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# State of Vermont Salt Usage

## Understanding The Basics

VTrans

Vermont Agency of Transportation

# Goals

- Know the available technology tools to help you succeed as a Snow Fighter
- Understand winter storms and weather conditions
- Understand how and when materials are applied
- Understand VTrans approach to snow and ice control
- Be familiar with the materials available, how they are generally used and how the costs compare
- Be aware of the environmental impacts of chlorides and how to minimize them

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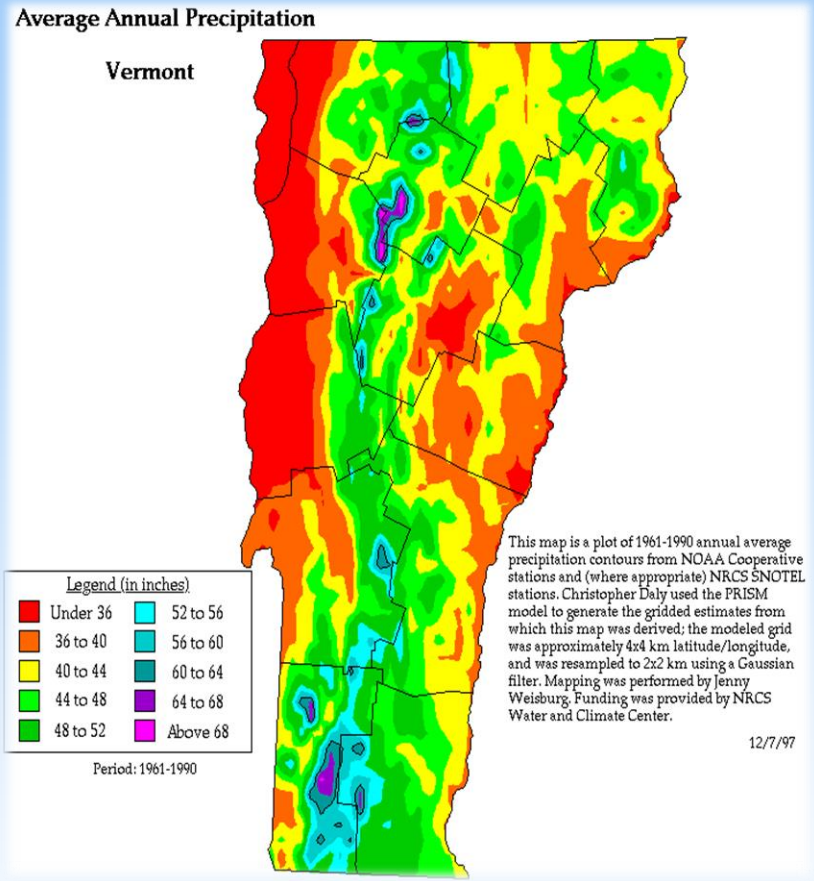
# Overview




