

Predicting Road Weather Emergencies:

Advancements in Storm Forecasting and Risk Communication

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Overview

- TECHNOLOGY
 - Investment in supercomputing
 - Weather observing advancements
- RESEARCH
 - Crash analysis findings & application
- COMMUNICATION
 - Messaging amplification through cross-agency coordination
 - Conveying possibilities & uncertainty
 - Snow squall warning (reaching motorists in winter)
 - Winter storm severity index



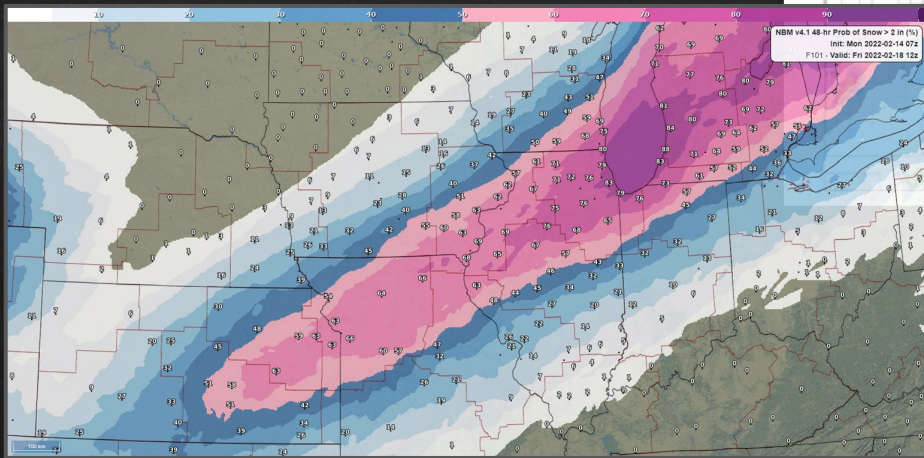
NWS Investment in Supercomputing

Twin supercomputer named DOGWOOD and CACTUS each operating at a speed of 12.1 petaflops, which is 3 times faster than NOAA's former system.

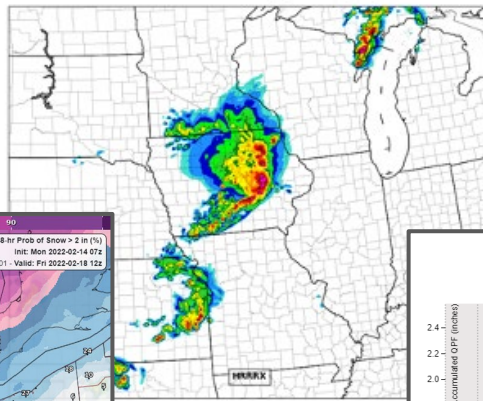
Combined with other NOAA supercomputers, capacity is now 42 petaflops.

Supercomputing Weather Forecast Advancements

1. Larger Number of Individual Model Simulations
2. Collaborative Development in the Cloud
3. Higher Spatial & Temporal Resolutions
4. More Realistic Model Physics
5. Enhances the National Blended Model



07Z 08/10 Composite Reflectivity Forecasts and Observations
Valid at 18Z 10 Aug 2020 (F11)

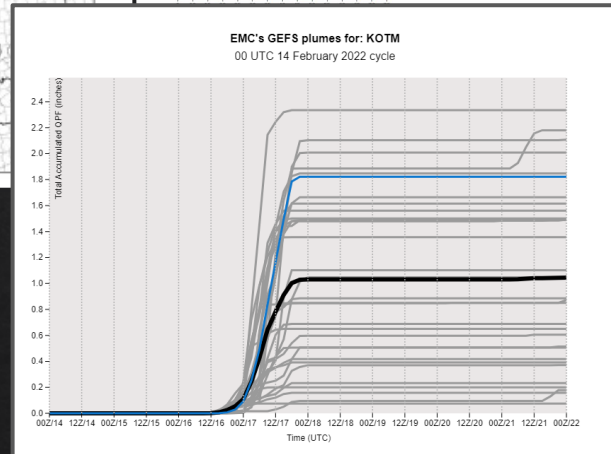
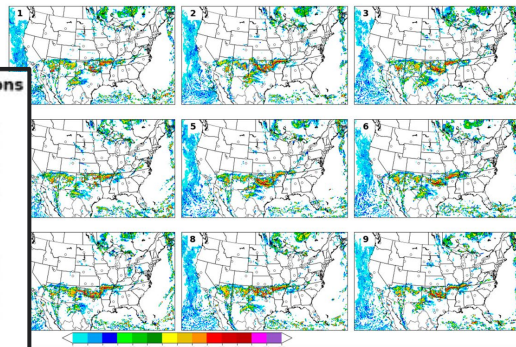


RRFS Model Fields - Experimental

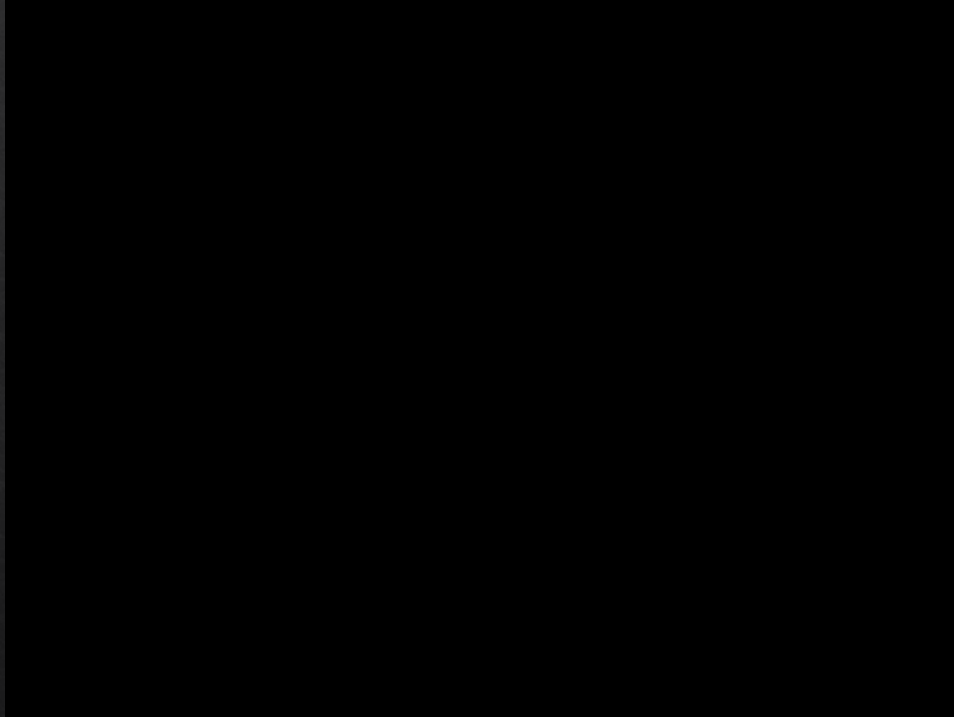
Composite Reflectivity (dBZ, shaded)

RRFS: B - 20221016 00 UTC

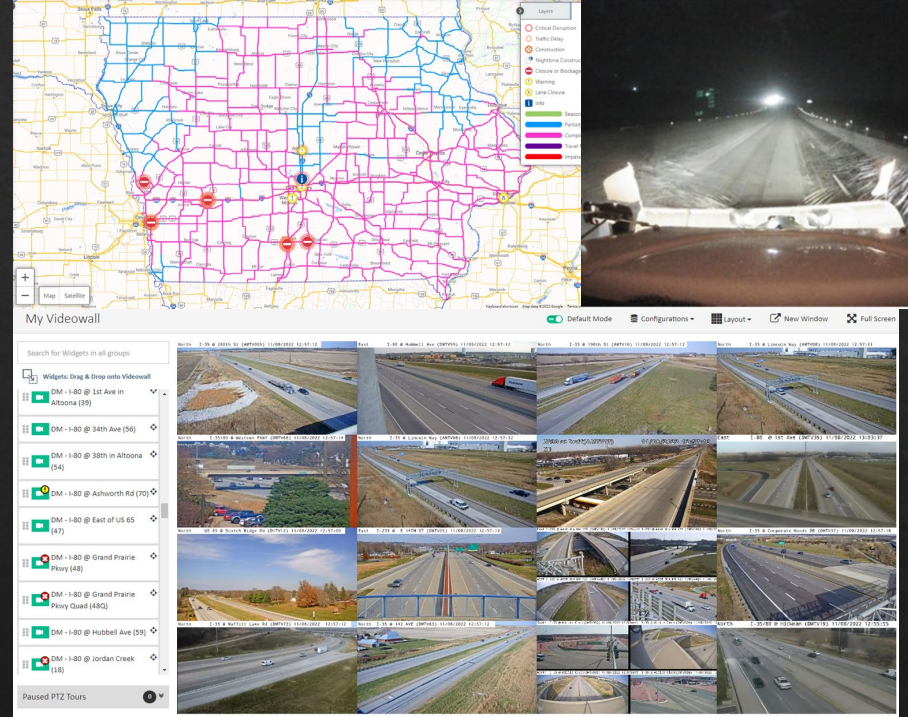
F01-F09: B - 20221016 00 UTC



Weather Observing Advancements



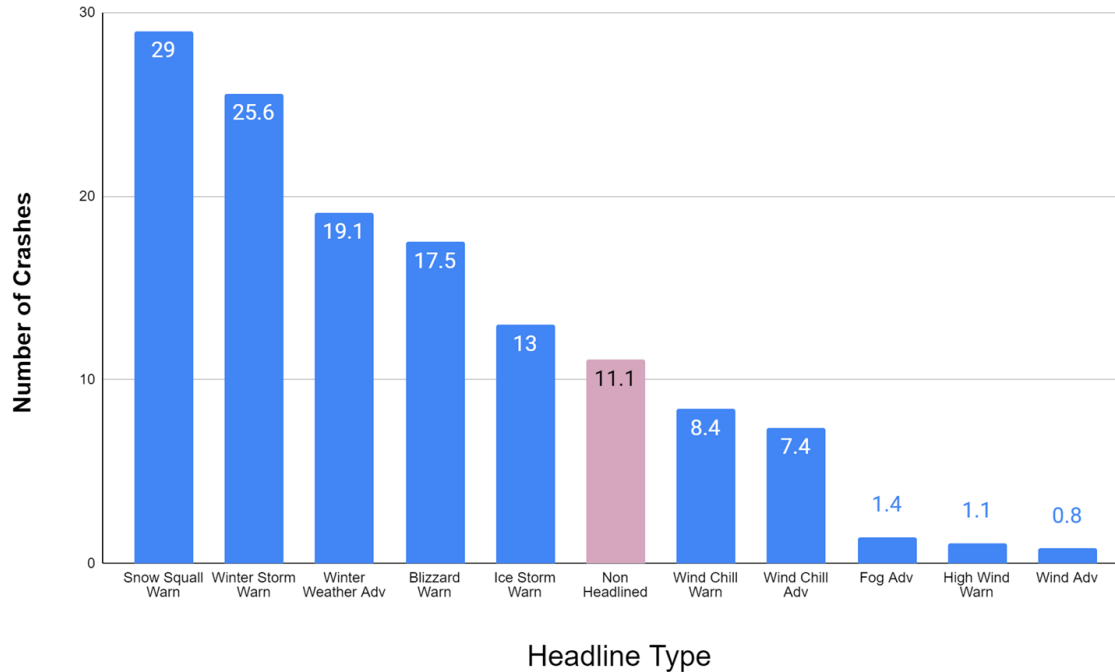
Satellite Showing Blowing Snow



Real-time DOT Information

Crash Analysis Findings & Application

2005 - 2022 Polk County Crash Frequency Per Headline Occurrence

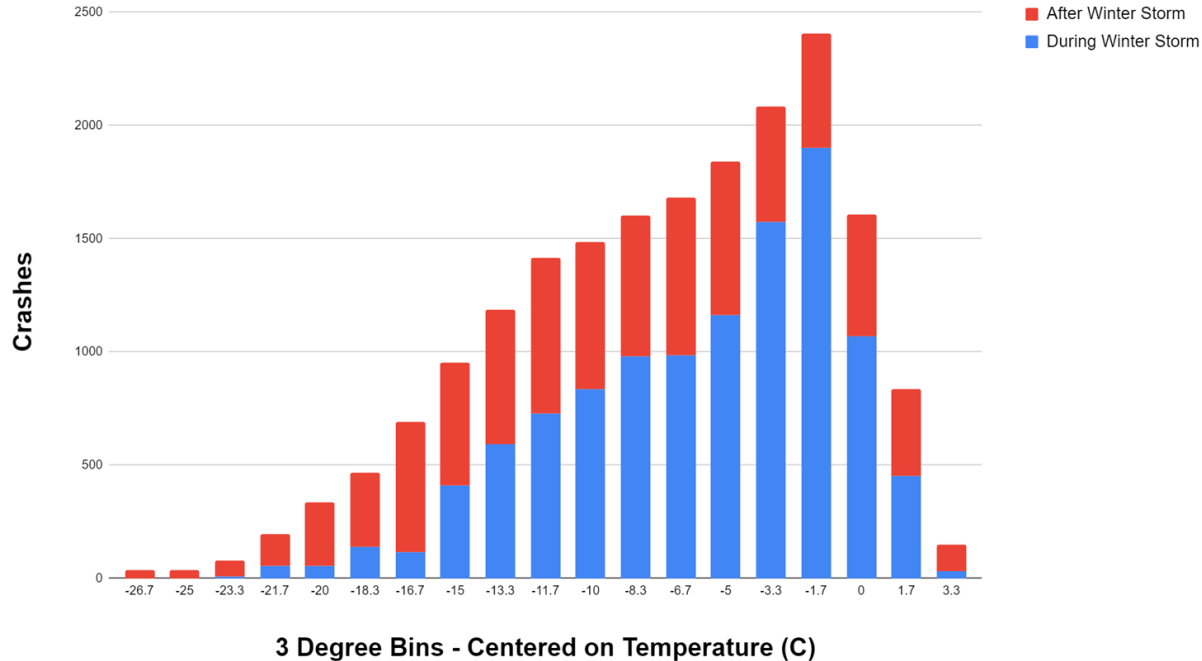


Travel Impacts

- #1 Snow Squalls
- #2 Major Winter Storms
- #3 Winter Storms
- #4 Blizzards
- #5 Ice Storms
- #6 Sub-Advisory
- or
- Non Advisory
- #7-8 Wind Chill Events

Crash Analysis Findings & Application

2001-2019 Polk County Crashes During Winter Events and After Winter Events



Temperature Impacts

Warmer Conditions:

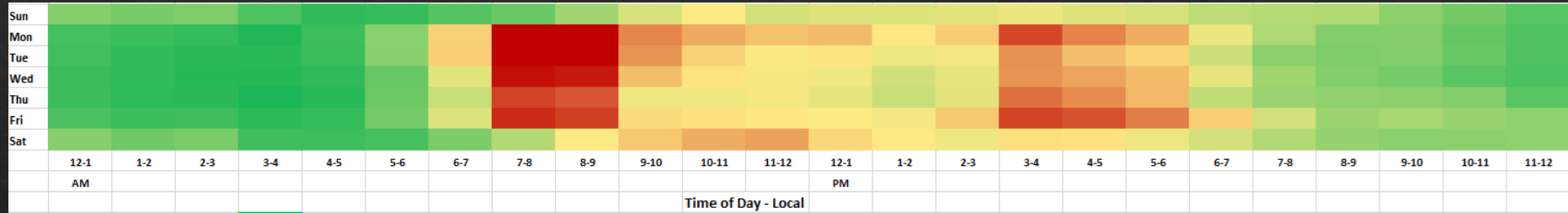
Fewer crashes after events than during events at those temperatures.

Colder Conditions:

More similar numbers of crashes before/after events at those temperatures.

Crash Analysis Findings & Application

Crash Heat Map of Central Iowa Counties 2001 to Spring 2022 - Peak Crash Periods & Travel Impacts



Winter Travel Messaging - Targets of Opportunity:

- Morning and afternoon weekday rush hours
- Saturday & Sunday late morning through afternoon/evening
- Slight increase in late night Friday/Saturday and late Sunday evening

Crash Analysis Findings & Application

Heat Map Analysis of Polk County 2001 to 2019 - After Winter Event and Precipitation Has Ended

- Visibility Equal or Greater than 6 statute miles (9.67 km)
- Temperatures across a spectrum of -16 F to 38 F (-26.7 C to 3.3 C)
- Wind/wind gust across 5 binned categories in mph (kmh = ~ 1.61 x mph)

	Visibility is >= 6.0 miles																		
Wind > 45 mph	0	0	0	0	0	0	0	0	0	1	1	10	2	0	2	3	3	7	0
Wind 35 to 45 mph	0	0	0	0	4	10	17	13	17	7	15	14	42	51	10	24	23	7	7
Wind 25 to 35 mph	0	0	2	2	5	41	30	47	49	73	80	92	56	80	40	51	53	52	8
Wind 15 to 25 mph	0	1	2	7	29	26	116	120	109	170	84	105	137	114	89	79	48	44	24
Wind 0 to 15 mph	37	35	65	131	234	241	356	338	372	416	416	328	372	319	251	236	201	121	49
Temperature in F	-16	-13	-10	-7	-4	-1	2	5	8	11	14	17	20	23	26	29	32	35	38
Temperature in C	-26.7	-25	-23.3	-21.7	-20	-18.3	-16.7	-15	-13.3	-11.7	-10	-8.3	-6.7	-5	-3.3	-1.7	0	1.7	3.3

When No Precipitation is Occurring:

Crashes tend to be more frequent in colder temperatures and during periods of light to modest winds.

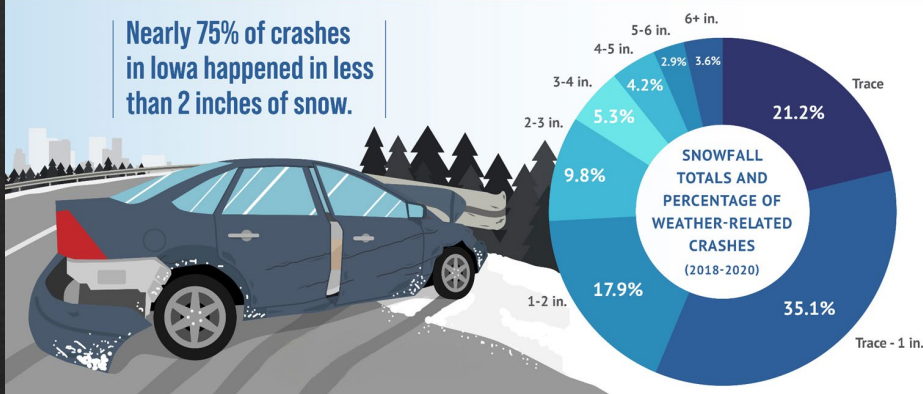
This May be Due To:

Ground blowing snow - Continued impacts to Road Conditions - Complacency of Motorists

Messaging Amplification through Cross-Agency Coordination

Less snow doesn't always mean you're good to go...
 Slow down and allow plenty of space between vehicles.

Nearly 75% of crashes in Iowa happened in less than 2 inches of snow.



Iowa Department of Transportation
 May 27 · 🌐
 Here's a look ahead to the holiday weekend weather from our US National Weather Service Des Moines Iowa partners.

Strong To Severe Storms For Holiday Weekend May 27, 2022 8:09 AM
 Severe Storms Possible in North and Western Iowa Sunday Night

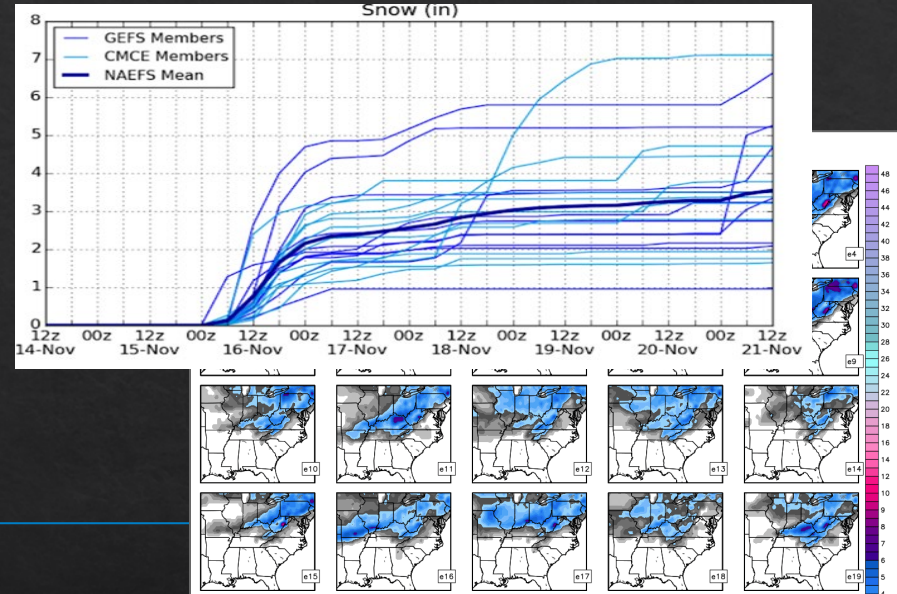
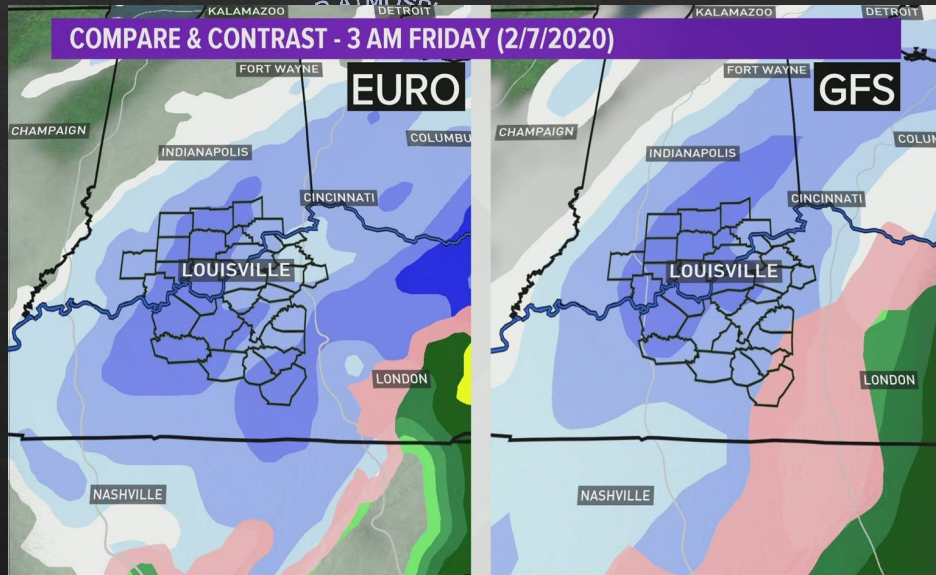
Sunday's Storms

- Strong to severe storms possible on Sunday night starting around 7pm then lasting through the night
- Main threats are strong wind and large hail but a few tornadoes are also possible
- Greatest chances for severe weather Sunday night will be in northwest Iowa

IOWA DOT, IOWA STATE PATROL, AND NATIONAL WEATHER SERVICE WINTER RESOURCES WEBINAR

- Debbie McClung, Department of Public Safety
- Andrea Henry, Iowa DOT
- Craig Bargfrede, Iowa DOT
- Sgt. Alex Dinkla, Iowa State Patrol
- Chad Hahn, NOAA/National Weather Service-Des Moines
- Sinclair Stolle, Iowa DOT

Conveying Possibilities & Uncertainties



You've probably heard of a couple of our weather models like the American (GFS) or the European (Euro)...

