin spends roughly \$35 million annually for salt on state highways alone, and the price of road salt is increasing.



Salt up 168%



Gas up 46%



Consumer Price Index up 47%

Creating efficiency

Regardless of what Mother Nature throws at us, winter maintenance professionals are working hard to make every grain of salt count by focusing on education, best practices and methods development.

State Highway System Salt Use

2018–2019
553
thousand
TONS

2019–2020
425
thousand
TONS

2020–2021
325
thousand
TONS

Increased opportunity

Liquid brine, a mixture of salt and water, can help stretch budgets over traditional rock salt distribution.

Why it matters?

Smart salt management = investment for future.



Budget control



Safety focus



Benefits environment

\$1,000
of road
salt

83 LANE MILES



217 LANE MILES



Goal: Safe, clear winter roads

Salt use data based on 3-year trend. Salt cost data from Consumer Price Index, 20 year comparison.





Winter 20/21 Brine Liquid Use

- Statewide
 - Liquid Use: 11,542,358 gallons
326 gal/LM
- Northwest Region
 - Liquid Use: 846,515 gallons
109 gal/LM
- Southwest Region
 - Liquid Use: 2,851,355 gallons
295 gal/LM
- Southeast Region
 - Liquid Use: 1,337,082 gallons
218 gal/LM
- North Central Region
 - Liquid Use: 3,278,172 gallons
526 gal/LM
- Northeast Region
 - Liquid Use: 3,039,234 gallons
590 gal/LM



Salt Brine Cost: 2021/22 Winter Season

brine = 23.3% salt and water

- Cost per gallon of salt brine with adm. fee = \$0.24
- Cost per gallon for transportation = \$0.16

Total Brine Delivered Cost = \$0.40



- Cost per gallon for “**Hot Load**” (90% brine – 10% Calcium Chloride) with adm. Fee = \$0.43
- Cost per gallon for transportation = \$0.16

Total Hot Load Delivered Cost = \$0.59



- Anti-icing:** Spraying salt brine mixtures (straight salt brine, salt brine and organic mixtures or salt brine and calcium chloride) on the pavement prior to a snow storm.

- De-icing:** Spreading salt with liquid mixtures during and after a snowstorm.

- Pre wet:** spraying salt solution on the salt at the spinner/spinner as it's applied to the pavement. This takes place during de-icing.

- “Hot Load”:** liquid containing 90% Brine and 10% Calcium Chloride (CaCl) solution >> mixed in order to reduce the freezing point to approximately 10 degrees.

- Refreezing:** the point at which a solution loses melting power reverts back to a solid.