Average Snow Fall:
Ranges from 46 – 146 inches

Plowing Responsibility:
6,626 MILES

Budget (FY2013):
Approximately 69,302,000

Snow & Ice Budget:
APPROX 25 MILLION

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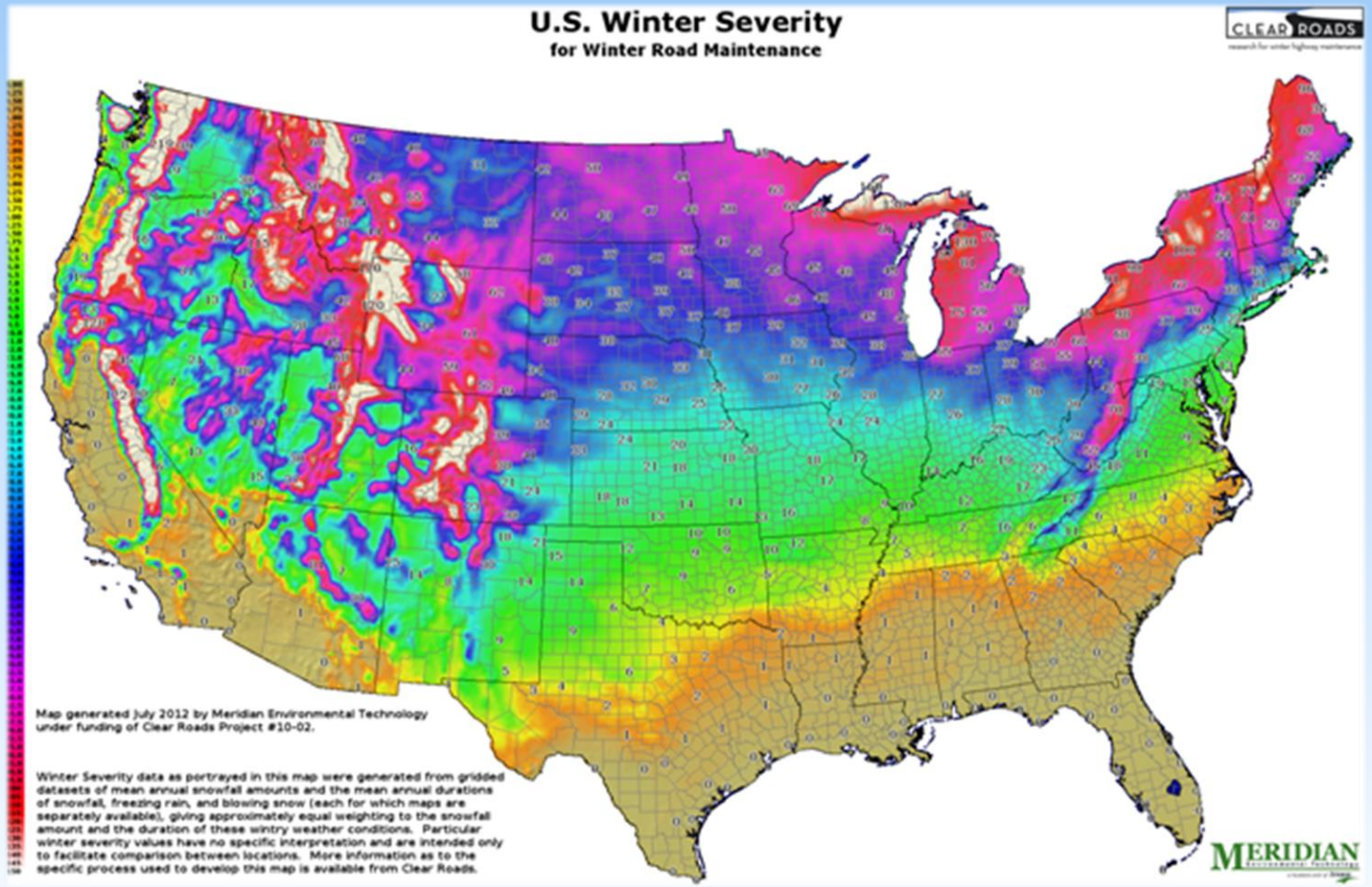
# Vermont compared to the U.S.