...but now due to increased technology, we actually have access to over a hundred models!

Conveying Possibilities & Uncertainties

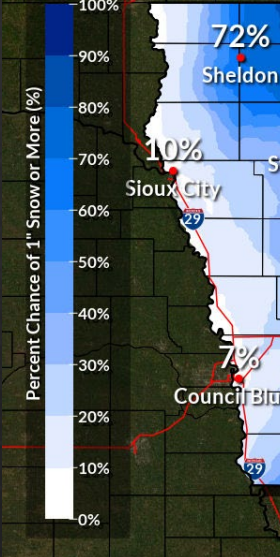
<https://www.weather.gov/desmoines>

The screenshot shows the NWS Forecast Office Des Moines website. At the top, there is a navigation bar with links for HOME, FORECAST, PAST WEATHER, SAFETY, INFORMATION, EDUCATION, NEWS, SEARCH, and ABOUT. Below this, there are sections for local forecast by city/zip, news headlines, and a weather alert: "SNOW WILL CONTINUE TO IMPACT MOST OF IOWA TODAY. HAZARDOUS TRAVEL IS LIKELY!". The main content area features the "NWS Forecast Office Des Moines, IA" header, a "Local Programs" menu, and a "FIRST SNOW OF THE SEASON!" announcement. A map of Iowa shows the forecast area in purple, with a legend for "Winter Weather Advisory" and "Hazardous Weather Outlook". A sidebar on the right contains a list of links including Blog, Publications, Statewide Maps, Decision Support, Winter Weather, Current Weather, Interactive Map, Forecast Graphics, Storm Spotting, Preparedness, Weather History, Weather Radio, COOP Observers, Iowa Flood Center, NOHRSC Snowfall, Local Forecast Info, Social Dashboard, Latest Newsletter, Past Weather Plots, Education, and Our Office. Two red arrows point to the "Local Programs" menu and the "Winter Weather" link. The bottom of the page includes a "Small Decisions can have a BIG IMPACT." banner and a "change location" link.

Percent Chance of 1" Snow or More

Valid 6 AM Mon Nov 14, 2022 through 6 AM Thu Nov 17, 2022 CST

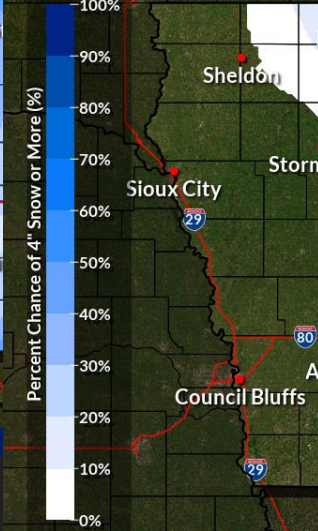
Weather Forecast Office
Des Moines, Iowa



Percent Chance of 4" Snow or More

Valid 6 AM Mon Nov 14, 2022 through 6 AM Thu Nov 17, 2022 CST

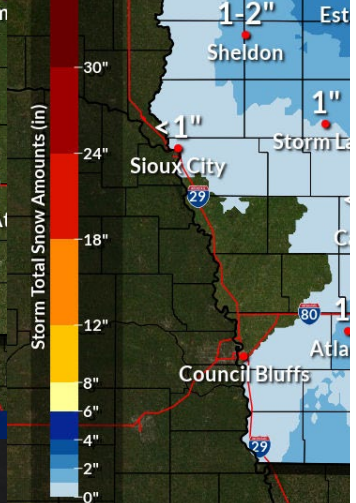
Weather Forecast Office
Des Moines, Iowa



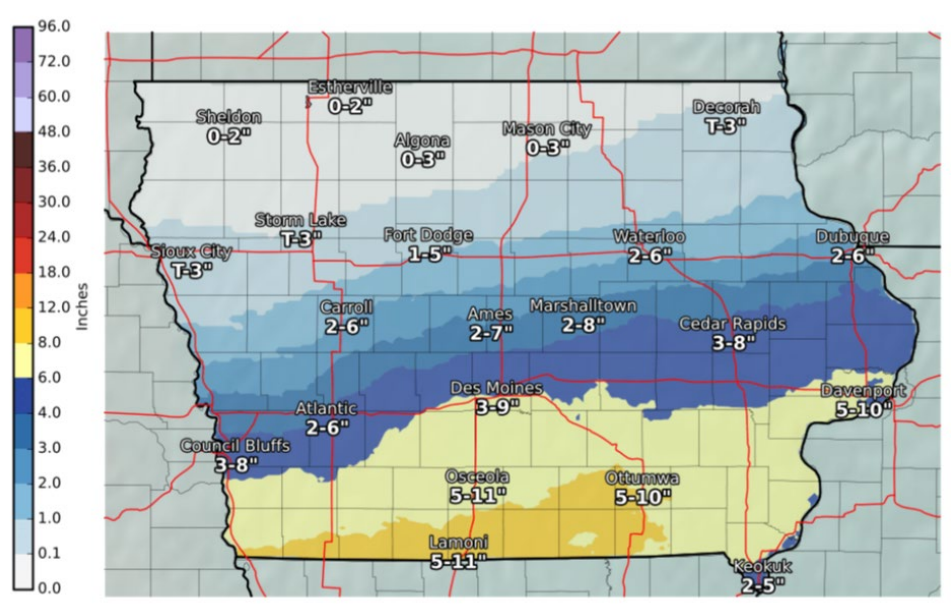
Event Total Snowfall

Valid 6 AM Mon Nov 14, 2022 through 6 AM Thu Nov 17, 2022 CST

Weather Forecast Office
Des Moines, Iowa



Types of Products:



f NWSDes Moines

f NWSDes Moines

f NWSDes Moines

Conveying Possibilities & Uncertainties

Location	Snow Amount Potential			Chance of Seeing More Snow Than							
	Low End Snowfall	Expected Snowfall	High End Snowfall	>=0.1"	>=1"	>=2"	>=4"	>=6"	>=8"	>=12"	>=18"
Estherville, IA	1	3	5	98%	92%	79%	34%	6%	0%	0%	0%
Mason City, IA	2	3	5	100%	97%	86%	32%	2%	0%	0%	0%
Fort Dodge, IA	1	3	4	97%	88%	65%	12%	0%	0%	0%	0%
Waterloo, IA	2	3	4	100%	97%	79%	7%	0%	0%	0%	0%
Carroll, IA	0	1	2	82%	52%	20%	1%	0%	0%	0%	0%
Ames, IA	1	3	4	99%	93%	72%	10%	0%	0%	0%	0%
Marshalltown, IA	2	3	4	100%	97%	78%	11%	0%	0%	0%	0%
Grinnell, IA	2	3	4	100%	96%	80%	12%	0%	0%	0%	0%
Des Moines, IA	1	2	4	98%	90%	62%	7%	0%	0%	0%	0%
Atlantic, IA	0	1	2	80%	50%	18%	0%	0%	0%	0%	0%
Creston, IA	<-1	2	3	97%	79%	43%	4%	0%	0%	0%	0%
Ottumwa, IA	1	2	3	100%	91%	51%	3%	0%	0%	0%	0%
Greenfield, IA	<-1	2	3	94%	77%	44%	4%	0%	0%	0%	0%
Corning, IA	<-1	1	2	91%	63%	21%	0%	0%	0%	0%	0%
Centerville, IA	1	2	3	99%	91%	56%	2%	0%	0%	0%	0%
Audubon, IA	0	<1	2	79%	48%	18%	1%	0%	0%	0%	0%
Boone, IA	1	3	4	98%	92%	71%	12%	0%	0%	0%	0%
Waverly, IA	2	3	4	100%	96%	76%	13%	0%	0%	0%	0%
Allison, IA	2	3	4	100%	97%	78%	15%	0%	0%	0%	0%
Rockwell City, IA	<-1	1	3	93%	73%	40%	4%	0%	0%	0%	0%
Osceola, IA	<-1	1	3	98%	81%	44%	4%	0%	0%	0%	0%
Denison, IA	0	<1	1	73%	30%	6%	0%	0%	0%	0%	0%
Adel, IA	<-1	2	3	97%	84%	53%	6%	0%	0%	0%	0%
Bloomfield, IA	1	2	3	99%	93%	61%	3%	0%	0%	0%	0%
Lamoni, IA	1	2	3	98%	87%	53%	1%	0%	0%	0%	0%
Hampton, IA	2	3	5	100%	97%	86%	27%	1%	0%	0%	0%
Jefferson, IA	<-1	2	3	94%	77%	46%	6%	0%	0%	0%	0%
Grundy Center, IA	2	3	4	100%	98%	81%	13%	0%	0%	0%	0%
Guthrie Center, IA	<-1	1	3	93%	71%	41%	6%	0%	0%	0%	0%
Webster City, IA	1	3	4	98%	92%	72%	17%	1%	0%	0%	0%
Garner, IA	2	4	5	99%	97%	88%	42%	7%	0%	0%	0%
Eldora, IA	2	3	4	99%	96%	79%	19%	1%	0%	0%	0%
Humboldt, IA	1	2	4	97%	88%	65%	15%	1%	0%	0%	0%
Newton, IA	2	3	4	99%	96%	78%	10%	0%	0%	0%	0%
Algona, IA	1	3	5	98%	92%	77%	31%	6%	0%	0%	0%
Chariton, IA	1	2	3	99%	91%	63%	4%	0%	0%	0%	0%
Winterset, IA	<-1	2	3	97%	81%	45%	4%	0%	0%	0%	0%
Oskaloosa, IA	1	3	4	99%	94%	71%	6%	0%	0%	0%	0%
Knoxville, IA	1	3	4	99%	92%	69%	5%	0%	0%	0%	0%
Albia, IA	1	2	4	99%	94%	68%	6%	0%	0%	0%	0%
Emmetsburg, IA	1	2	5	97%	89%	70%	23%	3%	0%	0%	0%
Pocahontas, IA	<-1	1	3	96%	77%	46%	7%	0%	0%	0%	0%
Mount Ayr, IA	<-1	2	3	97%	82%	43%	1%	0%	0%	0%	0%
Sac City, IA	0	<1	2	80%	44%	14%	0%	0%	0%	0%	0%
Toledo, IA	2	3	4	100%	96%	76%	5%	0%	0%	0%	0%
Bedford, IA	<-1	2	3	93%	71%	28%	0%	0%	0%	0%	0%
Indianola, IA	1	2	3	99%	91%	62%	4%	0%	0%	0%	0%
Corydon, IA	1	2	3	99%	88%	52%	4%	0%	0%	0%	0%
Forest City, IA	3	5	6	99%	97%	92%	59%	16%	1%	0%	0%
Northwood, IA	3	4	6	100%	99%	95%	59%	11%	0%	0%	0%
Clarion, IA	2	3	5	99%	95%	81%	25%	1%	0%	0%	0%

Snowfall ranges and probabilities for all 51 counties in central Iowa


Snow Squall Warnings


Brief (30-60 minutes) warnings issued for short duration intense bursts of snow & wind leading to white out visibility & flash freezes on roads

Snow Squall Warning


Valid Until
12:45 PM CDT Monday
October 19, 2020


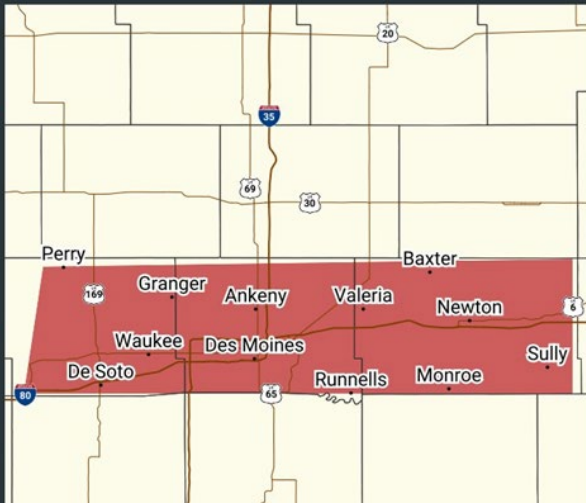
Threat Information

 **Hazard**
White out conditions in heavy blowing snow

 **Impact**
Dangerous life-threatening travel

Potential Exposure

 Population: 626,748
Highways: I-35
I-80
I-235



SNOW SQUALL
WARNING
UNTIL 12:45PM

Page 1 ✖

11:43 29°

33°
11:43
OCT 19 MON

Emergency alert:
Severe
Oct 19, 11:43 AM

Snow Squall Warning til 1245 PM CDT. Sudden whiteouts. Icy roads. Slow down! -NWS

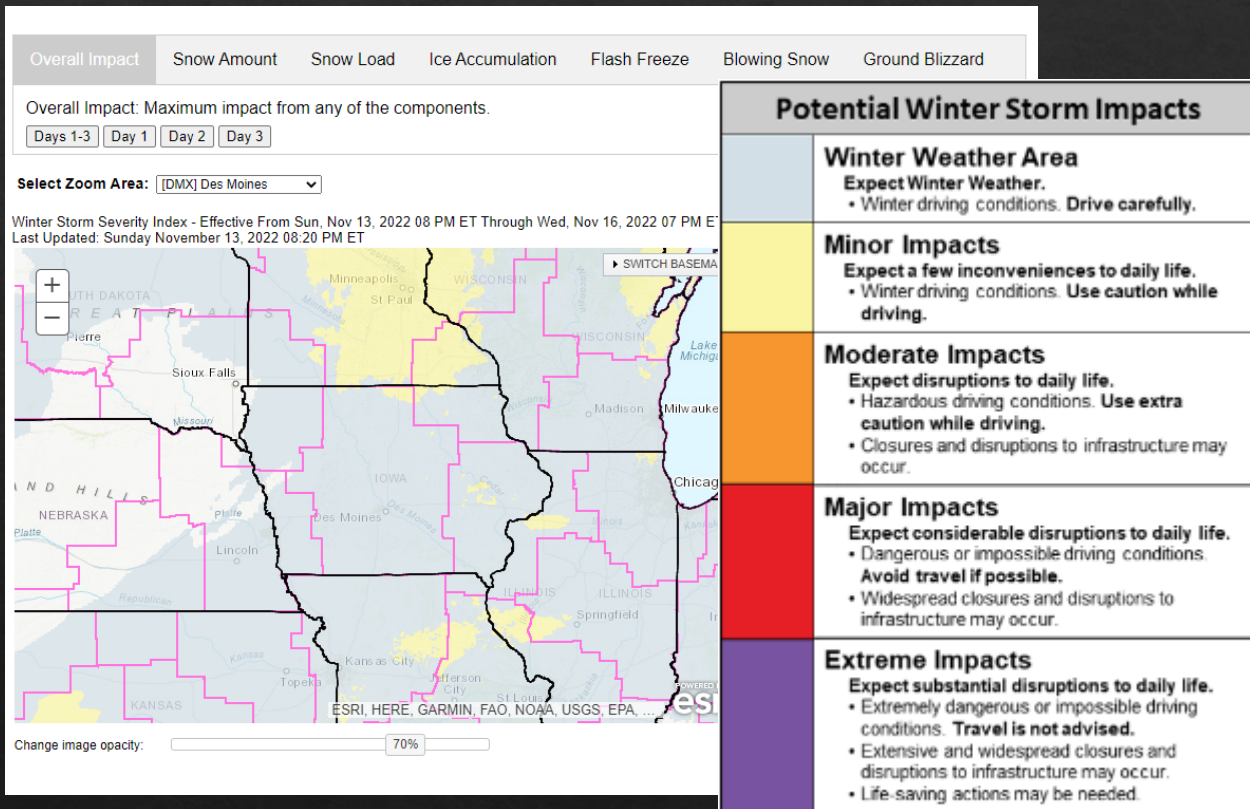
OK

Tadpoles Parent NWS Mobile

Google Play Store Gmail Chrome Yahoo Mail

Phone Messages Mountain Photos Camera

Winter Storm Severity Index- WSSI



WSSI Specifics

- Defines Greatest Threats for Area
- Easy to understand
- Based on specific winter inputs
- Produced 5x daily
- Complementary to official weather forecast

Predicting Road Weather Emergencies:

Advancements in Storm Forecasting and Risk Communication

Chad Hahn

Warning Coordination Meteorologist

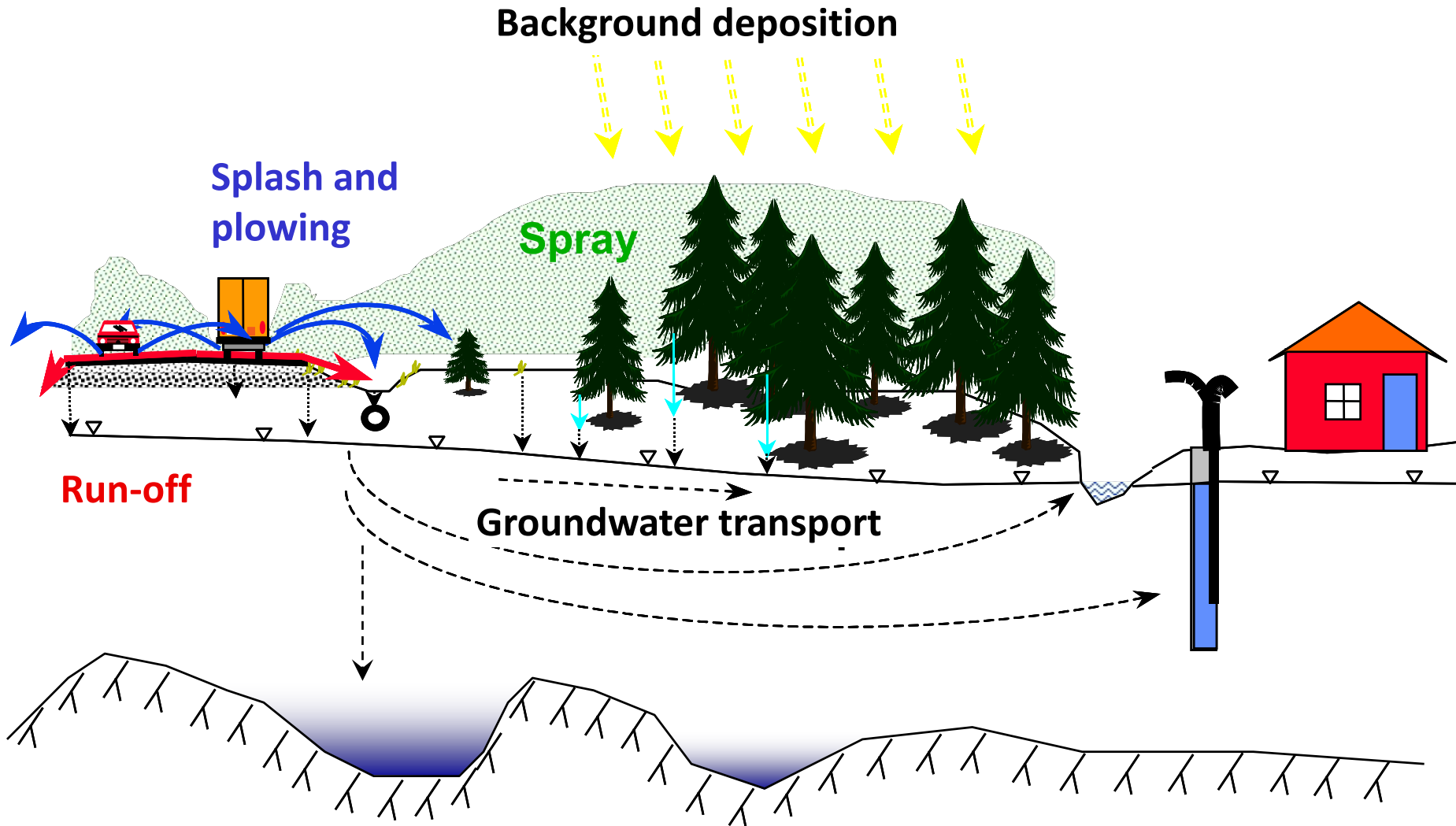
National Weather Service - Des Moines, Iowa

chad.hahn@noaa.gov

The loss of salt from the road surface – a coin with two sides: environmental implications

- Göran Blomqvist, PhD, senior researcher, VTI, Sweden

Environmental implications...



Impacts:

- Infrastructure
- Groundwater
- Surface waters
- Vegetation
- Soils
- Fauna
- Cultural heritage

Environmental research:

- Unfortunately, emphasis on environmental research is too often on the effect & impact side of the system, without connecting it to the decisions that road keepers and contractors have to do!