- Brine = 10 degrees

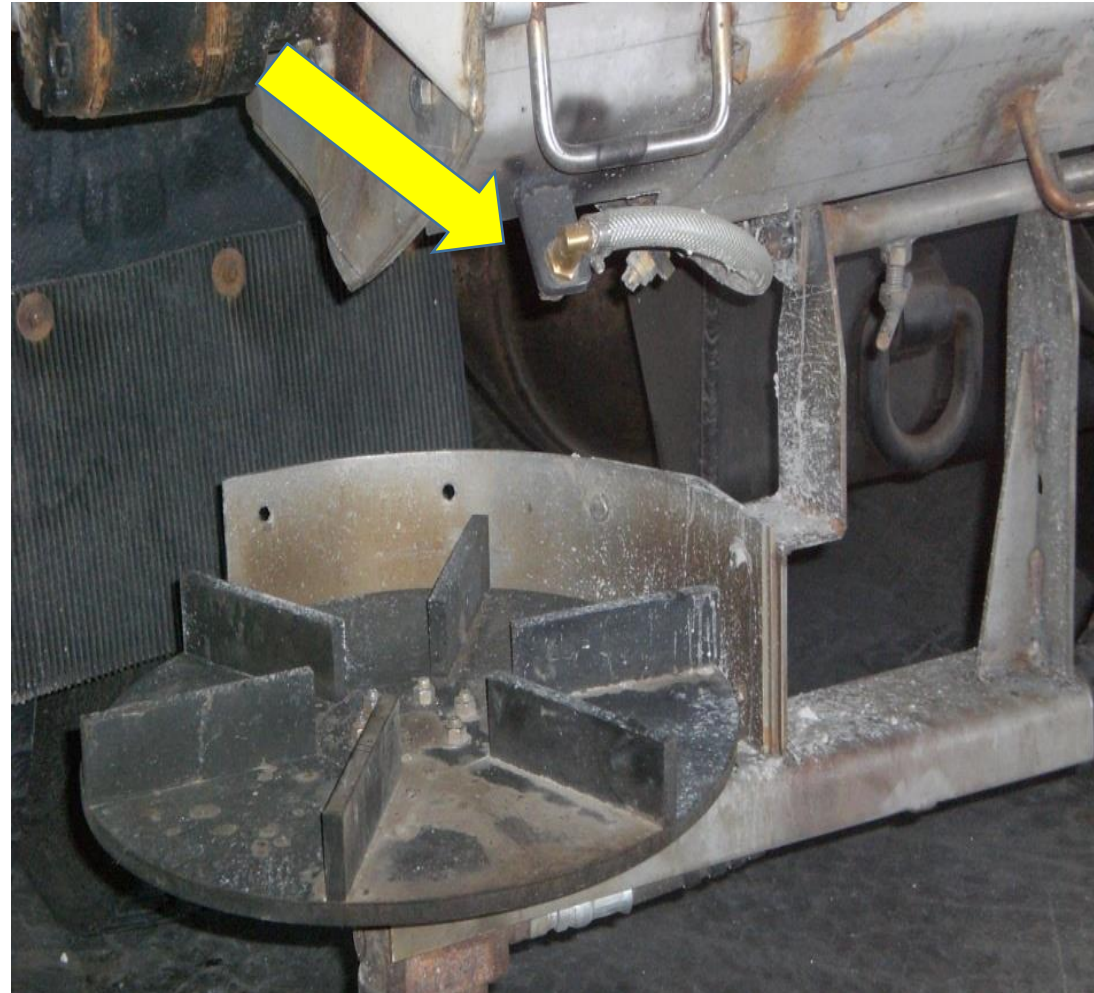
- Hot Load (CaCl) = -35 degrees

Definitions

Pre-Wet Salting



- Spraying Salt Brine on the salt as it comes off the spinner.
- Reduces salt bounce which leads to the salt staying on the paved surface where we want it not in the shoulder or ditches.
- 20 to 30 % saving for this alone.
- Activates salt immediately. No waiting for precipitation moisture to create brine.
- Salt Brine Solution contains 23% salt. The oceans are about 3.5 %.
- 23% solution requires 2.33 pounds of salt/gallon of water.



Pre-Wet Salting

Equipment



Anti-Icing



- Spraying Roadways with Salt brine prior to storm.
- Places a fine layer of salt on roadway so that when the first snow falls, the moisture in the snow creates salt brine to keep the snow/ice from bonding to the pavement.
- In small storms <1" or frost events this may be adequate treatment requiring no additional applications.
- Gives snow crews a "head start" on de-icing applications.



Potential.....Salt Savings!!

Nissen	Seasonal			
	Salt	Calcium	Brine	Snow
10_11	708.50	5220	19690	85.9
9_10	628.225	150	0	29.2
08_9	1236.625	900	0	89.8
Diff 08-09	528.13 Tons			
Gruendeman				
10_11	604.5	1452	19615	85.9
9_10	3295.06	48	0	29.2
08_9	1100.125	192	0	89.8
Diff 08-09	495.625 Tons			
Tordik				
10_11	522.75	1450	21300	85.9
9_10*	759.58	0	0	29.2
08_9*	1188	0	0	89.8
Diff 08-09	665.25 Tons			

Over 25% in the first year!

If you calibrate, train, update equipment



Devil in the Details....document, document, document

Yep, this is an eye chart!