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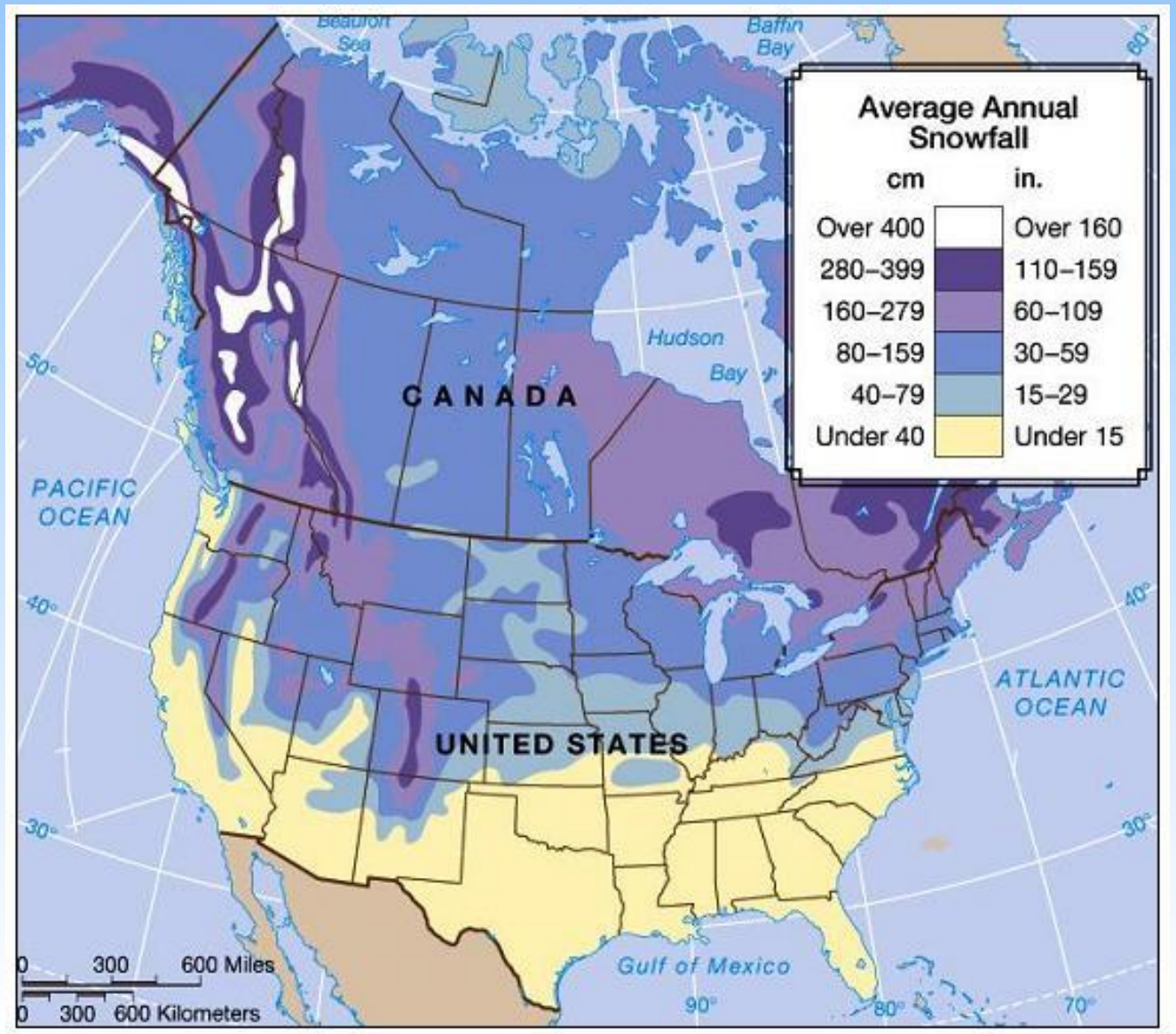
Average Annual Snowfall
cm
in.
Over 400
Over 160
280–399
110–159
160–279
60–109
80–159
30–59
40–79
15–29
Under 40
Under 15
CANADA
UNITED STATES
PACIFIC OCEAN
ATLANTIC OCEAN
Gulf of Mexico
Hudson Bay
Baffin Bay
Beaufort Sea
0 300 600 Miles
0 300 600 Kilometers
50°
40°
30°
90°
80°
70°

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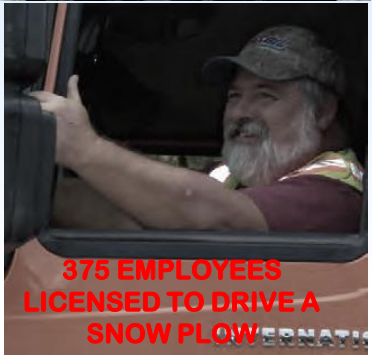
# Infrastructure Maintenance Statistics







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# Snow and Ice Control Plan


**Handout**

- Purpose and Need
- Level of Service – General Information
- Corridor Priorities
- Program efficiency
- Materials and Application Procedures
- Equipment
- Operations
- State and Federal Regulatory Oversight
- Best Management Practices, Tracking and Reporting

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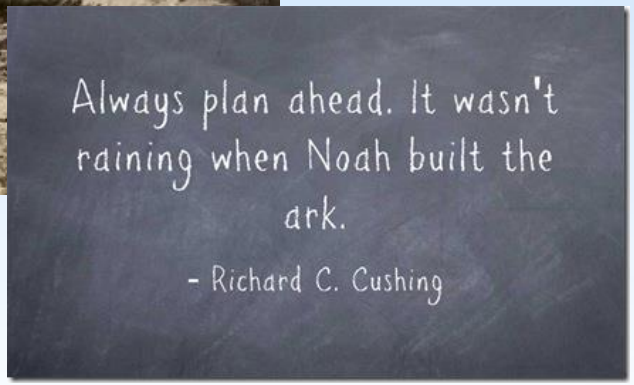
# BE PREPARED