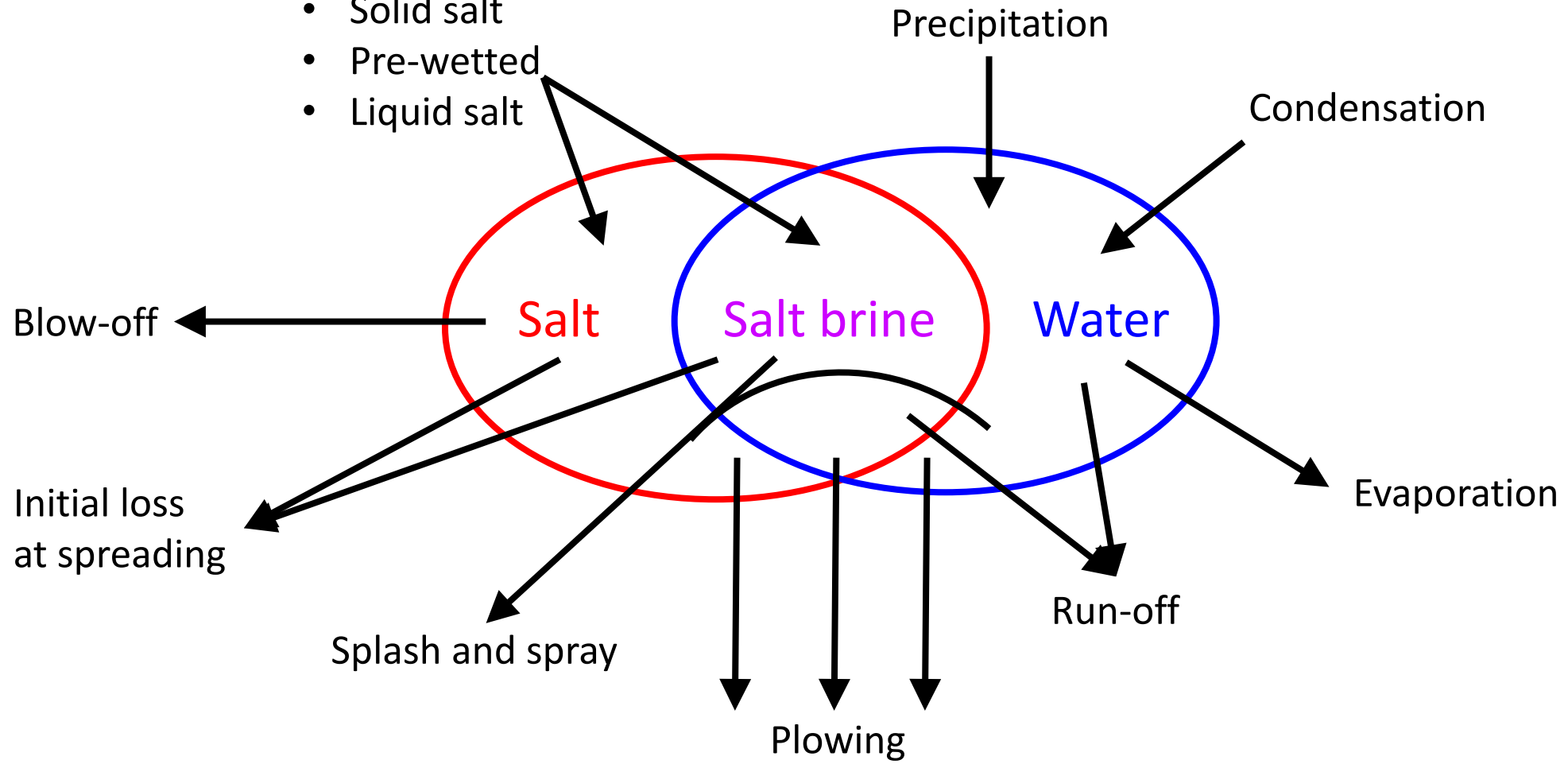
Key is
understanding
the processes

So, let's discuss the
salt- and water balance

Highways:

Salting:

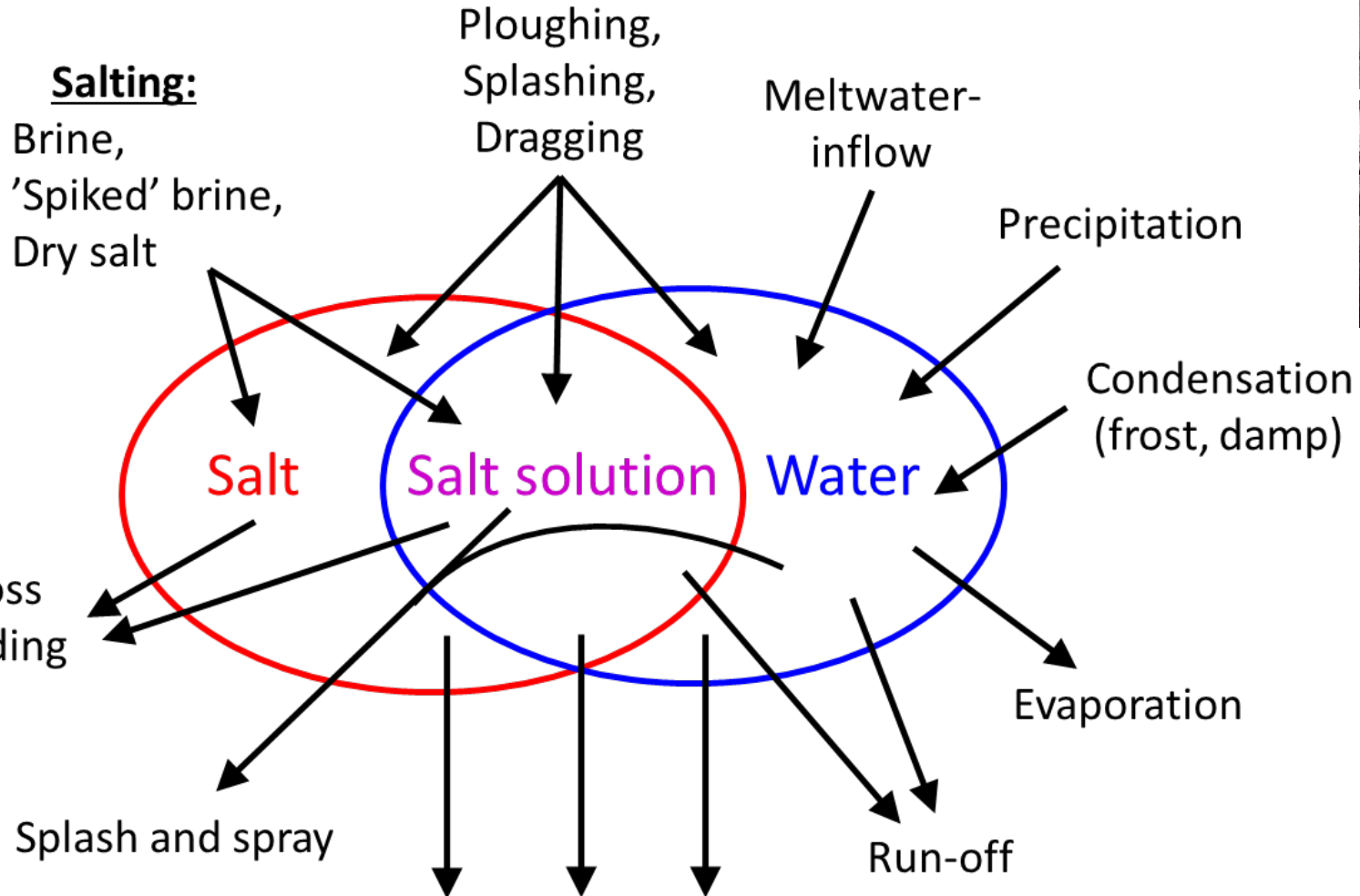
- Solid salt
- Pre-wetted
- Liquid salt



Cycleways:

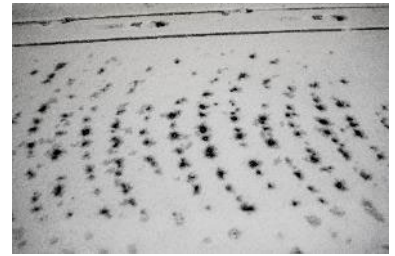
Salting:

- Brine,
- 'Spiked' brine,
- Dry salt



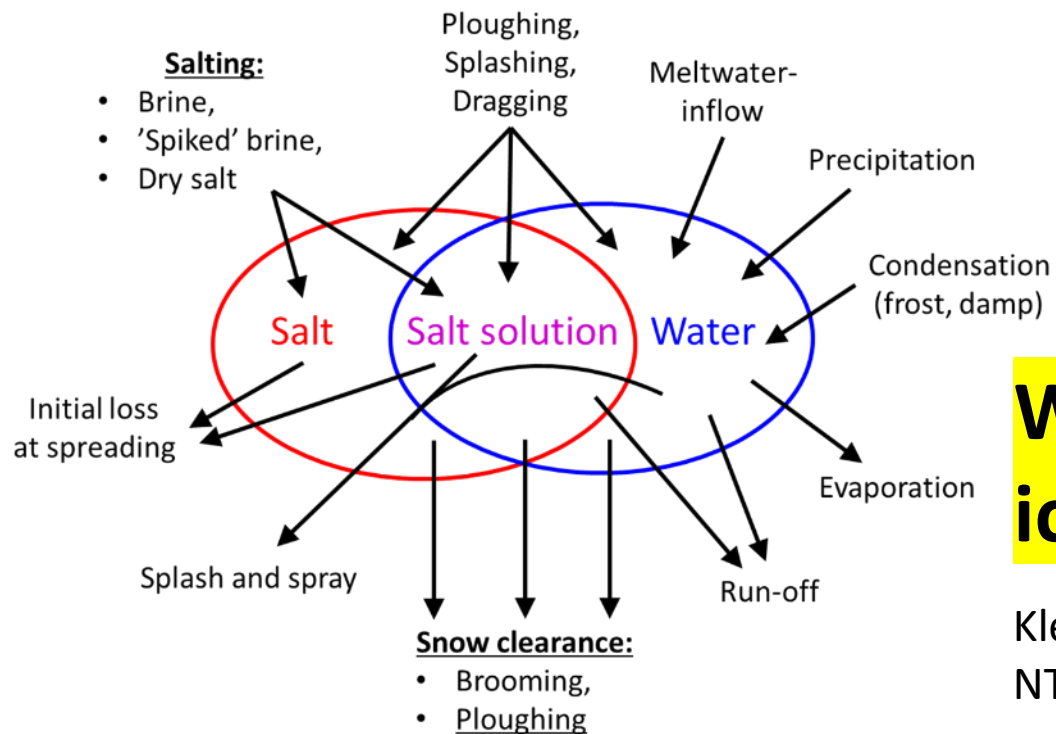
Snow clearance:

- Brooming,
- Ploughing



What is the optimal salt dose?

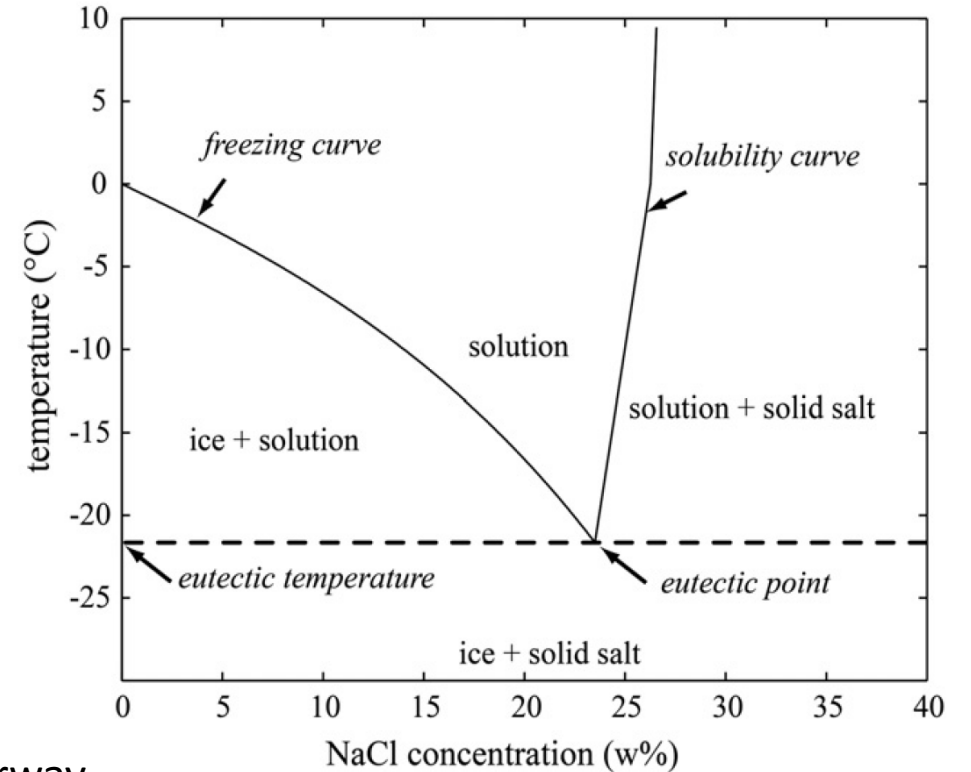
- How much salt is there to start with?
 - How much 'water'?
 - When can you pass the place next time?
 - What will happen in the mean time?
- + Safety margin



What about ice quality?

Klein-Paste & Wåhlin,
NTNU, Trondheim, Norway

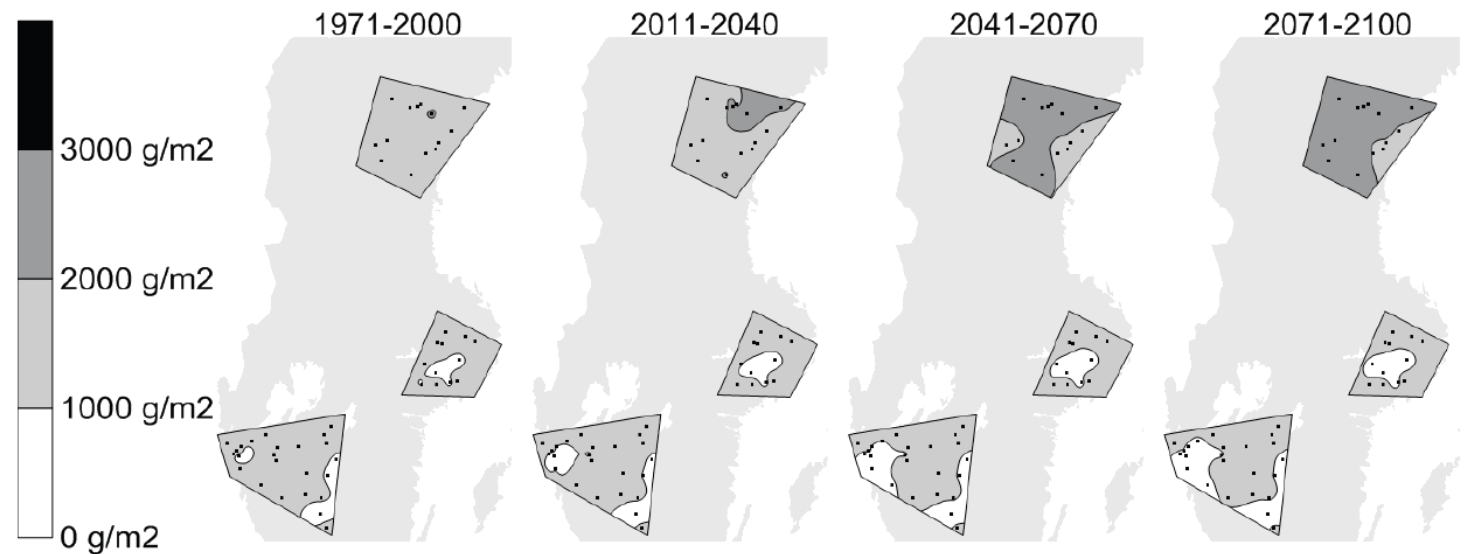
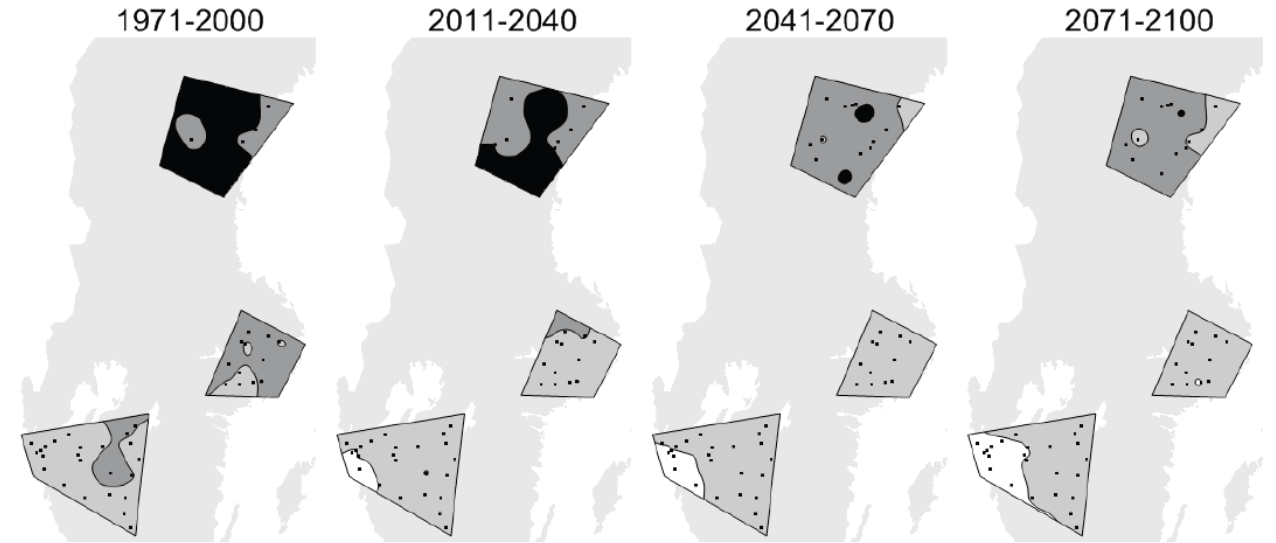
Temperature and wetness!



Climate change adaption

Impact on winter maintenance:

- Salt consumption from
a) snow-related and
b) temperature related
Winter maintenance



(ARVIDSSON, BLOMQVIST & ÖBERG, 2012)

FIGURE 5 Development in yearly salt consumption (g/m^2) ($1 \text{ g/m}^2 = 0.029 \text{ oz/yd}^2$) for snow-related maintenance (top) and temperature-related maintenance (bottom).