Xzalt Slide In Unit Salt Analysis								
	Salt	Calcium	Brine	Seasonal Snow				
Nissen								
11_12	445.25	5450	17740	35.6				
10_11	708.50	5220	19690	85.9				
9_10	628.225	150	0	29.2				
08_9	1236.625	900	0	89.8				
Diff 08-09 / 10-11	528.13							
Diff 09-10 / 11-12	182.98							
Gruendeman								
11_12	442.00	144	18526	35.6				
10_11	604.5	1452	19615	85.9				
9_10	578.50	48	0	29.2				
08_9	1100.125	192	0	89.8				
Diff 08-09 / 10-11	495.625							
Diff 09-10 / 11-12	136.50							
Tordik								
11_12	248.88	450	13250	35.6				
10_11	522.75	1450	21300	85.9				
9_10*	759.58	0	0	29.2				
08_9*	1188	0	0	89.8				
Diff 08-09 / 10-11	665.25							
Diff 09-10 / 11-12	510.70							
* Different operator on this section								
** None of the trucks on these sections had prewet or liquid capabilities prior to 10-11 winter season.								
Salt per ton =		\$53.16						
Brine per Gallon =		\$0.04						
Calcium per Gallon =		\$0.58						
08-09 / 10-11 Difference								
Cost		Total Salt Savings	Brine Use	Cost	Total Brine Cost	Calcium Use	Cost	Total Calcium Savings
528.13	\$53.16	\$28,075.13	19690	\$0.04	\$787.60	5220	\$0.58	\$3,027.60
495.625	\$53.16	\$26,347.43	19615	\$0.04	\$784.60	1452	\$0.58	\$842.16
665.25	\$53.16	\$35,364.69	21300	\$0.04	\$852.00	1450	\$0.58	\$841.00
		\$89,787.24			\$2,424.20			\$4,710.76
Brine and Calcium Cost		\$7,134.96						
Total Salt Savings 10-11		\$82,652.28						
08-09 / 10-11 Difference								
Cost		Total Salt Savings	Brine Use	Cost	Total Brine Cost	Calcium Use	Cost	Total Calcium Savings
182.98	\$53.16	\$9,726.95	17740	\$0.04	\$709.60	5450	\$0.58	\$3,161.00
136.50	\$53.16	\$7,256.34	18526	\$0.04	\$741.04	144	\$0.58	\$83.52
510.70	\$53.16	\$27,148.55	13250	\$0.04	\$530.00	450	\$0.58	\$261.00
		\$44,131.84			\$1,980.64			\$3,505.52
Brine and Calcium Cost		\$5,486.16						
Total Salt Savings 11-12		\$38,645.68						
3 Xzalt Units - Approx. Cost		\$150,000.00						
2 season savings		\$121,297.96						
ROI Time		1.24						

Collect data and share information!





“Dirty” Water Recycling

- defined as water contained in holding tanks from vehicle washing at four (4) DPW locations
- “dirty water” contains approximately 15-18% chlorides
- “dirty water” is transported to the Highway Operations Center and stored in a 30,000-gallon underground holding tank
- “dirty water” used in making salt brine at a concentration of 23.3% salt water
- limited only by the ability to store dirty water
- Waukesha County is the only DPW in Wisconsin using recycled water

Note: Waukesha DPW made over 800,000 gallons of salt brine so far in 2021-22 Snow Season