**HANDOUTS**

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# EQUIPMENT

**Category 17 Truck with right-hand wing plow**

**Category 16 Truck with right-hand wing plow and right-hand fixed –angle front plow**

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# EQUIPMENT

Category 27 truck (baby dump)


Under body plow (and wing) on grader


Loader

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# EQUIPMENT

**Fixed angle front mounted plow**

**(right hand plow)**

**Reversible front mounted plow**

**(left or right)**

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# EQUIPMENT

**Reversible front mounted plow (left or right)**

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# EQUIPMENT

**Material Shoot and Spinner**

**Bed chain and lift bed in all season body spreader**

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# EQUIPMENT

## Tow Plow

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# BRINE EQUIPMENT

Hopper spreader

(with brine tanks)


Slide-in Anti-Icing tank and spray bar

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# BRINE EQUIPMENT

**Super Tanker**

**Tailgate mounted Pre-Wetting applicator**

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# BRINE EQUIPMENT

Super Tanker Spray Bar

Super Tanker Tank

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# BRINE EQUIPMENT


Trailer Mounted Brine Applicators

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# BRINE EQUIPMENT

## Tub Trucks

Tandem Trucks carry 600 gallons of Brine

Single Axle Truck Carry 450 gallons of Brine

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# BRINE EQUIPMENT

Dickey John


TT Unit Tanker


State of Vermont currently uses multiple makes of ground speed controls; such as Dickey John, 3 types of Sirus and Certified Power.

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# BRINE EQUIPMENT

AccuBrine Brine Maker


Brine Extreme Brine Maker


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# R. W. I. S.

## Road Weather Information System

Providing extensive weather information including:

- Air Temp
- Pavement Temperature
- Freeze Pint of the Brine Solution
- Wind Speed and Direction
- Relative Humidity
- Precipitation Type
- And Much MUCH more…..

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# R. W. I. S. LOCATIONS

## Interstate Locations

| I - 89 | I – 91 |
|---|---|
| Georgia | Derby |
| Milton | Sheffield |
| Williston | St. Johnsbury |
| Bolton | Newbury |
| Berlin | Thetford |
| Brookfield | Hartford |
| Bethel | Weathersfield |
| | Westminster |
| | Guilford |

## US and VT Routes

US 2 - Cabot

US 4 - Fair Haven & Mendon

US 7 - Brandon

VT 9 - Woodford

VT 103 - Mount Holly

VT 242 - Jay Peak

VT 11/30 – Bromley Mtn

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VAISALA / Road Weather Navigator

Welcome district1 Logout Save as Default Page

Vermont State RWIS

- Summary
- Traffic Summary
- Stations...
  - I-89 Berlin...
  - I-89 Bethel...
    - Station Status
    - **Camera**
    - History Graph
    - History Grid
    - Traffic History Grid
    - Daily Traffic Summary
    - Sentry Warnings
  - I-89 Bolton...
  - Rt-4 Mendon...
  - Rt 7 Brandon...
  - I-89 Brookfield...
  - I-91 Derby...
  - I-89 Georgia...
  - Rt-4 Fair Haven...
  - I-91 Newbury...
  - I-89 Williston...
  - Rt- 9 Woodford...
  - I-89 Milton...
  - I-91 Guilford...
  - Rutland Airport...
  - I-91 Thetford...
  - I-91St Johnsbury...
  - I-91 Hartford...
  - US 2 Cabot...