A field case from Highway E18, Sagån

Let us follow a field case from January, 2022:

Two days, three salting occasions and nine detailed cross-sections of the residual salt on the road surface



Sagån, Testsite E18

2010

AADT: 20.000+

Research facilities

International



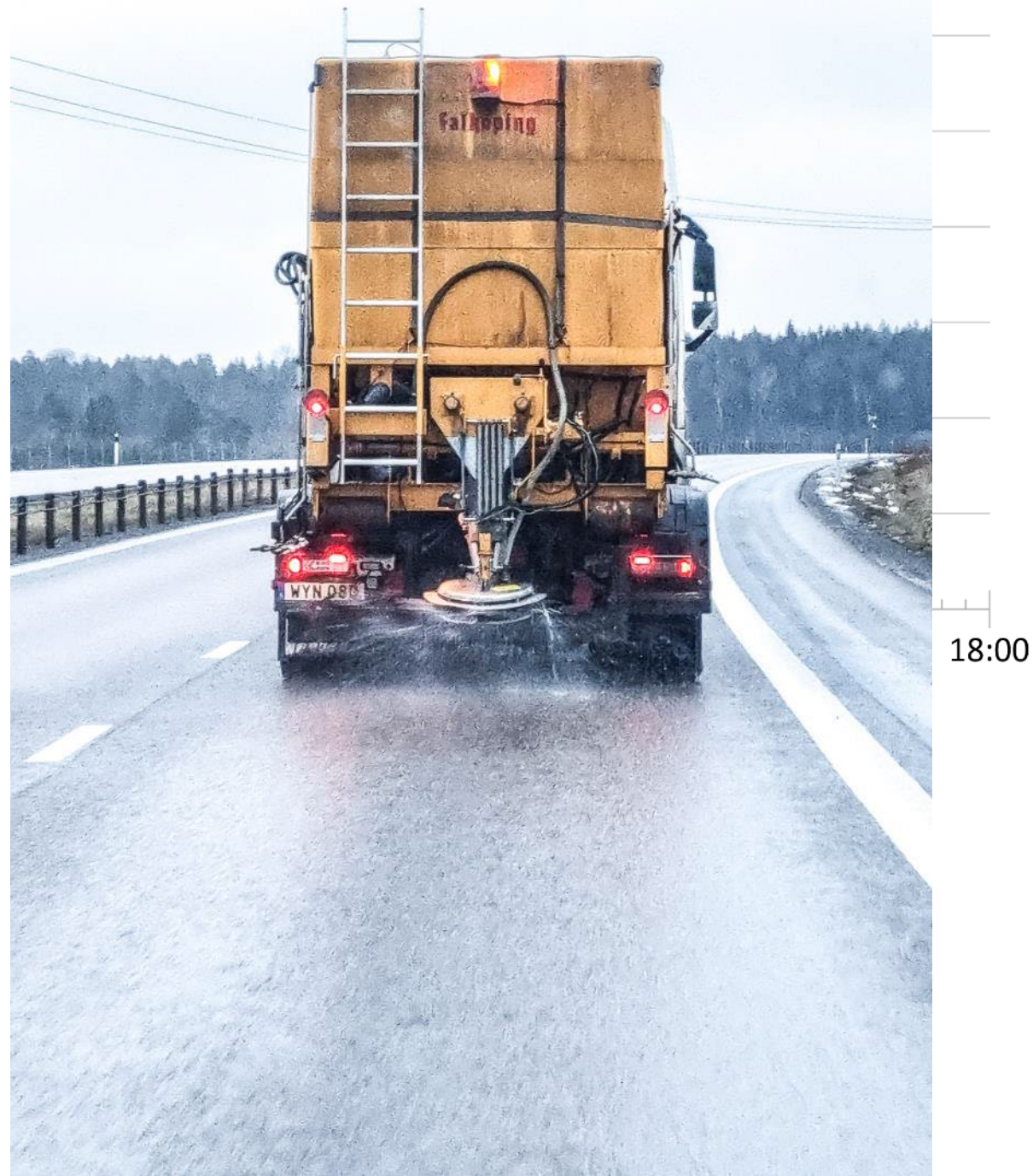
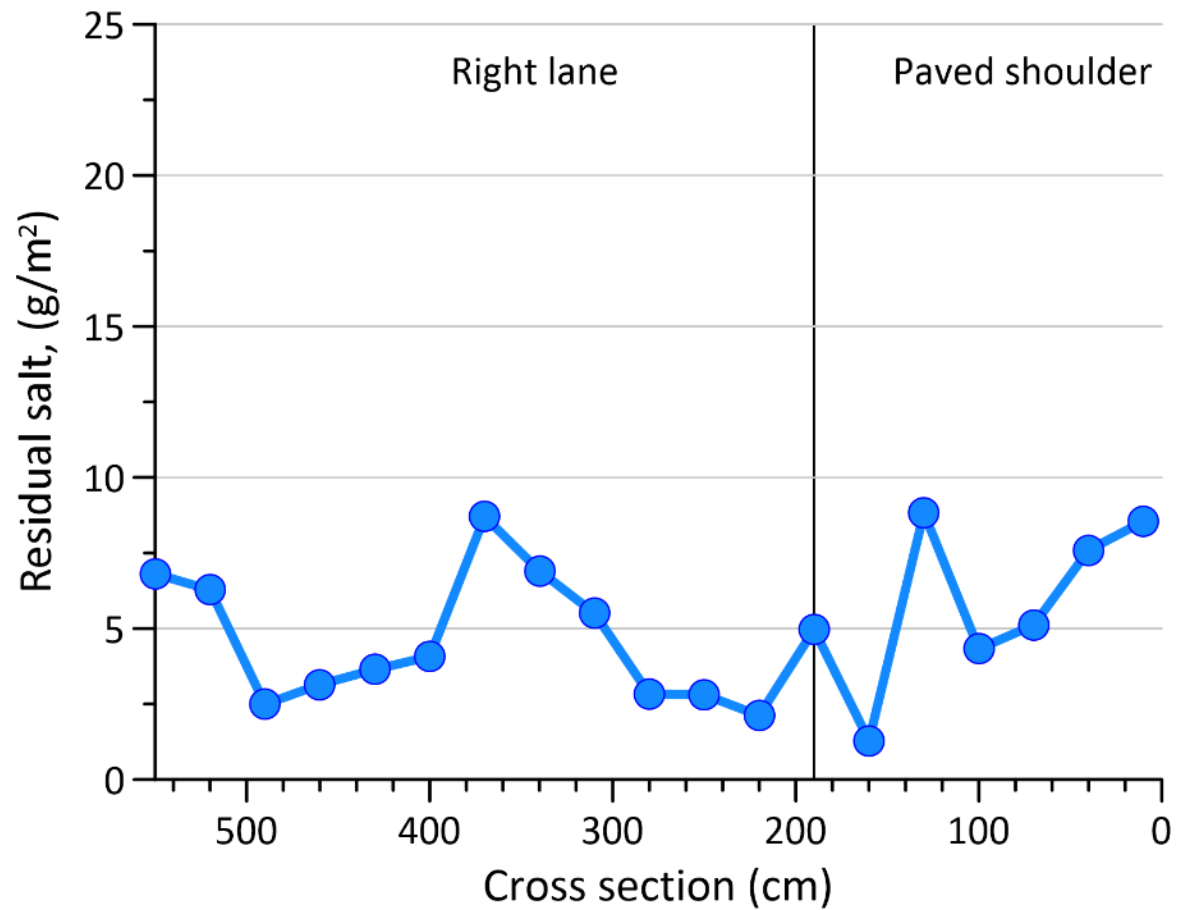
Reference measurements of salt:
Wet Salt Sampler (WSS)



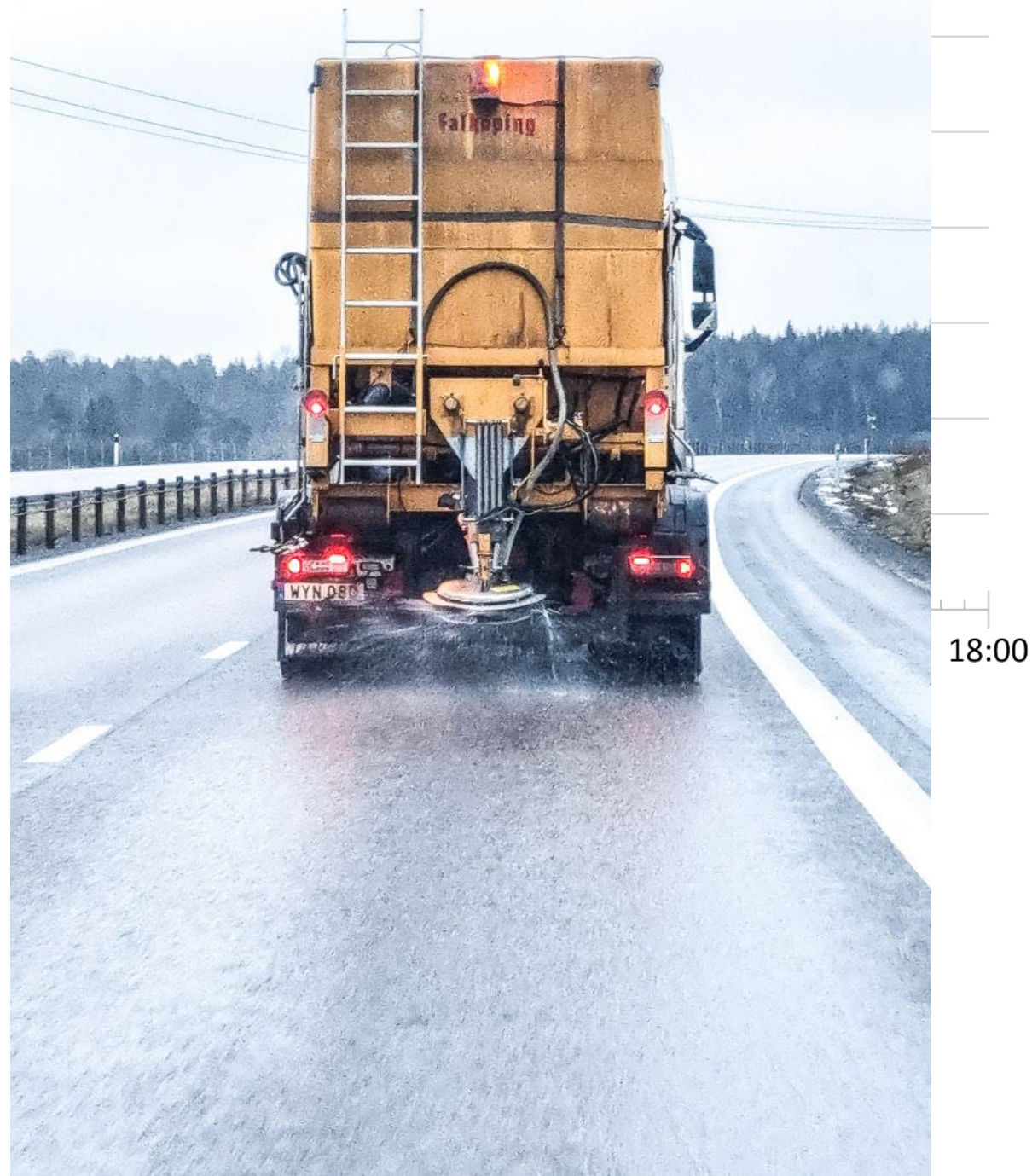
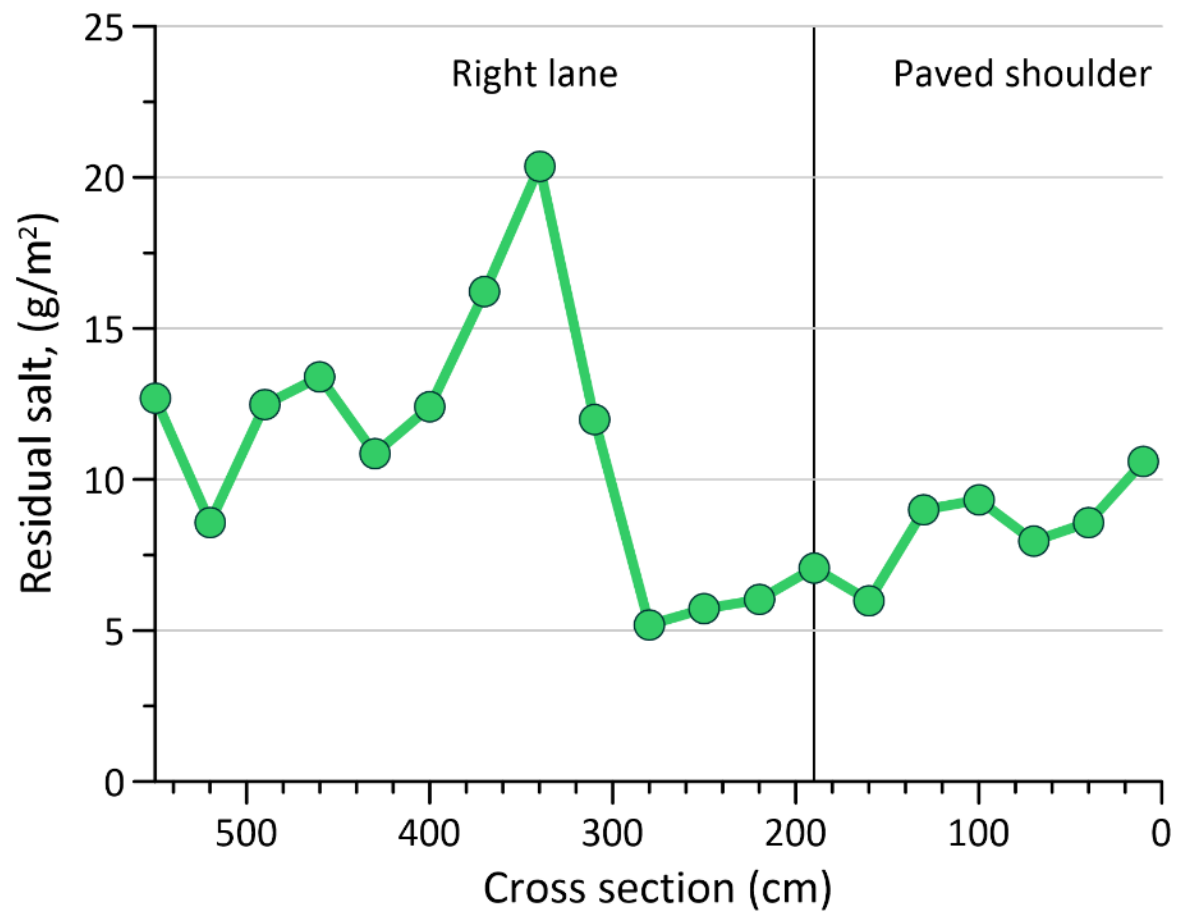
- Electric Conductivity
- Temperature
- Time and GPS-coordinates
- Single board microcontroller
- Open source, public-domain software
- Allows high salt concentrations
- Dissolves salt crystals
- Allows sampling



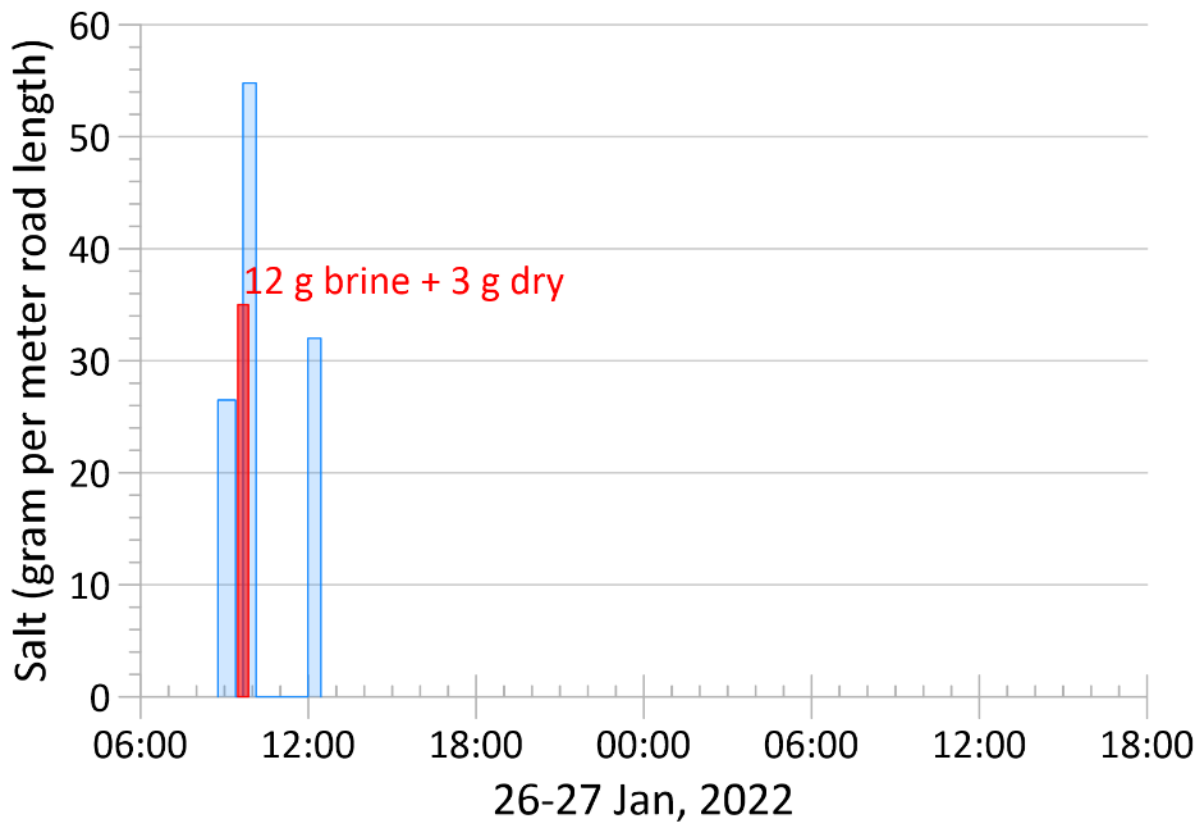
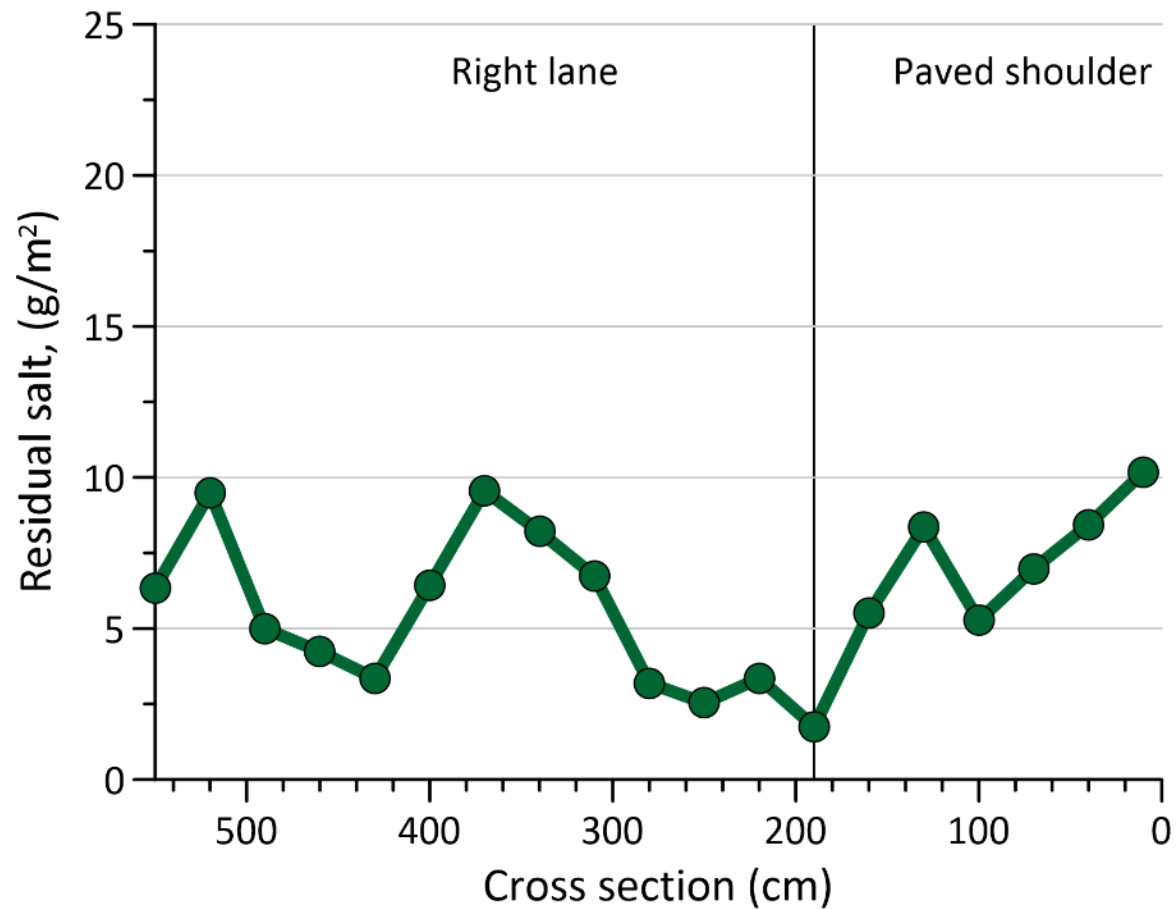
- 1. 08:46 Before salting
- 2. 09:40 After salting
- 3. 12:00
- 4. 14:30
- 5. 19:00
- 6. 21:30
- 7. 09:30
- 8. 12:00
- 9. 14:30



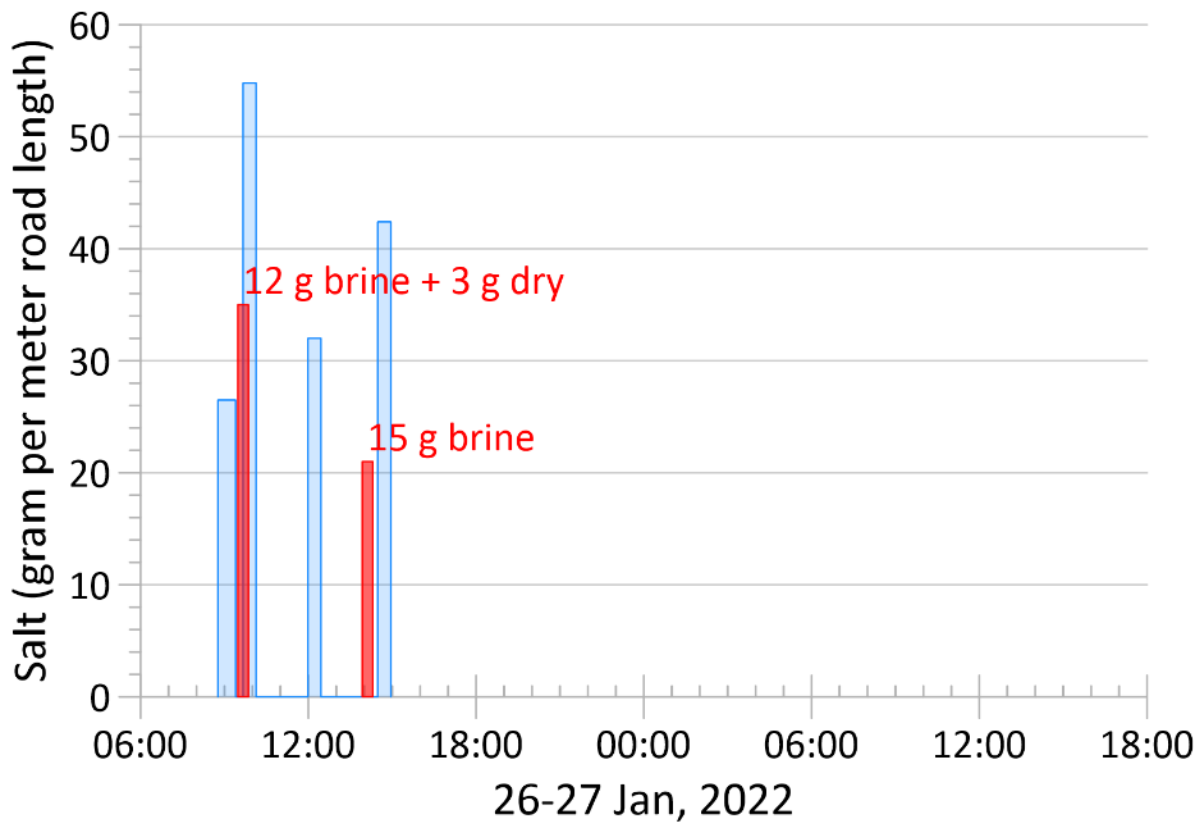
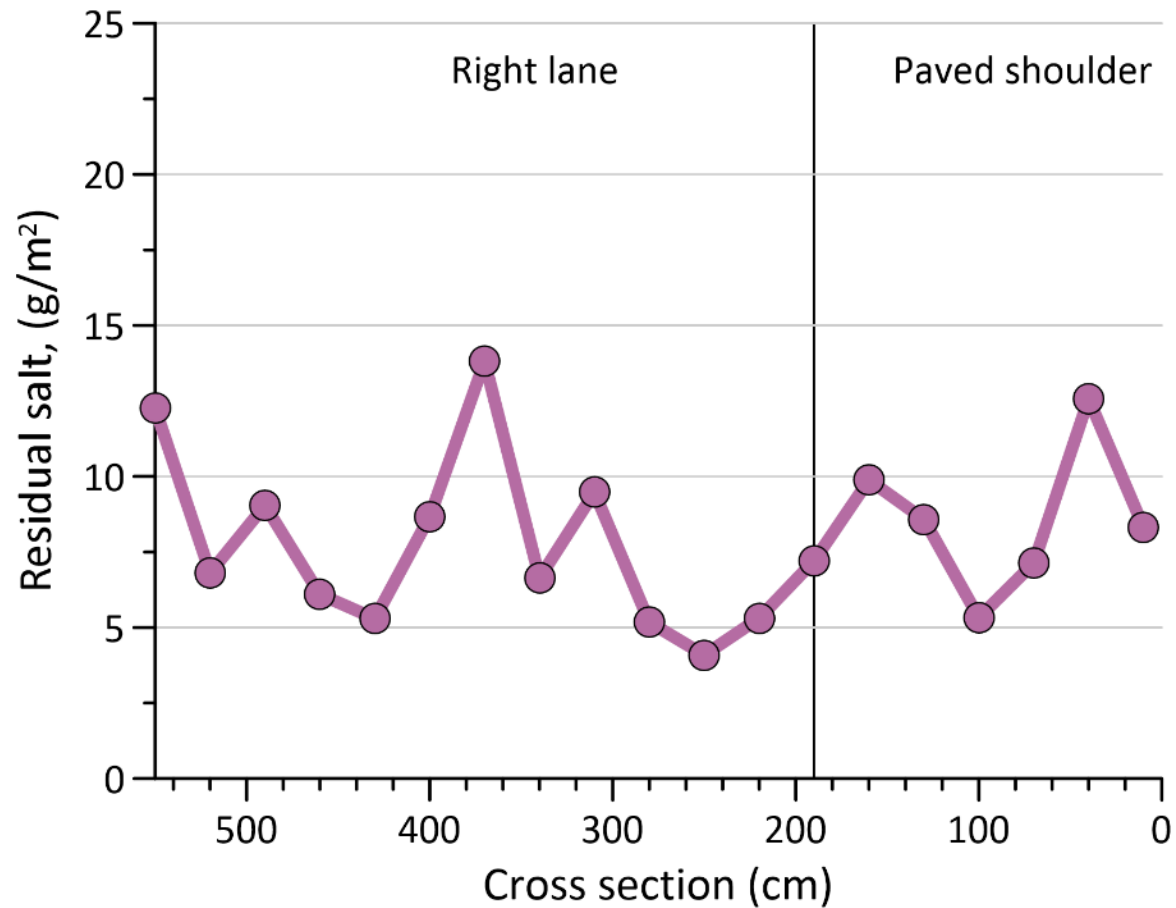
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- 6. 21:30
- 7. 09:30
- 8. 12:00
- 9. 14:30