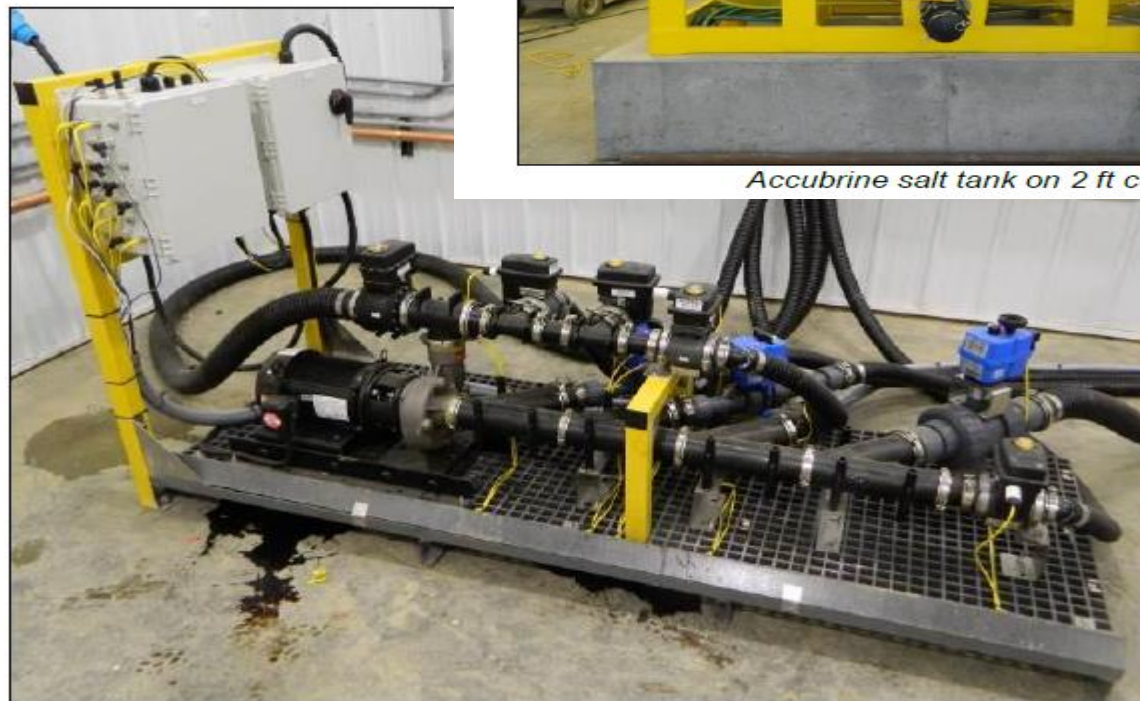




Brine Maker and "Dirty" Water Storage



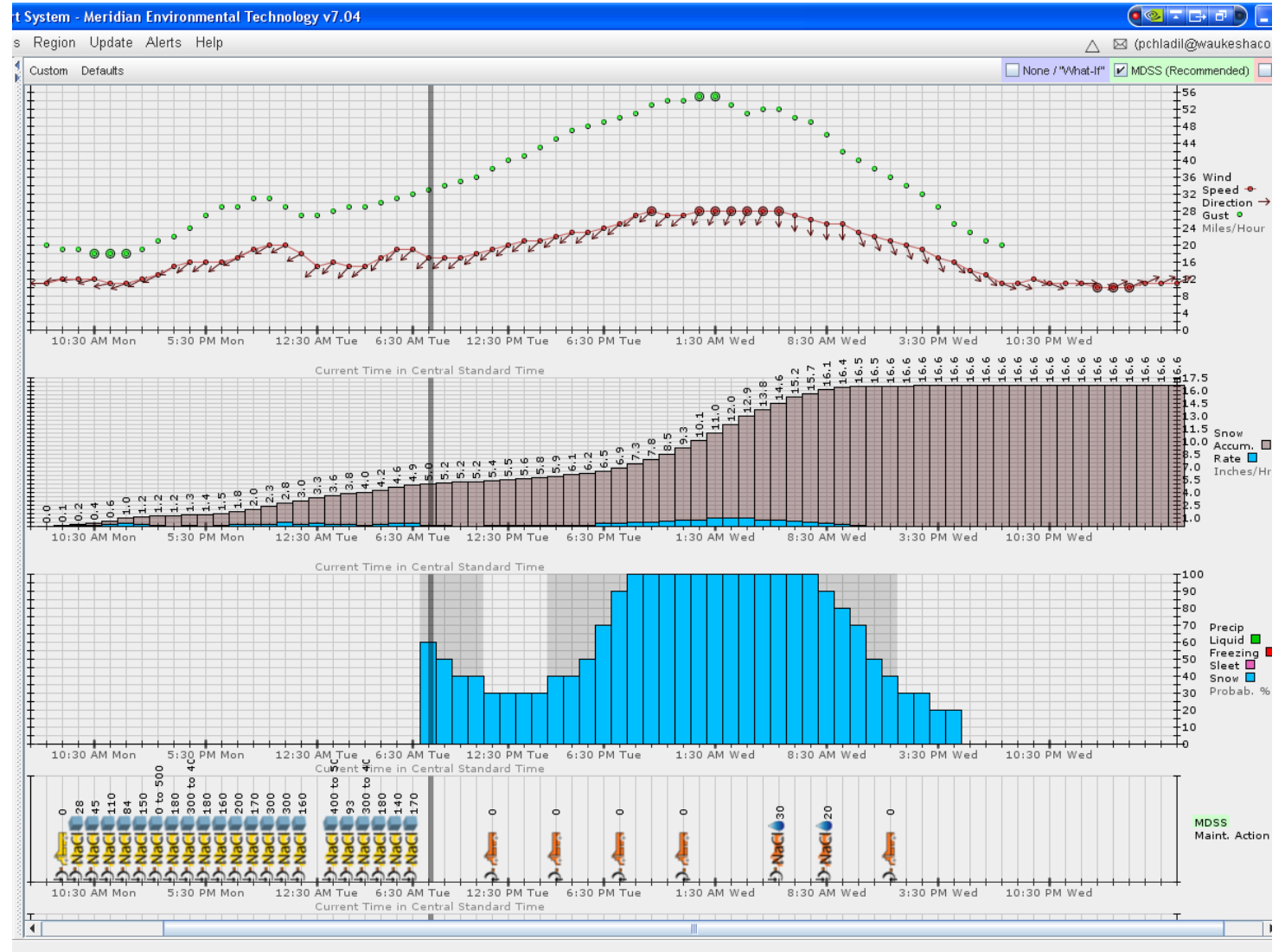
Accubrine salt tank on 2 ft concrete platform



Maintenance Decision Support System

- Weather Forecast using Truck Data to update future forecasts.
- Customizable down to Route by lane.