**I-89 Bethel Camera Posistion 0**
**10/4/2013 19:24 (UTC)**

**Camera Image Gallery**

Camera Images from:

10/4/2013 7:29 PM

Go Now

| Posistion 0 | Position 1 |
|---|---|
| 10/4/2013 19:24 (UTC) | 10/4/2013 19:23 (UTC) |


# INFRARED THERMOMETERS

**RoadWatch Infrared Thermometers**


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# INFRARED THERMOMETERS

- In-Vehicle device to measure surface temperature while driving at normal highway speeds
- Approximately  65  in use on Truck and Pickups
- Measures ONLY what it can see (Ice, Snow, Pavement)
- Check Accuracy with a pan of ice – Should read 32 Degrees
- Avoid placing too close to heat sources or blocking the view of the lens

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# VERMONT WEATHER

- EACH WINTER STORM IS DIFFERENT….
- Scientists estimate that there are 66,000 different storm possibilities.
- Knowing the weather prior to, during and after a winter storm helps determine the best action and material to use

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# APPLICATION OF MATERIALS AND PLOWING

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# WHAT IS THE GOAL?


Our Goal is to provide
**SAFE ROADS**
at
**SAFE SPEEDS**

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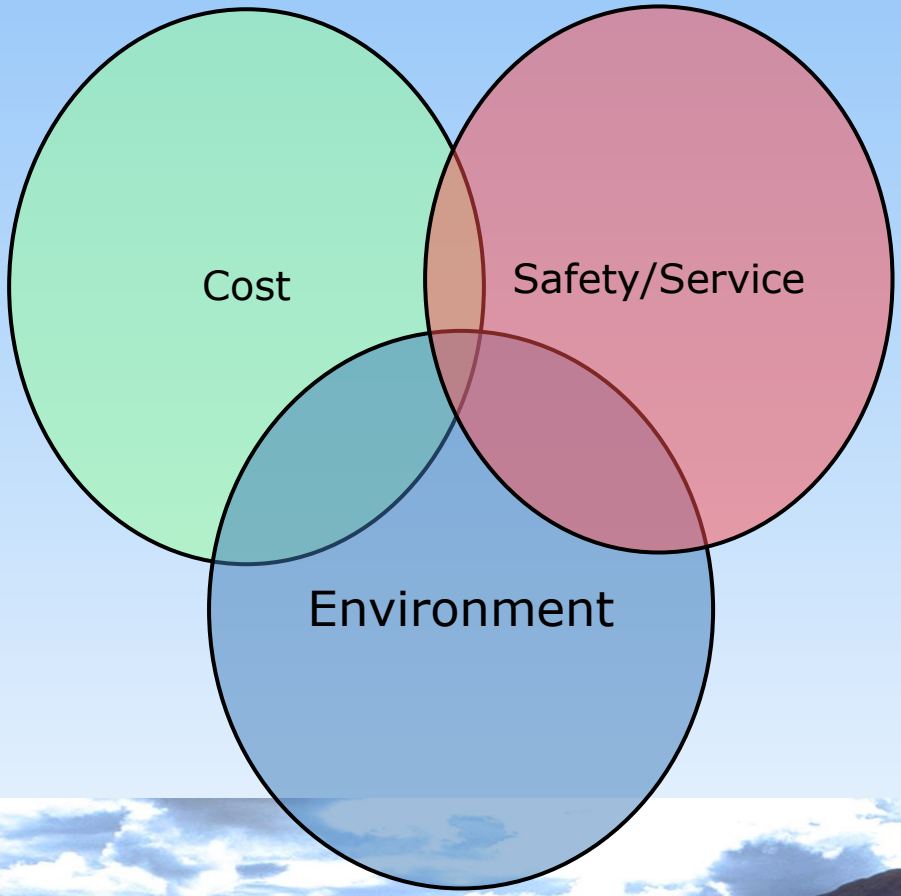
# Its about Balance ....