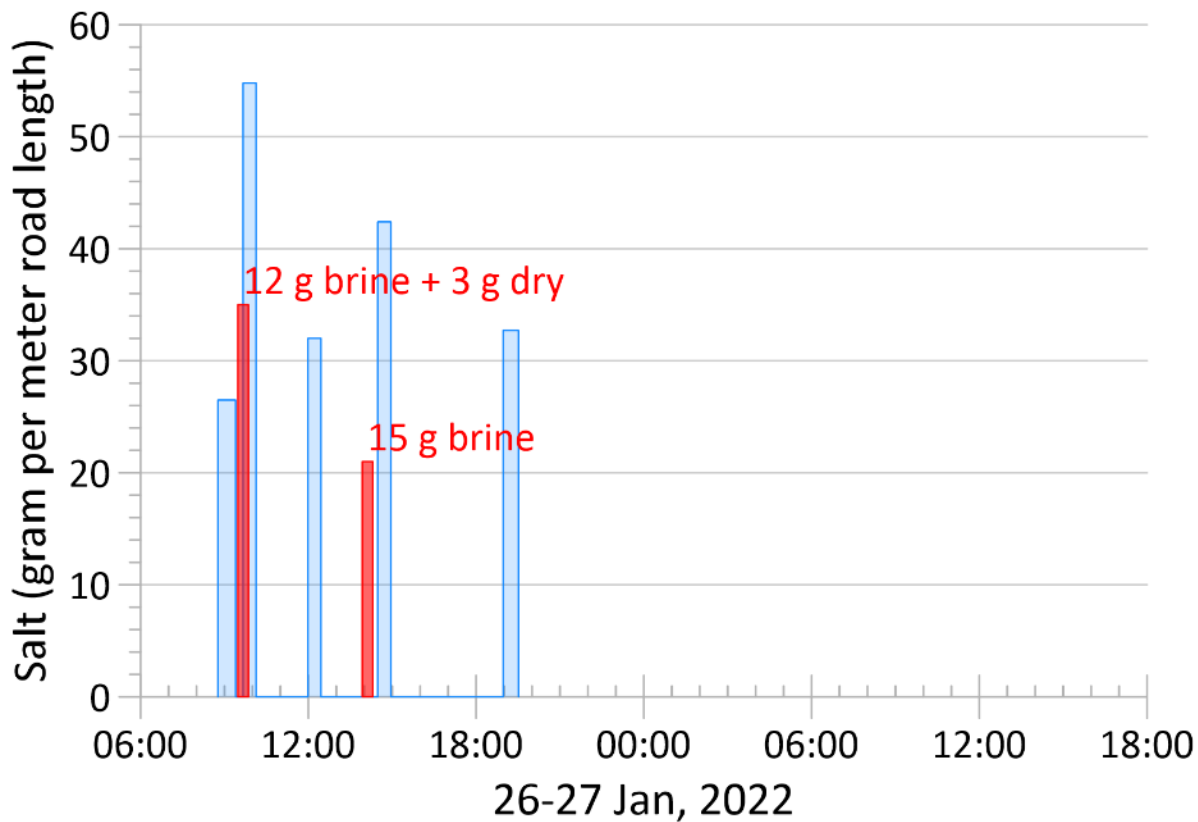
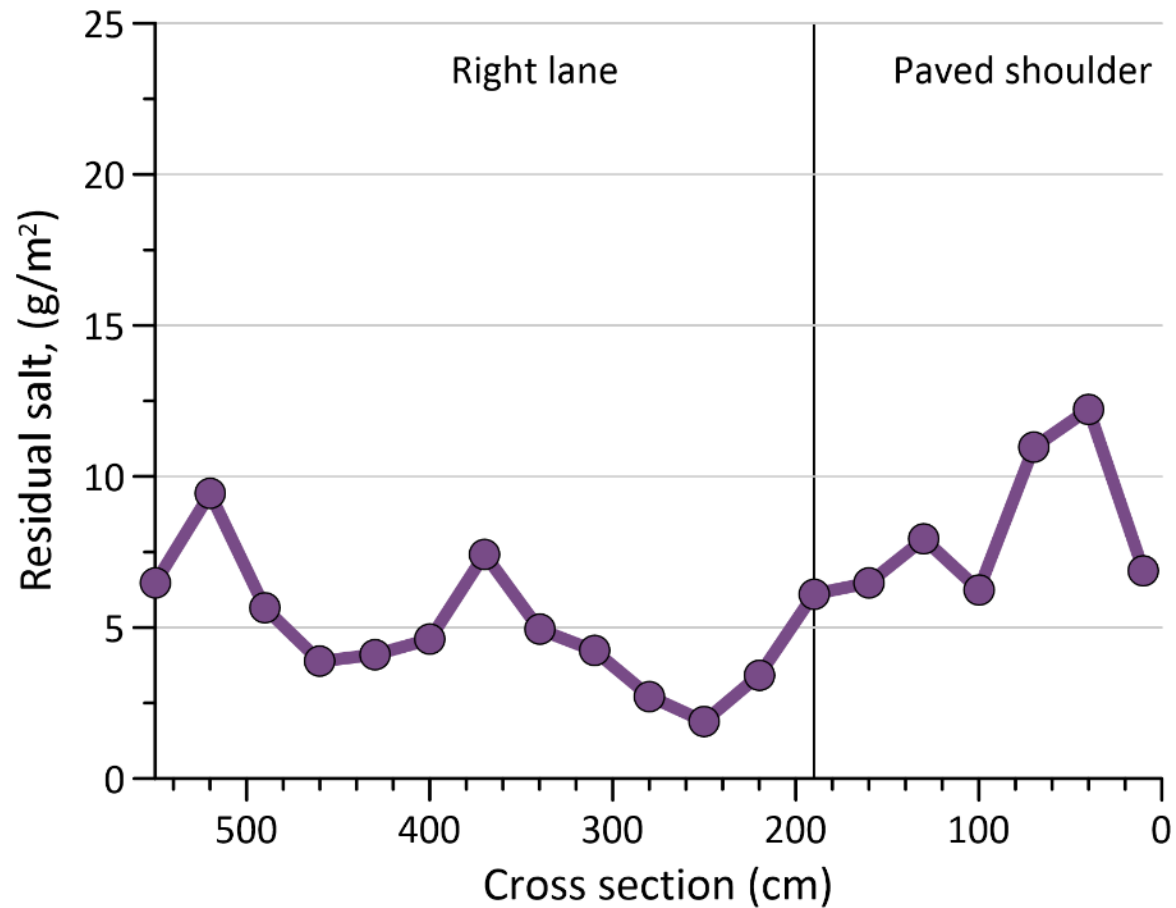
- 1. 08:46 Before salting
- 2. 09:40 After salting
- 3. 12:00
- 4. 14:30
- 5. 19:00
- 6. 21:30
- 7. 09:30
- 8. 12:00
- 9. 14:30



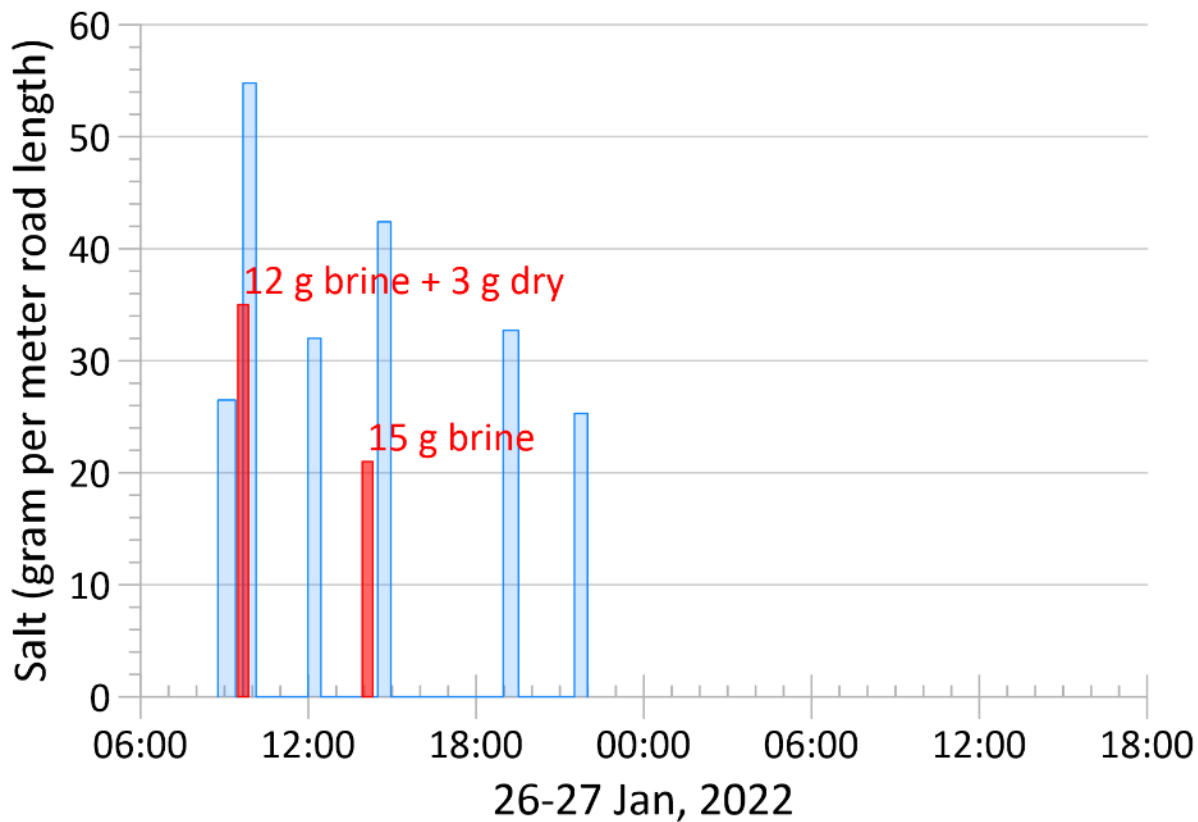
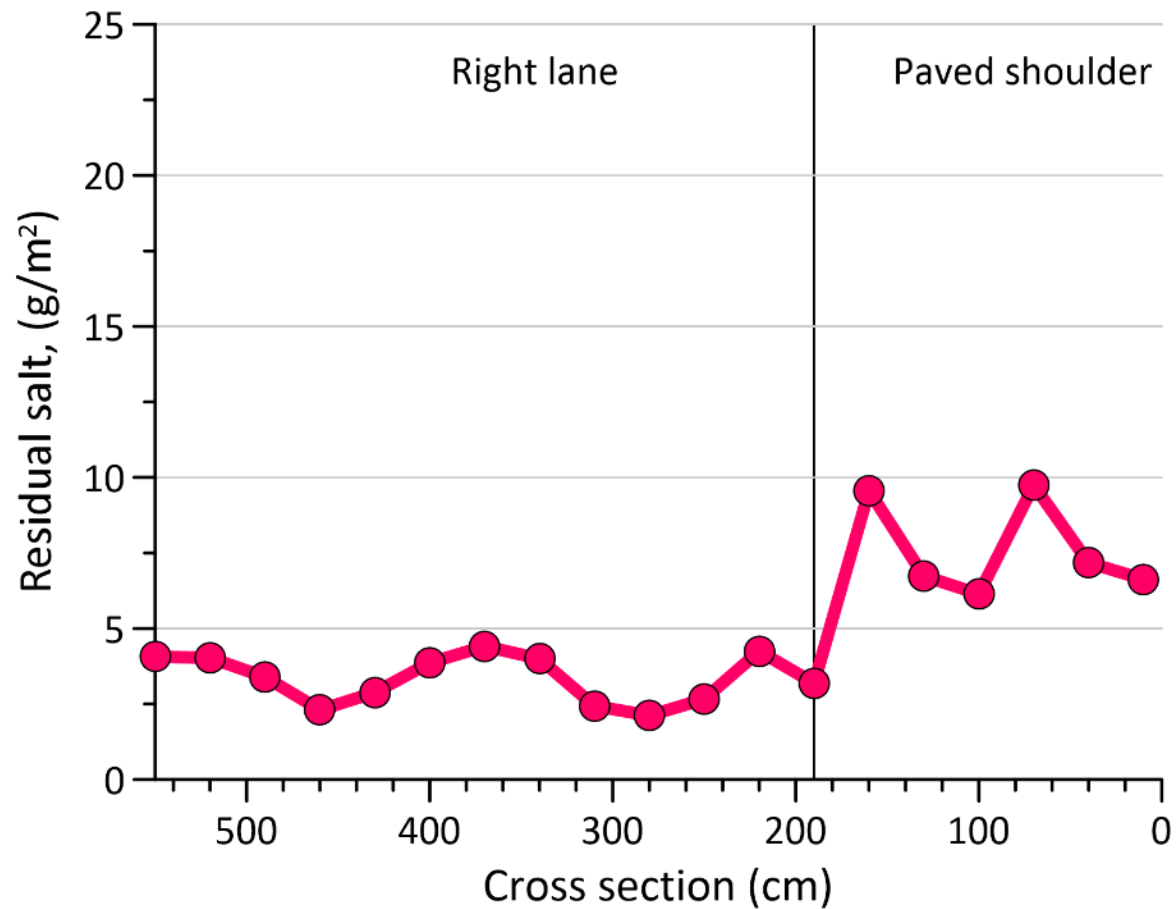
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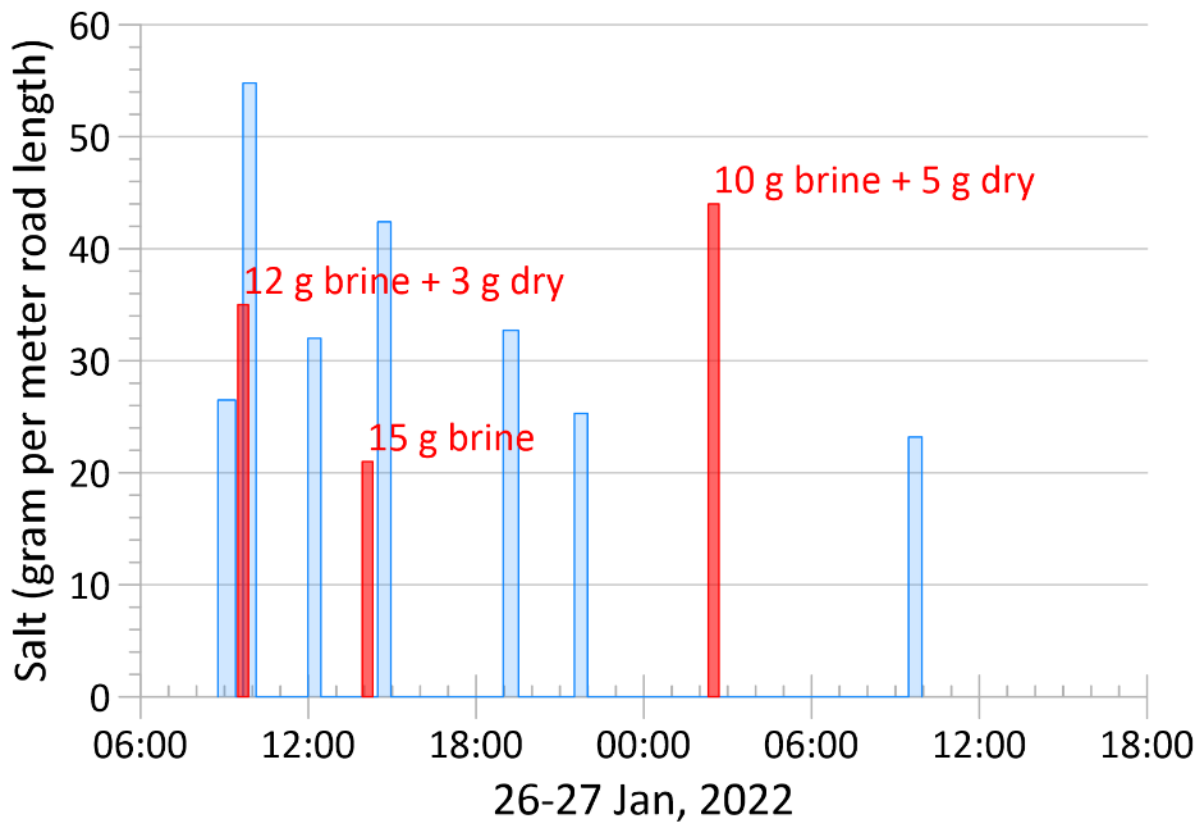
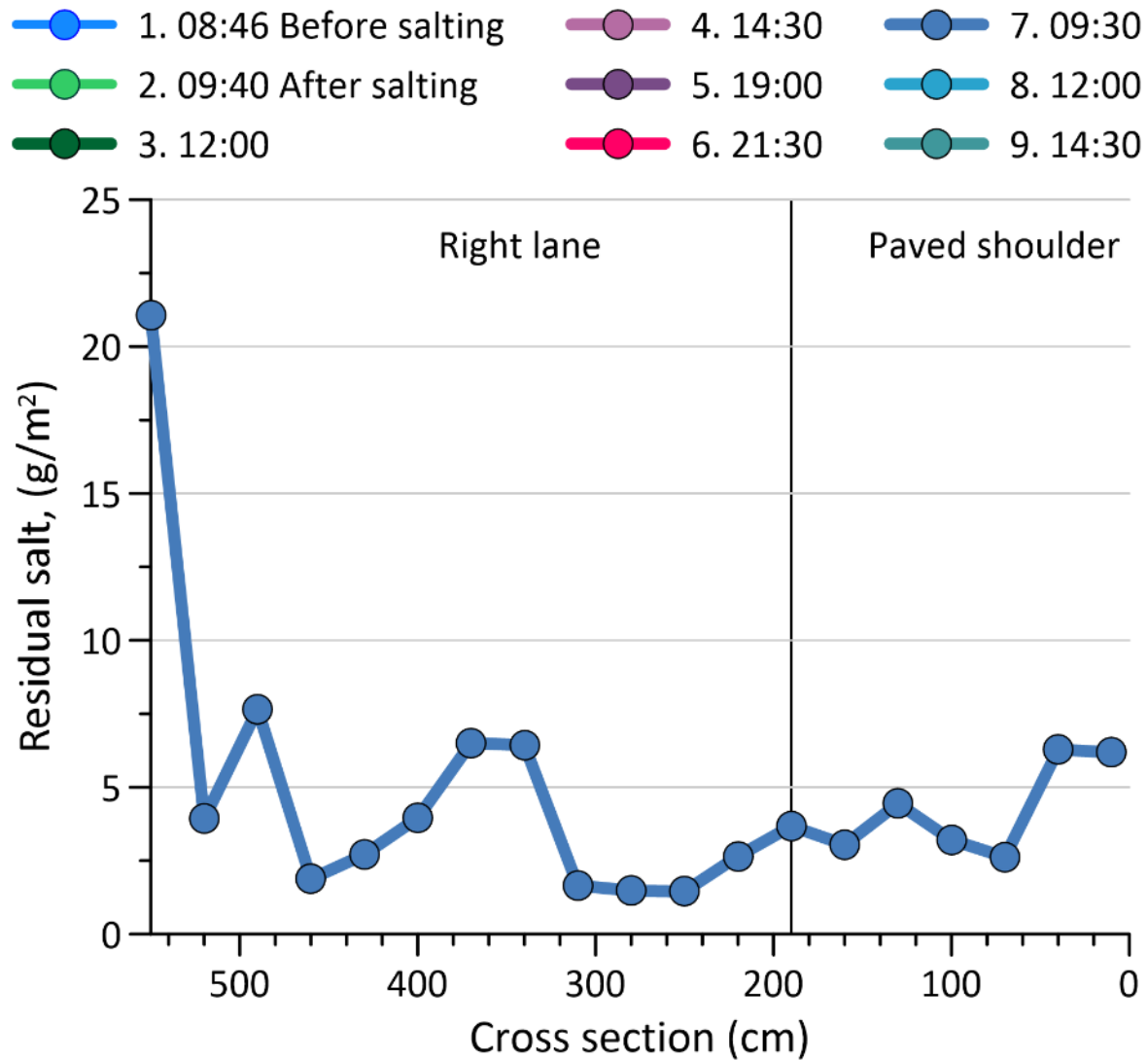