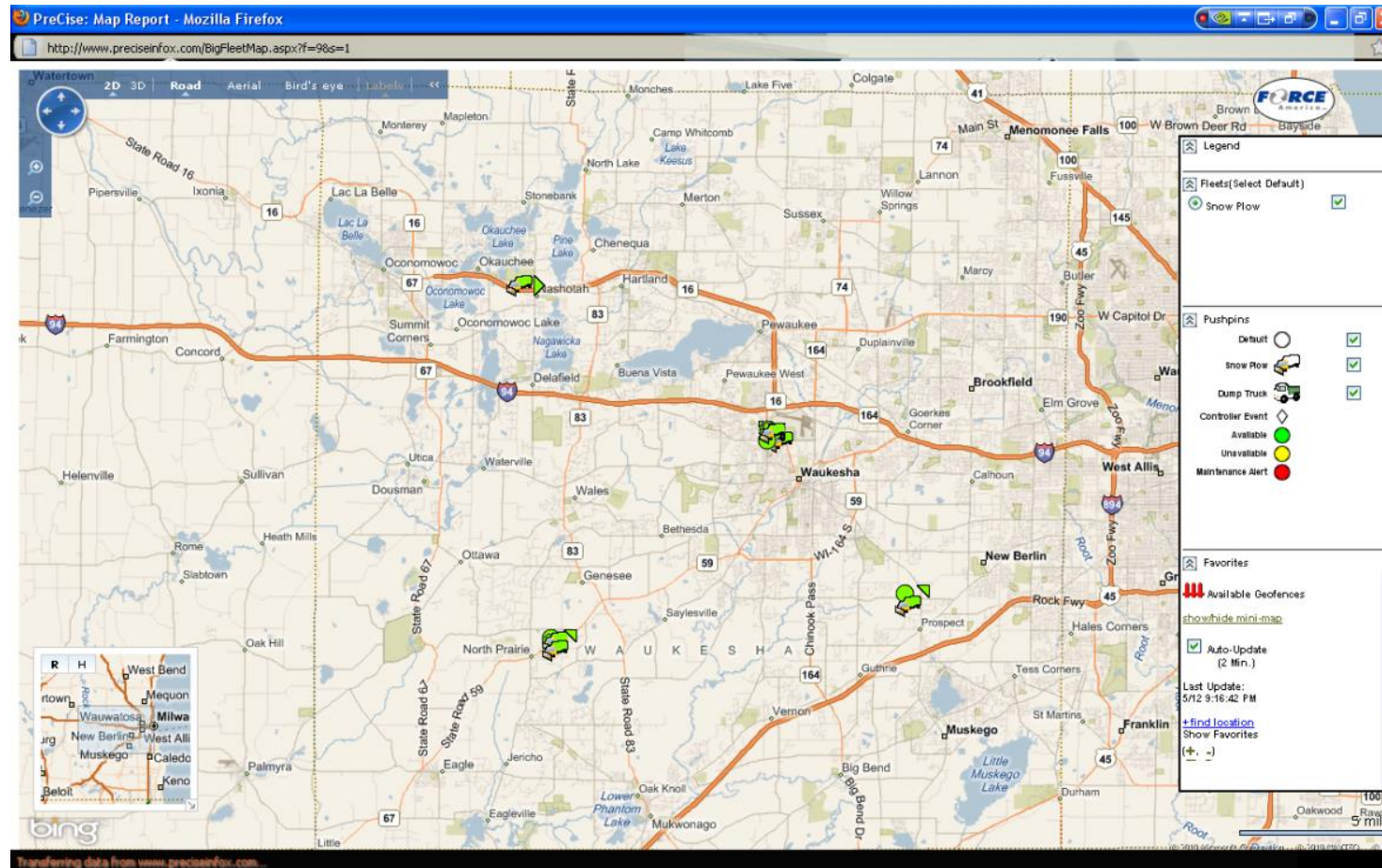
We use **weather forecasting** models to determine salt brine treatment applications rates



AVL/GPS & MDSS

Automatic Vehicle Location and Maintenance Decision Support System

- Can installation of these systems save money and reduce salt usage?

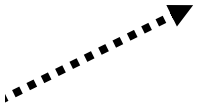


How PreCise Works

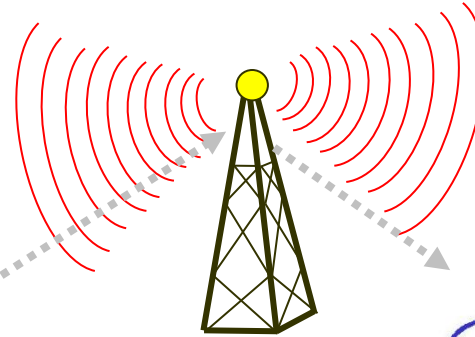
Accurate GPS data on location, heading, speed, elevation and time



5100/6100 Controller
Equipment Work Effort



Transmit via 802.11 or
GPRS (AT&T/T-Mobile)