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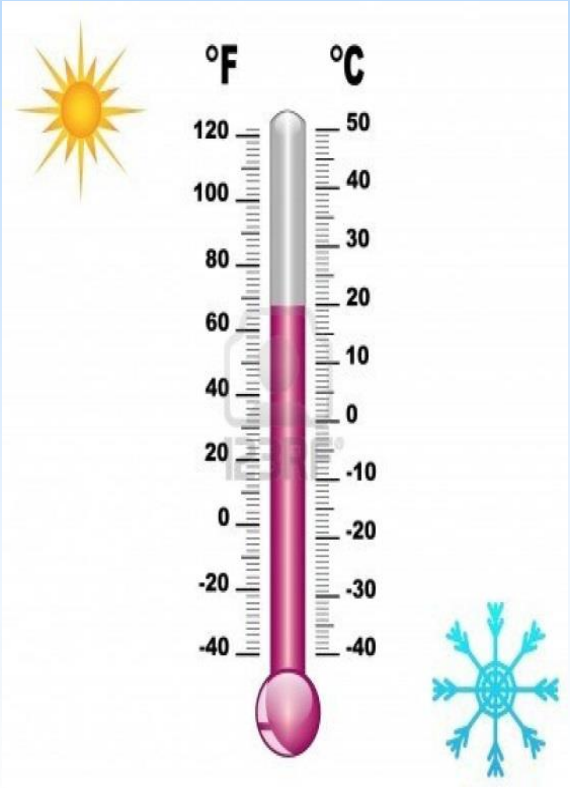
# IMPORTANT …….

It is **PAVEMENT** Temperature that matters




NOT
AIR Temperature

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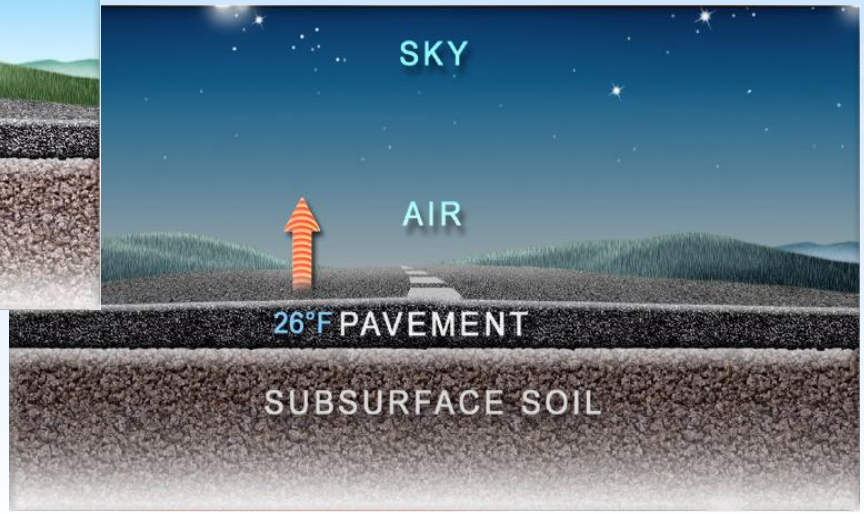
# Maximum / Minimum Pavement Temperatures

**Question:**

At what time of the day is the pavement typically at its
Highest? Lowest?

**Answer:**

Highest: **Early Afternoon**.
Lowest: **Near Sunrise**.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# De-Icing vs. Anti-Icing