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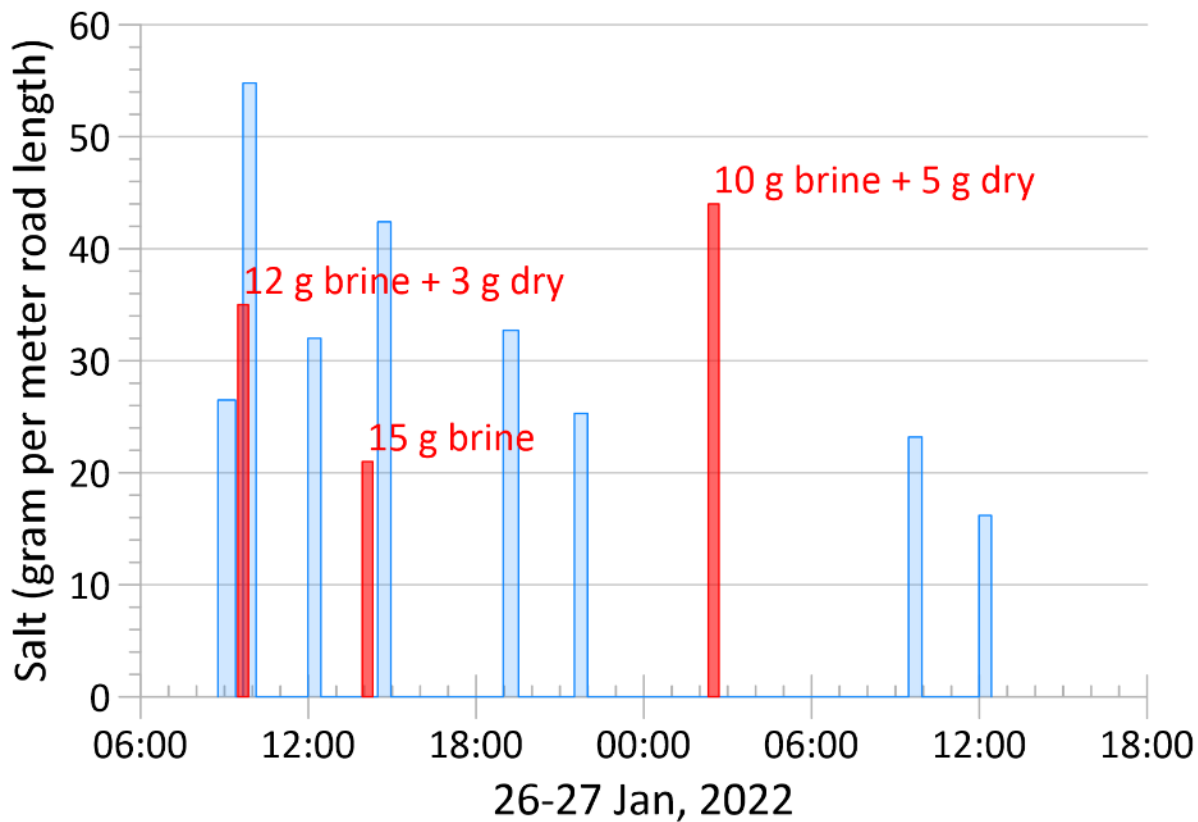
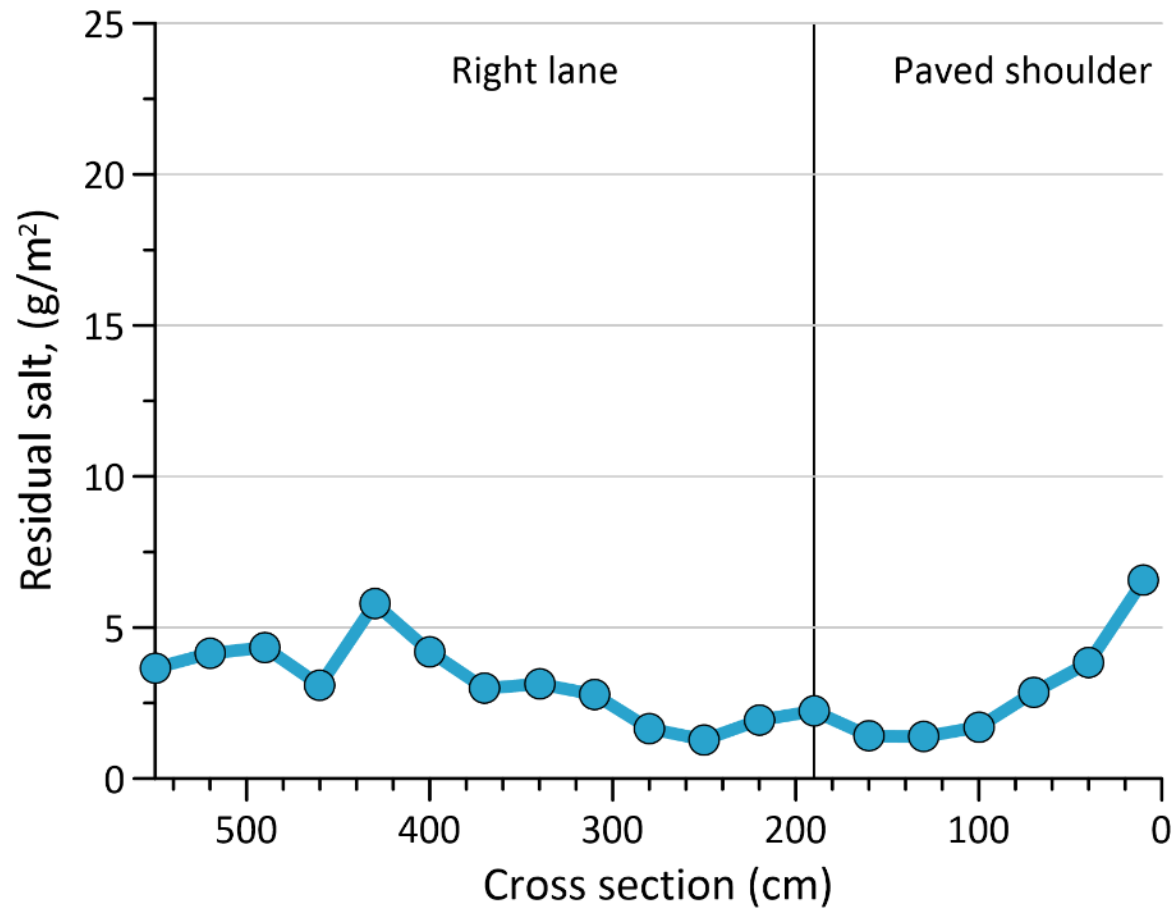


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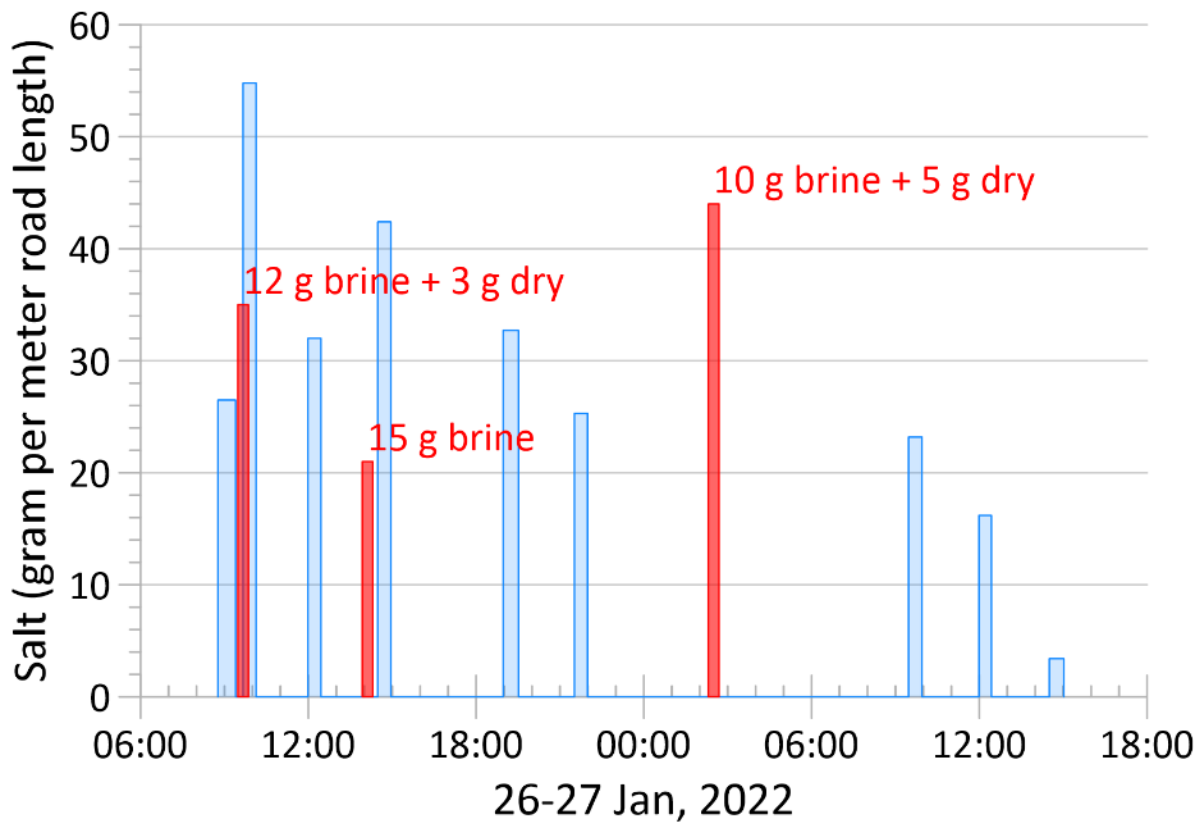
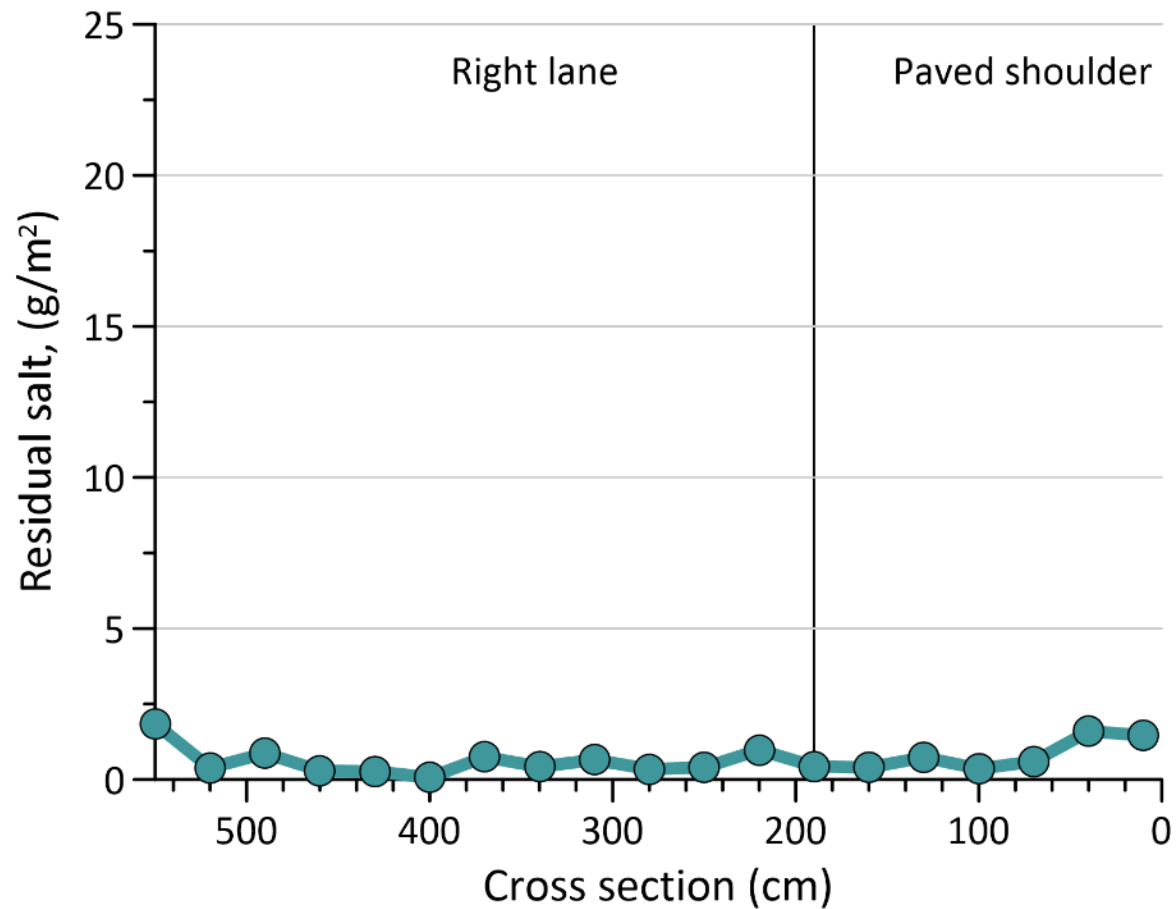




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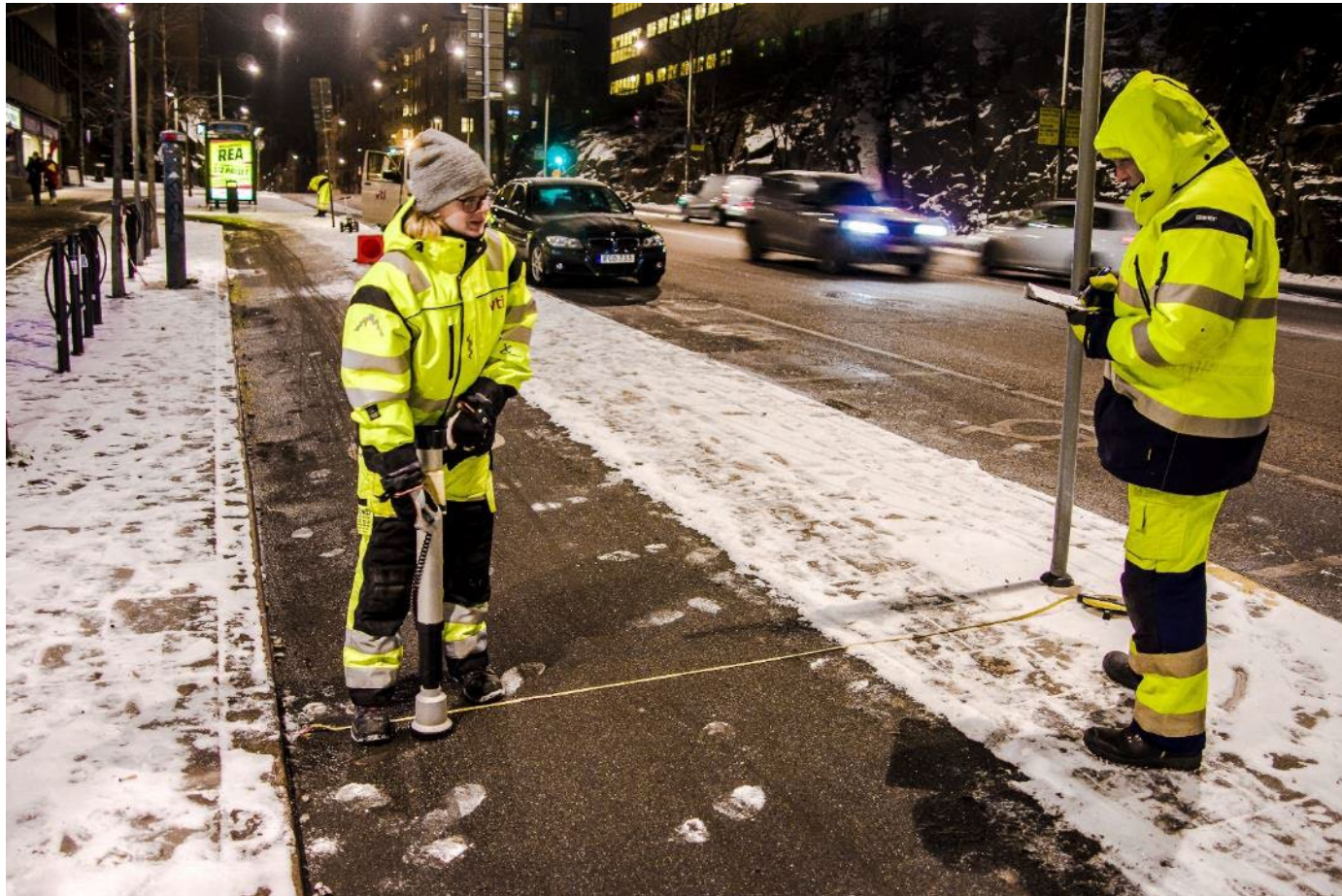


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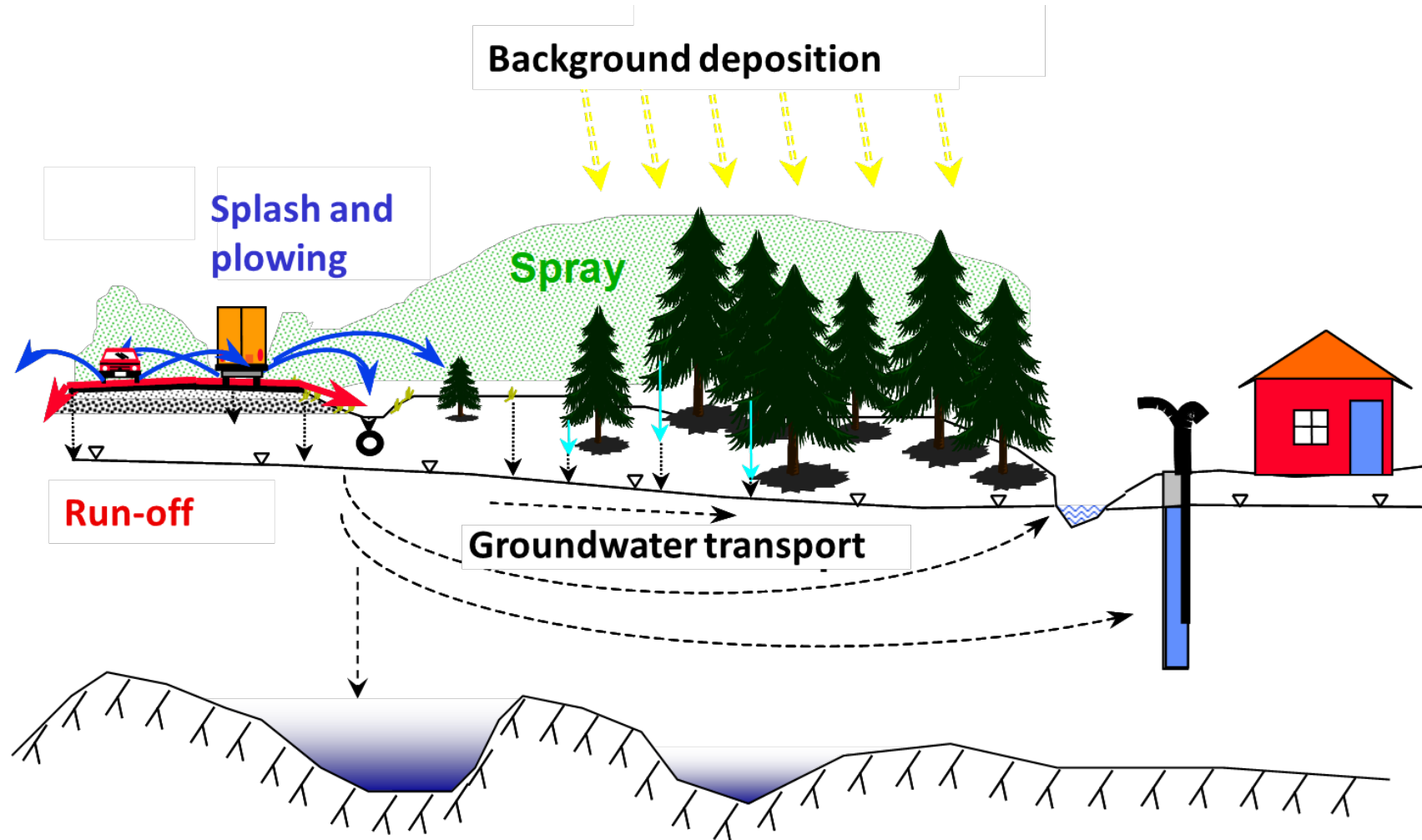


Residual salt monitoring – different methods

- How do they work?
- What does the measured value represent



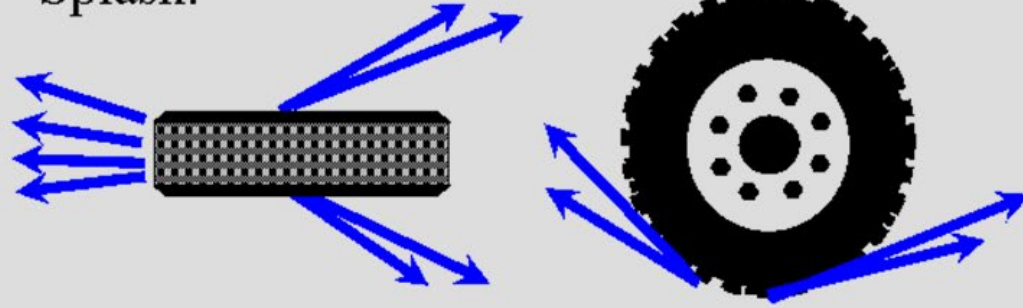
But, where did the salt go?