Securely access info from
any web browser



Last Known Vehicle Location

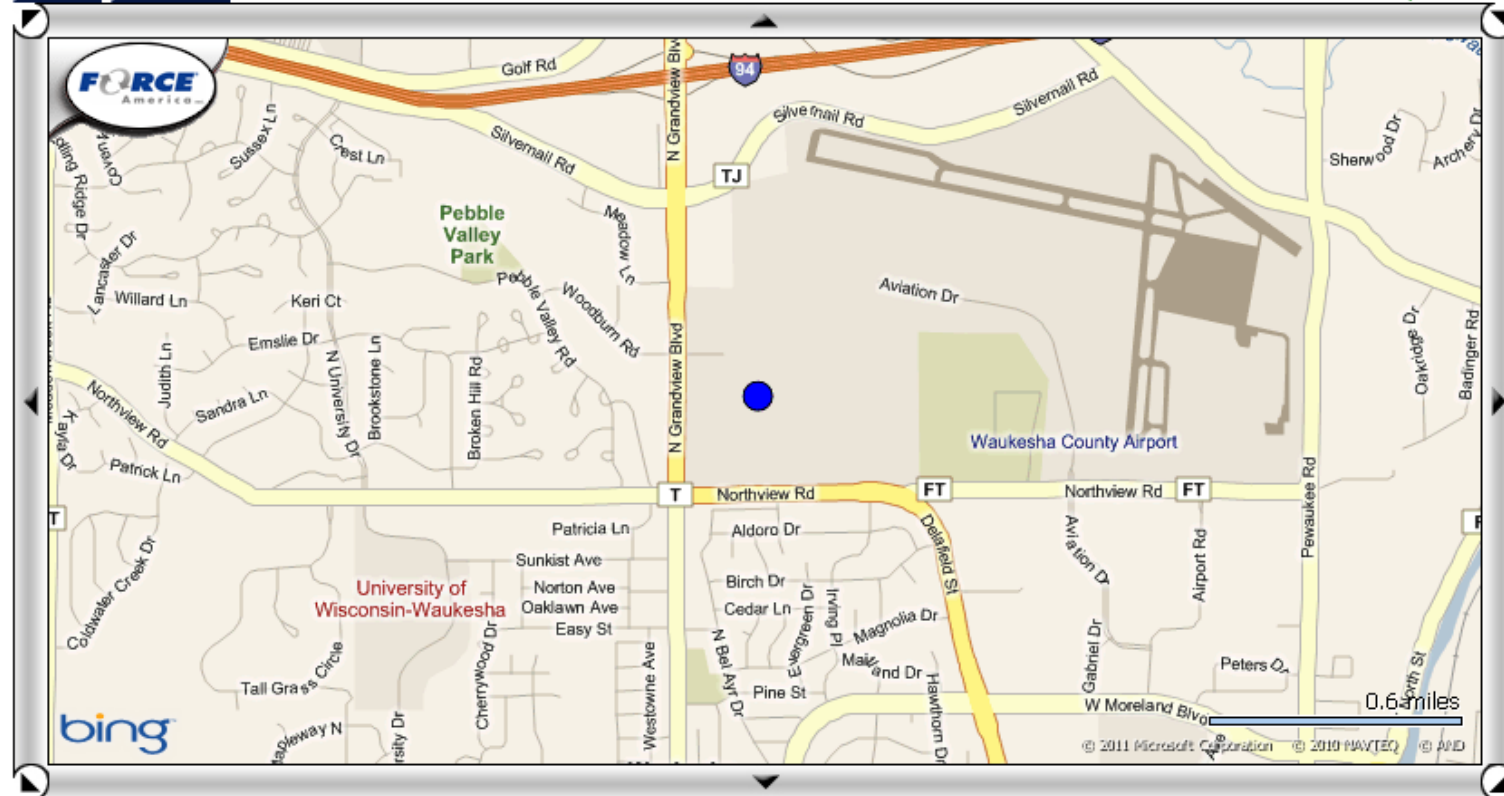
- Shows vehicle on Map

H129 Last Known Location

H129 

Road **Satellite**

The Time Zone Reflected is: **Central Time (US & Canada)**





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Review!!!

Definitions



Key Strategies

- Calibrate Trucks (salt and brine dispensers)
- Use Brine!
- Embrace technology...Upgrade to electronic salt control systems
- Train Operators on application rates and techniques
- Appeal to the hunters/fisherpersons/recreation users

Goal = Gain driver buy-in!!





Snow Fighting in 2022

There is an **Art** and **Science** to fighting snow

....you **MUST** use everything in your toolbox to be safe, effective, efficient, and **save money!!!!!!!!!!!!**





DPW/HIGHWAY OPERATIONS