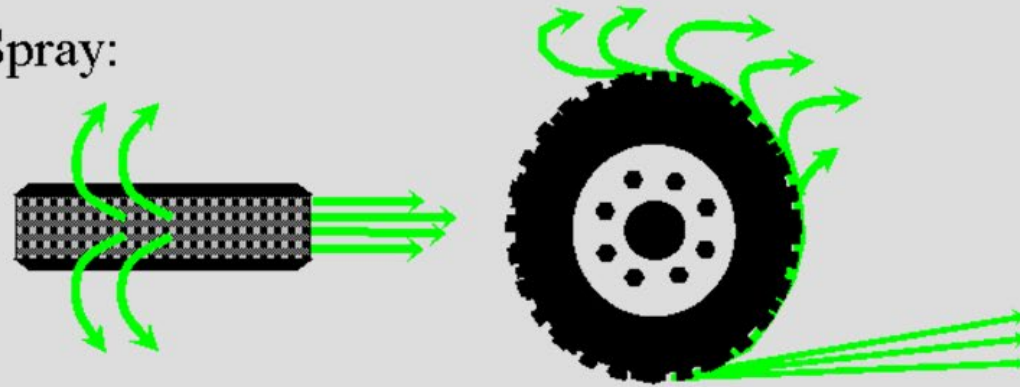


Splash and spray generation mechanisms

Splash:



Spray:

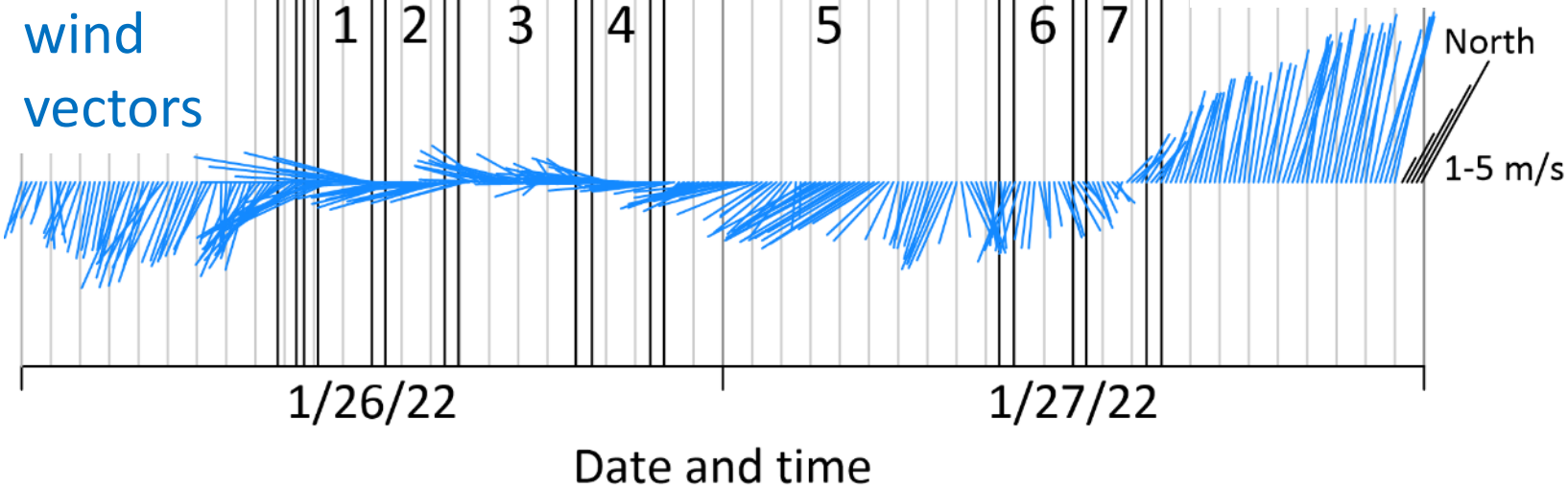
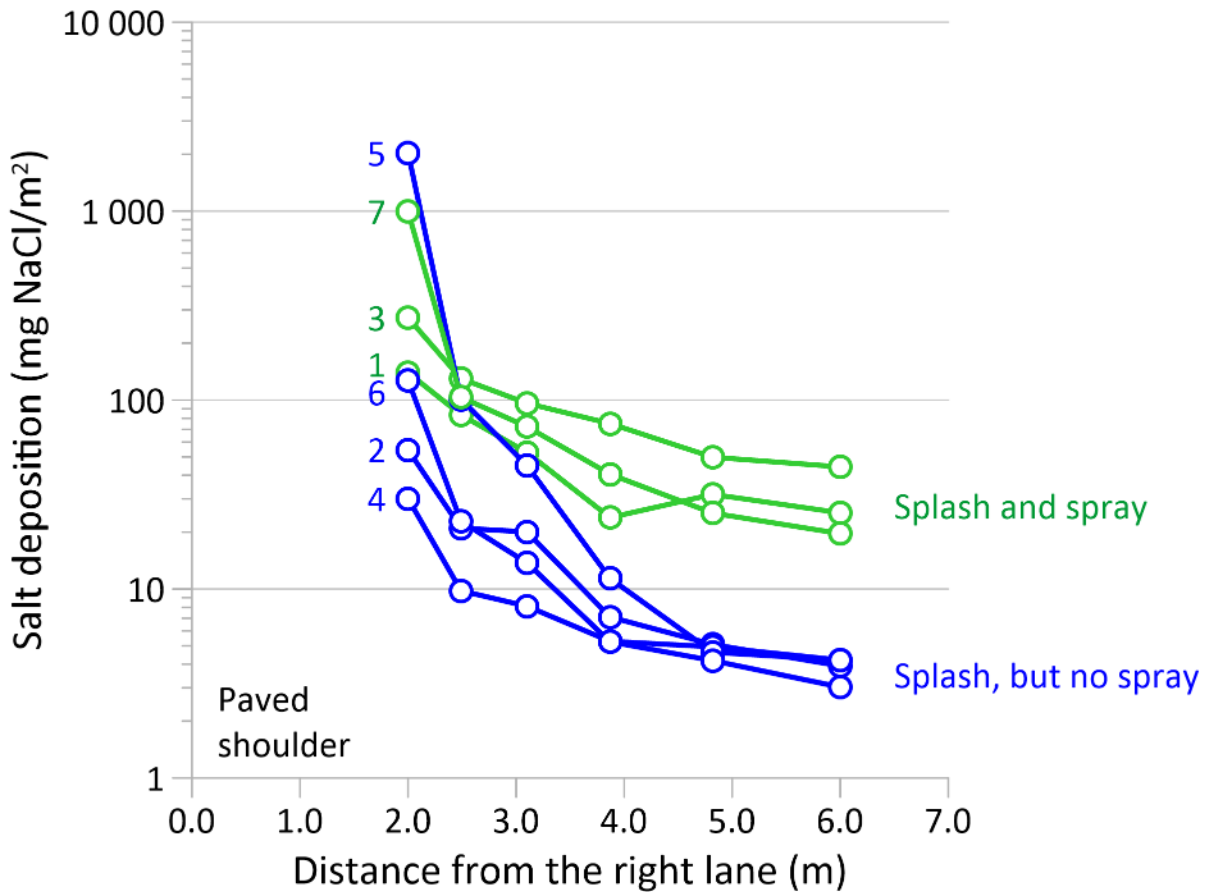
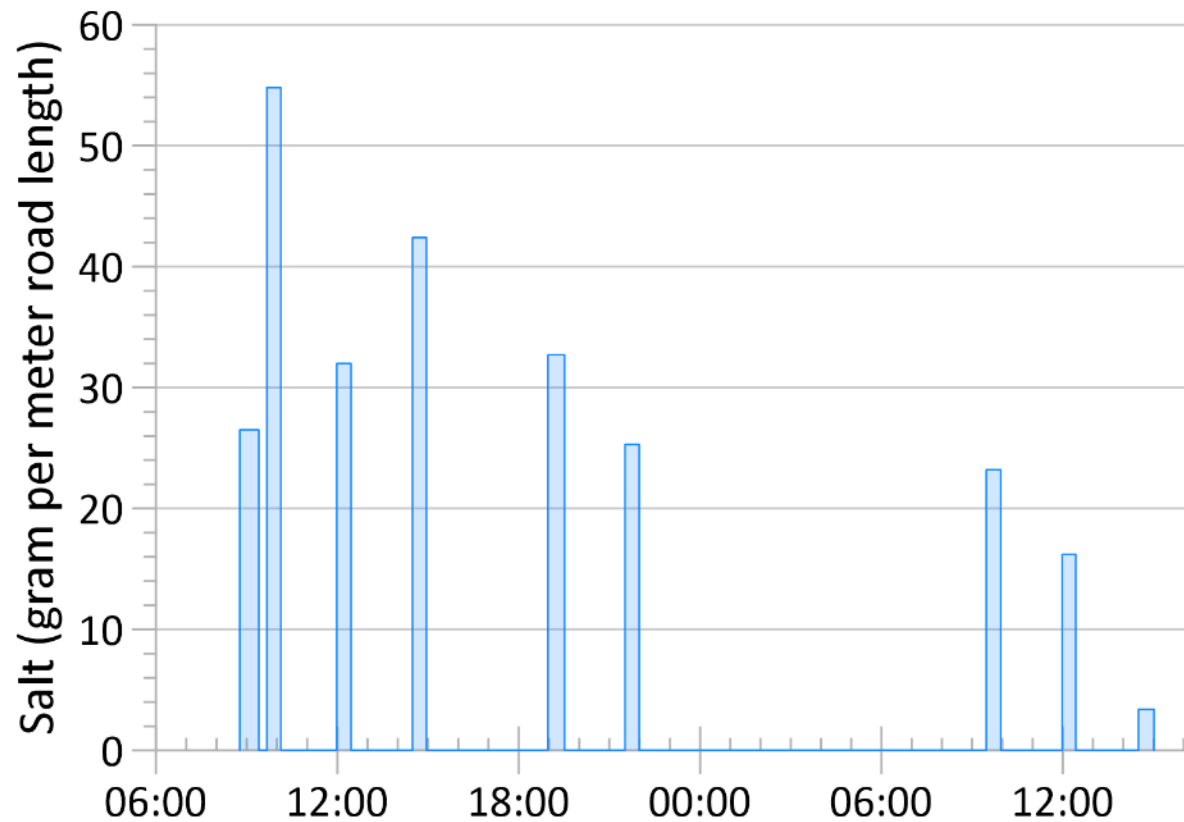


After: Weir and Strange 1978, U.S.D.O.T. Report No FHWA-RD-79-84

How do we measure splash and spray?

- Petri dishes collect the deposition
- The content is analysed at the lab.





- Understand the processes,
- Monitor the status,
- Remember "ice quality", not "melting capacity",
- Know where your sensitive environments are.

Thank you for listening!

Contact:
goran.blomqvist@vti.se



Leveraging Technology for Better Materials Management and Cost Savings at MassDOT



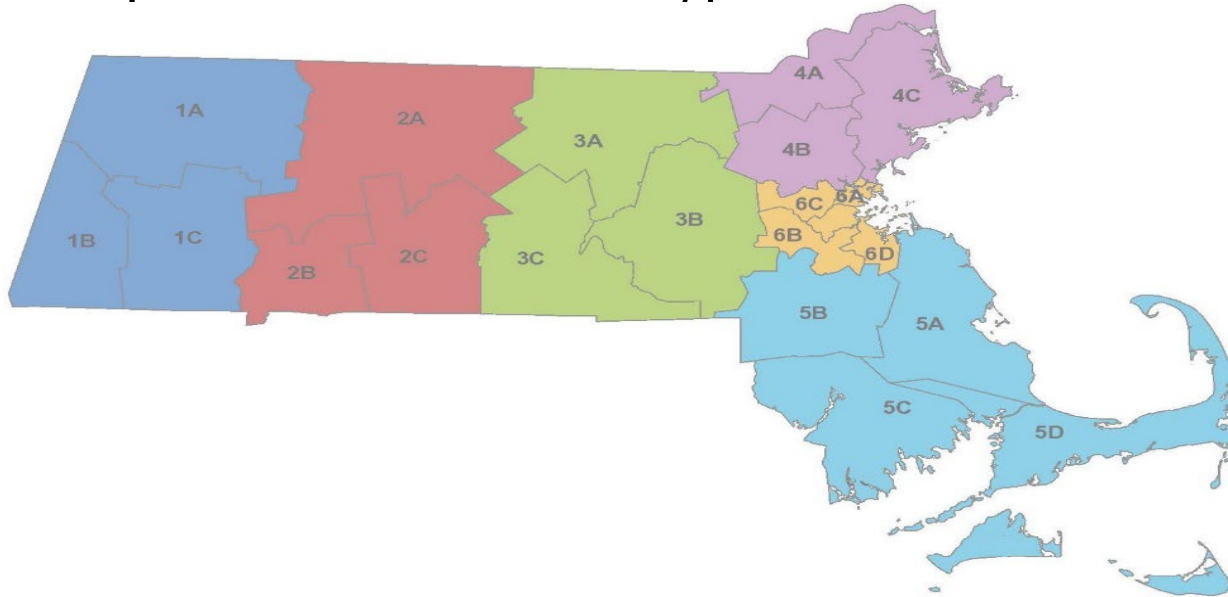
Introductions

- Mark Goldstein, Lead Statewide Snow & Ice Engineer



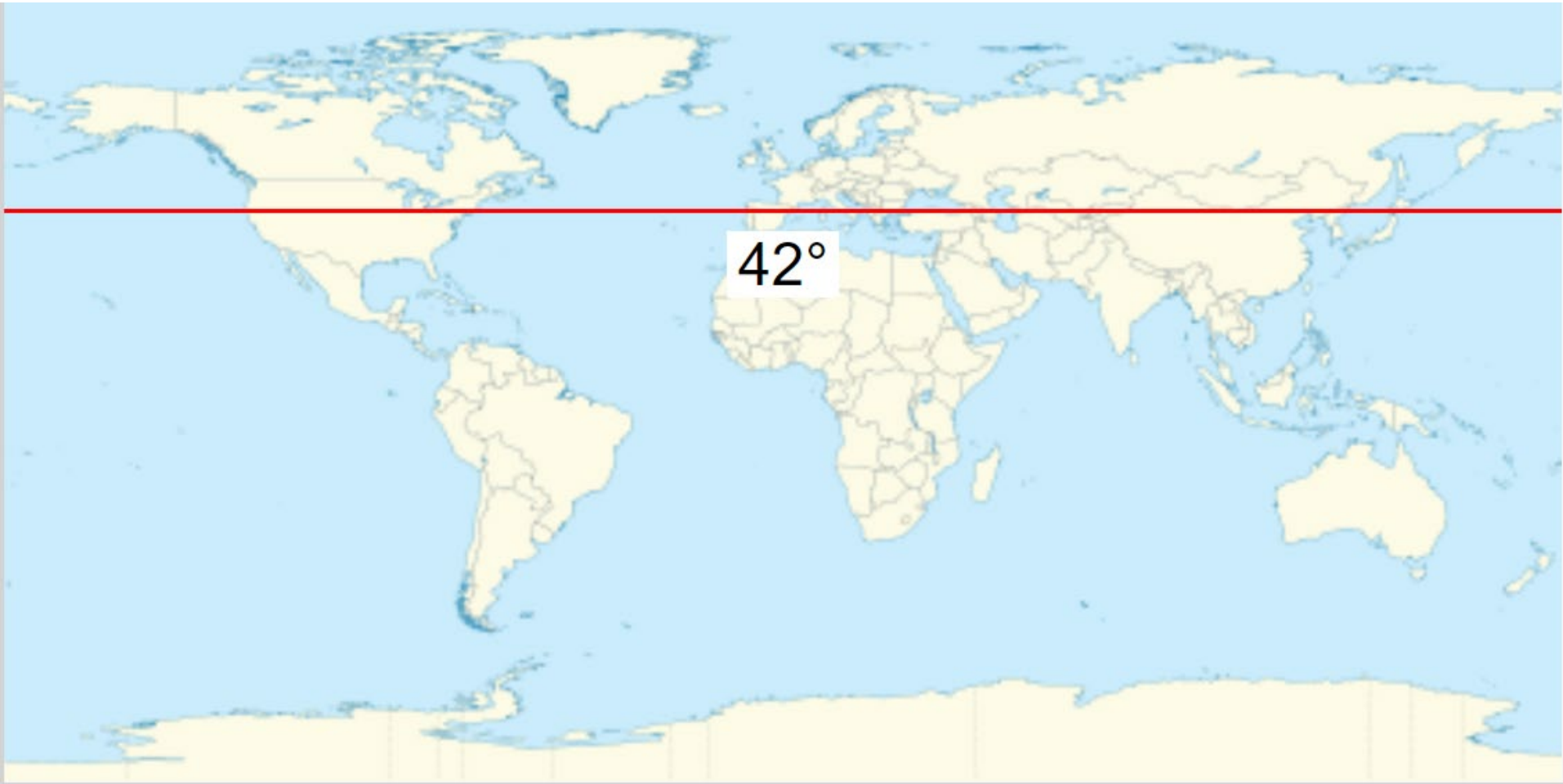
Overview

- Perform snow and ice removal on 15,000+ lane miles.
- 6 Districts and 20 sub-Districts
- 150 Depots/ Salt Storage Locations
- Over 700 personnel at the height of a storm





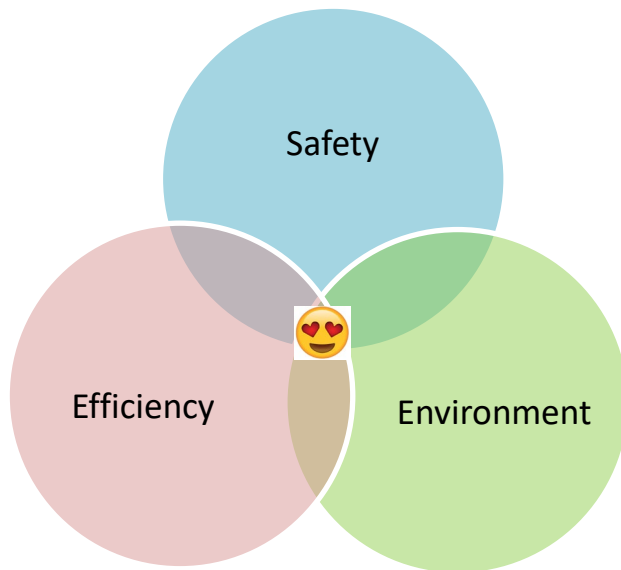






Snow and Ice Program: Goals

- Public Safety
- Efficiency and Effectiveness
- Environment

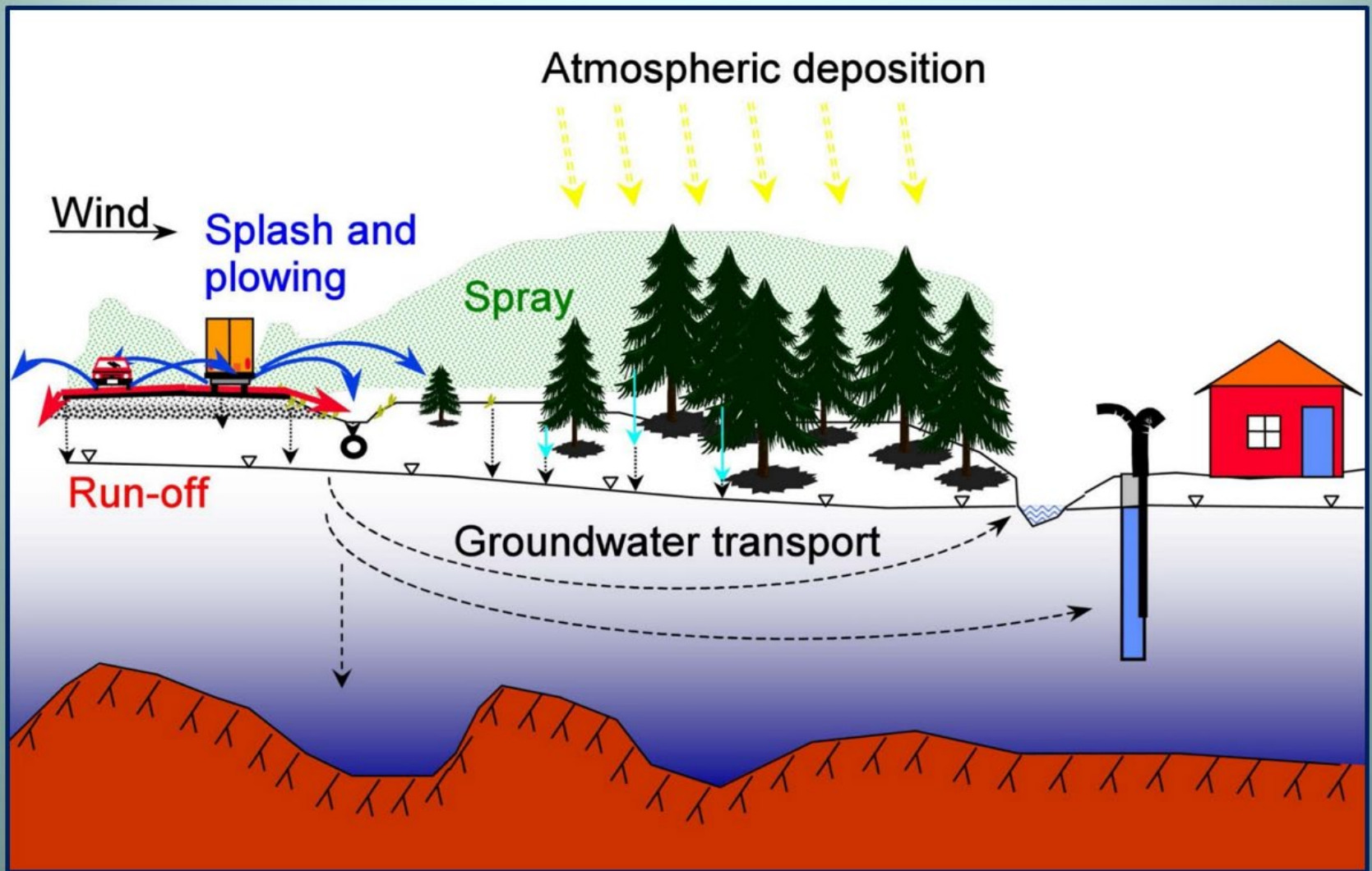


Environmental Issues

- Water Supply
- Chloride Impairments
- Corrosion
- Sand Impacts



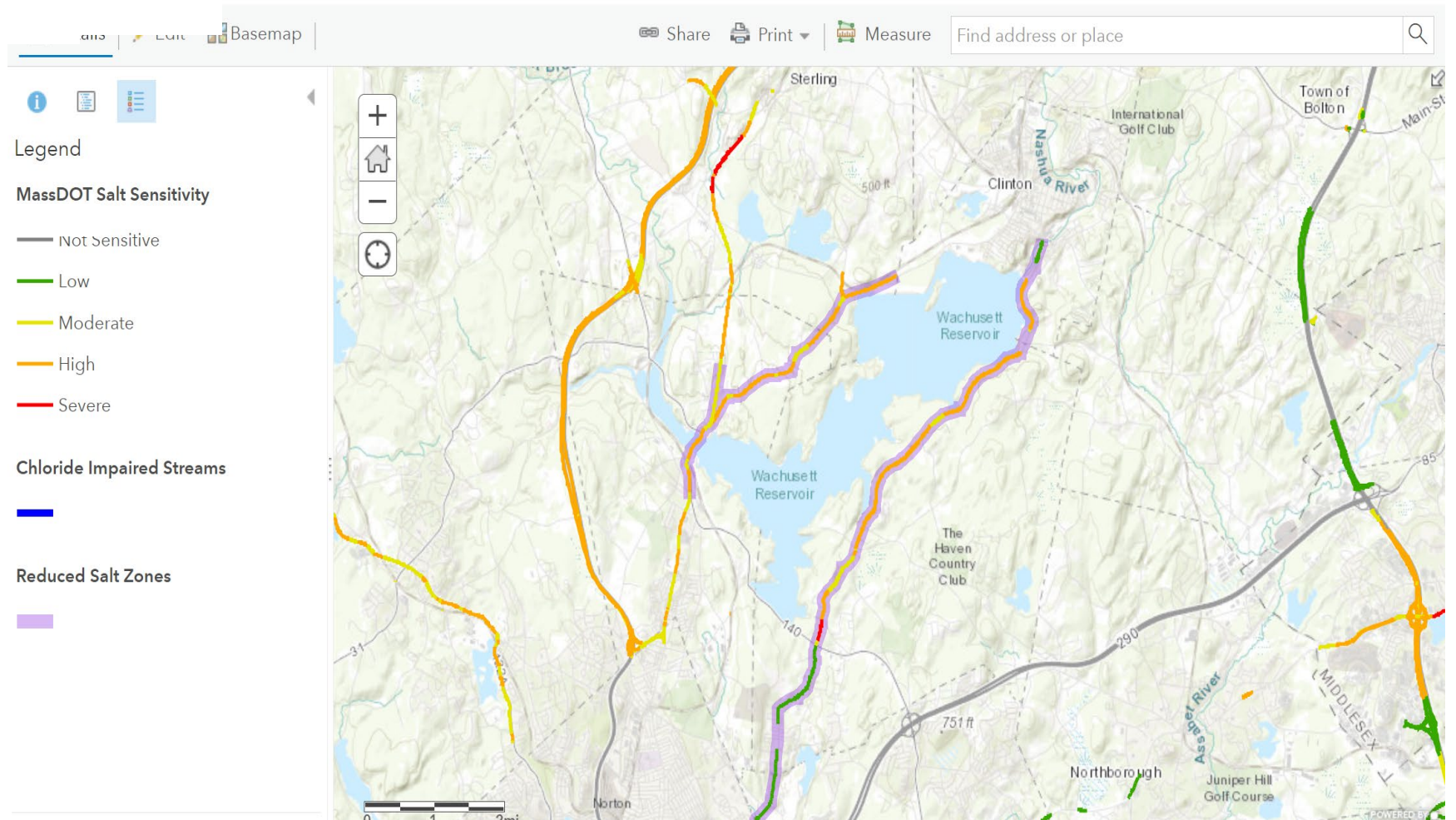
Salt Will Find Its Way Into the Environment



GIS Resources as a Training Aid

ArcGIS ▾ MassDOT Salt Sensitivity

[Open in Map Viewer](#) [Modify Map](#) [Sign In](#)



“Success Through Innovation”

- Pre-treatment
- Pre-wetting
- Closed-loop Controllers
- Pavement Friction Sensors/Meters
- RWIS Stations w/ cameras
- Tow Plows
- Segmented Plow Blades
- GPS/AVL Devices
- Loader Scales
- Reconfiguring Equipment Routes to do More with Less



RWIS / Pavement Friction Meters

Road Weather
Information Systems

Non-Intrusive Friction Meters



RWIS Site-Specific Information

File Edit View Favorites Tools Help

Reports Suggested Sites (2) Suggested Sites Vaisala RoadDSS - Station ... WeatherSentry - Pavemen... Web Slice Gallery

Massachuset... All 10:48

Map Station Summary Station Wall **Stations** Alerts Reports Mobile DSP

Stations

All

- Mass DOT - Andover Rte 93
- Mass DOT - Salisbury Rte 95
- Mass DOT - Billerica Rte 3
- Mass DOT - Quincy Rte 93
- Mass DOT - Concord Rte 2
- Mass DOT - Newton Rte 128
- Mass DOT - Woburn I-95
- Mass DOT - Peabody Rte 128
- Mass DOT - Gloucester Rte 128
- Mass DOT - Canton I-93
- Mass DOT - Hancock Rest Area
- Mass DOT - French King Bridge
- Mass DOT - Deerfield Weigh Station
- Mass DOT - Westborough I-495
- Mass DOT - Harvard Rest Area
- Mass DOT - Seekonk Weight Station
- Mass DOT - Hingham Rte 3**
- Mass DOT - Stoughton, Page Street
- Mass DOT - Camera site

▼ Mass DOT - Hingham Rte 3 (Show station on map)

Coordinates
70° 54' 47" W 42° 10' 34" N

Altitude
47 m

Nearest stations

Mass DOT - Quincy Rte 93	11.3 km
Mass DOT - Stoughton, Page Street Overpass	13.1 km
Mass DOT - Mobile Trailer 1	15.6 km
Mass DOT - Canton I-93	15.8 km
Mass DOT - Newton Rte 128	33.0 km

Groups
Districts - District 5

Station Overview Graph Camera History History Table


Current conditions 21-Feb-2017 10:37

- Air Temperature **40.8 °F**
- Dew Point Temperature **22.6 °F**
- Visibility **2000 m**
- Level of grip **0.82**
- Surface State **dry**
- Surface Temperature **51.1 °F**

Wind 21-Feb-2017 10:37

115°
3.4 mph

Roadside camera 21-Feb-2017 10:34



RWIS Treatment Recommendations

Home
Settings

- Briefing
- Dashboard
- Weather
- Local Forecast**
- Summary
- 15 Day
- Hourly**
- Graphs
- Animations
- RWIS Summary
- National Graphics
- International Graphics
- Hurricane Weather
- Historical Weather
- Slide Shows
- My Favorites
- Custom Forecasts

Hourly Forecast

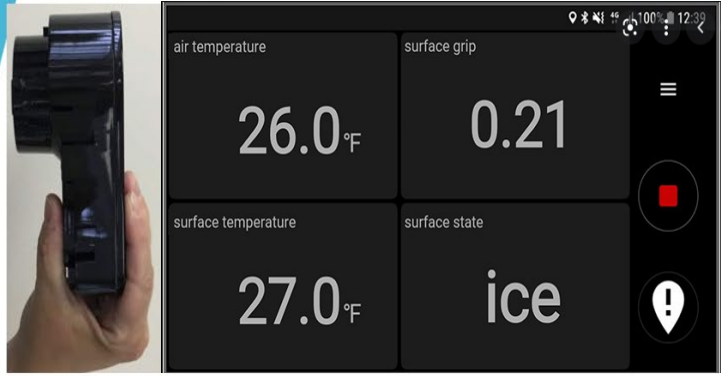
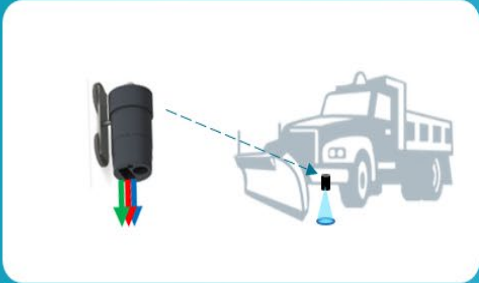
MA BLANDFORD SERVICE I90
Treatment Plan: FHWA (default)

MA BLANDFORD SERVICE I90

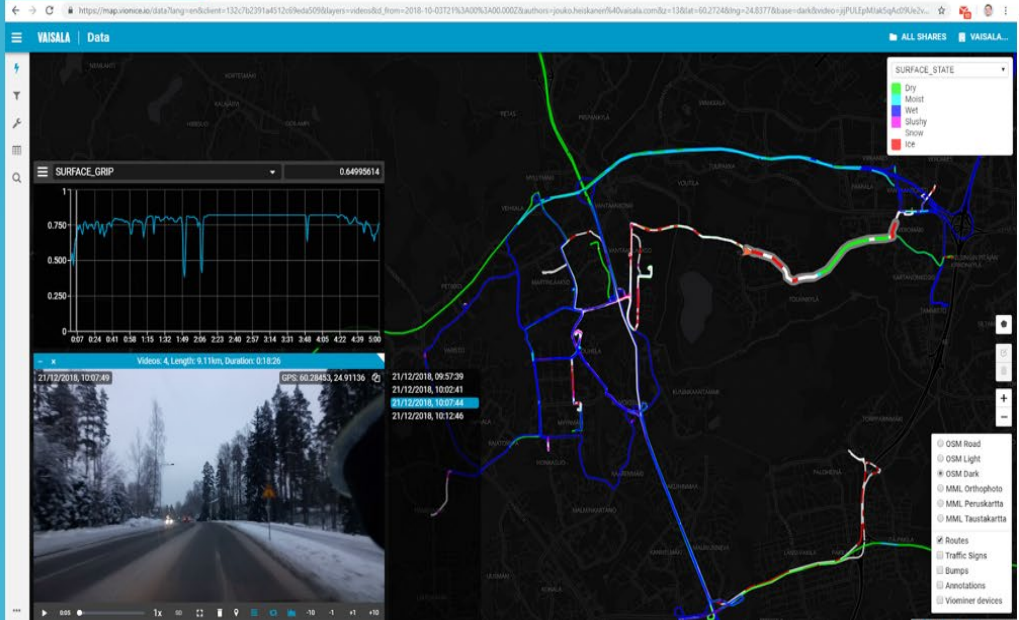
Hour	Tue 5 PM	Tue 6 PM	Tue 7 PM	Tue 8 PM	Tue 9 PM	Tue 10 PM	Tue 11 PM	Wed 12 AM	Wed 1 AM	Wed 2 AM	Wed 3 AM	Wed 4 AM	Wed 5 AM	Wed 6 AM	Wed 7 AM
Weather Condition															
Weather	Cloudy	Mostly Cloudy	Cloudy	Cloudy	Cloudy	Cloudy	Cloudy	Cloudy	Cloudy	Freezing Rain Showers Possible	Freezing Rain Showers Possible	Freezing Rain Possible	Mostly Cloudy	Cloudy	Cloudy
Temperature (°F)	39	36	34	32	32	32	32	31	31	31	30	30	30	31	31
Feels Like (°F)	39	32	29	27	26	26	26	25	26	26	25	30	30	31	31
Wet Bulb (°F)	35	33	32	31	31	31	31	31	31	31	30	30	30	31	31
Wind Direction	SSW	SSW	SSW	SSW	SSW	SSW	SSW	SSW	SW	SW	SW	SW	SW	SW	SW
Wind Speed/Gusts (mph)	3	5	5	5	6	6	6	6	5	5	5	3	3	3	3
Dew Point (°F)	29	29	30	29	29	30	30	31	31	31	30	30	30	31	31
Humidity (%)	67	76	85	89	89	92	92	100	100	100	100	100	100	100	100
Precipitation Chance (%)	-	-	-	-	-	-	-	-	-	20	27	34	-	-	-
Precipitation Type	-	-	-	-	-	-	-	-	-	Freezing	Freezing	Freezing	-	-	-
Precip Amount (Rain:in.,Snow:in.)	None	None	None	None	None	None	None	None	None	Trace	Trace	Ice 0.01	None	None	None
24 Hr Snow/Ice Accum (in.) (11 AM-11 AM)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01
Blowing Snow Potential	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bridge Temp (°F)	47	43	41	39	37	36	36	35	34	34	33	32	32	32	32
Road Temp (°F)	47	43	40	38	37	36	35	34	34	33	33	32	32	32	32
Bridge Frost Probability (%)	0	0	0	0	0	0	0	10	20	0	0	0	60	60	60
Pavement Frost Probability (%)	0	0	0	0	0	0	0	0	0	0	0	0	30	40	40
Treatment Recommendation	-	-	-	-	-	-	-	-							-
Tide Level (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

New Dashboard Enhancements

click for details



Mobile Detector



Pavement Grip Values

Braking distance vs. initial speed and friction

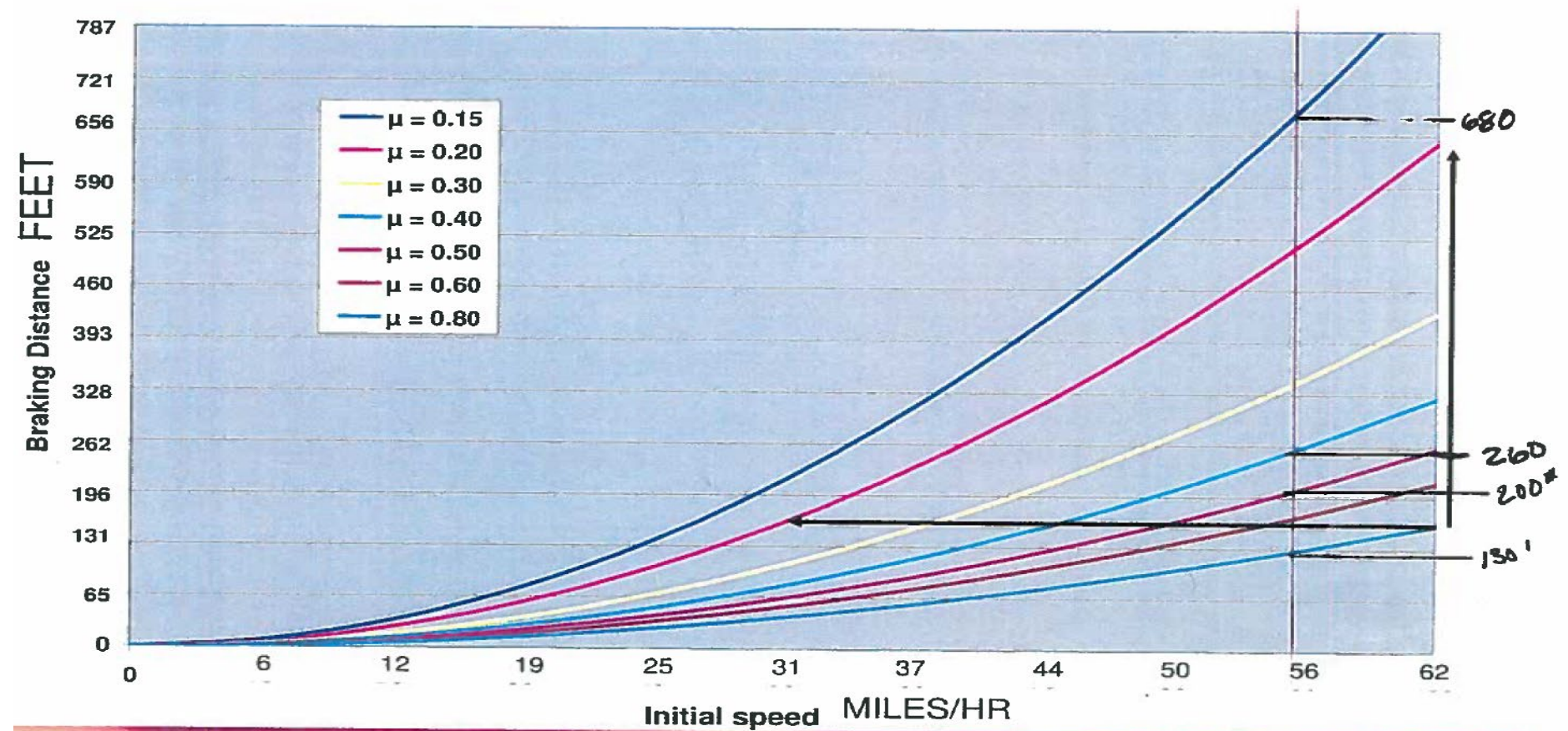


Photo Documenting Roadway Friction



Integration with Spreader Controllers



Use of Winter Severity Index (WSI) to Assess Performance / Salt Efficiency

Winter Severity Index (WSI) used as performance measure to
monitor annual road salt usage efficiency

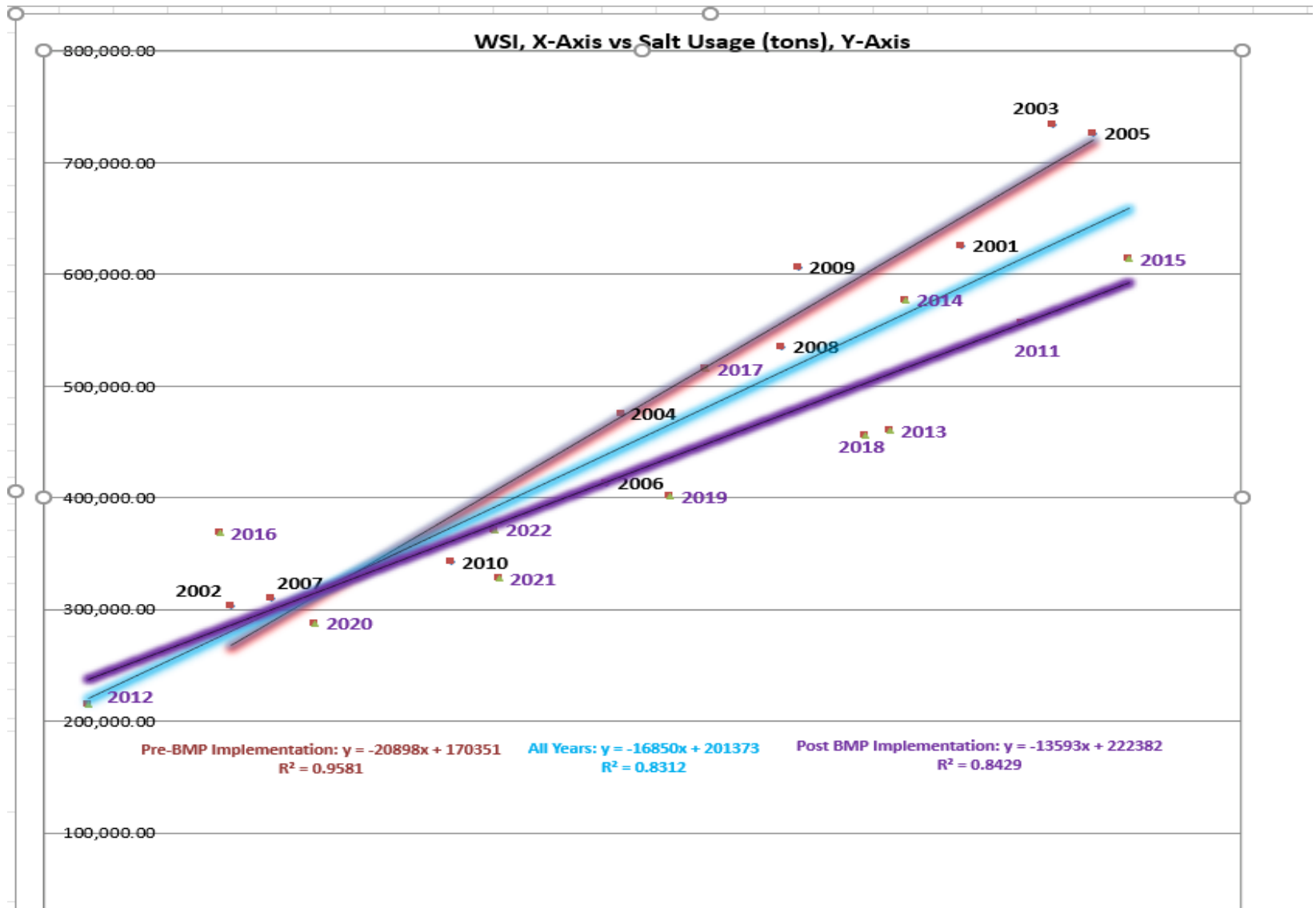
Boselly Index, Based on 3 Weather Parameters

Daily Snowfall

Daily Average and Minimum Temperature

Number of Days with Frost Potential

WSI and Salt Use Data



In Summary...

- We want to thank the TRB for the opportunity to talk with you all today.