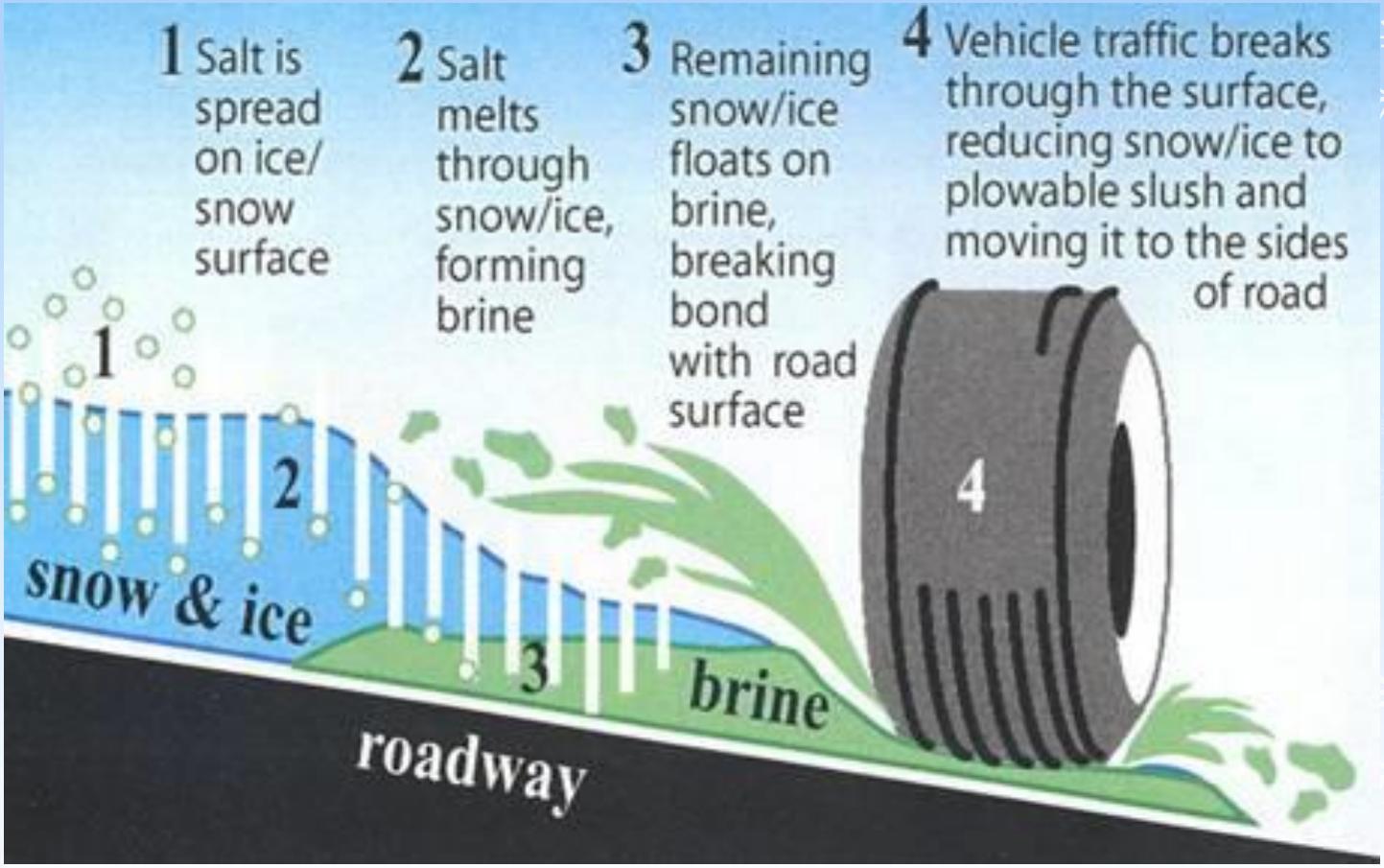
## De-Icing

- High sand usage
- High material costs
- Snow “pack”
- High operational costs

## Anti-Icing

- Strategic use of salt
- Leverages technology
- Bare pavement quicker after storms (Higher LOS)

# Snow and Ice Control
# De-Icing

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# Factors in Deciding Snow and Ice Treatment

- **Present Pavement Temperature**
  - What is the trend of the pavement temp?
- **Current Road Condition**
  - Is snow/ice bonded to the highway surface?
- **Current Weather**
  - What is the trend of the weather?
- **Traffic Volume and Timing**
- **Resources Available**

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# ANTI-ICING

The ice control practice of preventing the formation or development of bonded snow and ice by timely applications of Brine and other types of Anti-Icing Chemicals.

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# Components for an Effective Anti-icing Program

- Must be applied to a bare and dry surface.
- Maintain a working brine layer.
- Use only what you need for materials.
- Collect accurate information to know what needs to be done and to track what was done.

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# Anti-Icing Spray pattern and Coverage


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# Communication

***Communication with your Supervisor is critical! ***

- Supervisor must communicate your route conditions.
- Suggest how you should approached it.
- You should communicate how successful that approach was.
- Continued communication throughout storm is essential. Conditions Change! Applications and strategies may change!
- When the storm ends your supervisor will update you on your clean up strategy.

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Portland
THRU
LANES
Points South
NH - Mass
RIGHT LANE

# MATERIALS TO DO THE JOB


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# Salt Brine

A solution of raw salt and water mixed in a brine maker, tested with a hydrometer to a **23.3%** solution of salt and water, which results into **2.5** pounds of salt per gallon of water.

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# Salt Brine Properties

- Freeze Point: **-6 degrees F**
- Weight: **Approximately 10 Pounds / Gallon**
- Cost: Approximately **$.10 - $.15** (depending on blend percentage) per gallon Compared to Ice B' Gone at $1.24 per gallon

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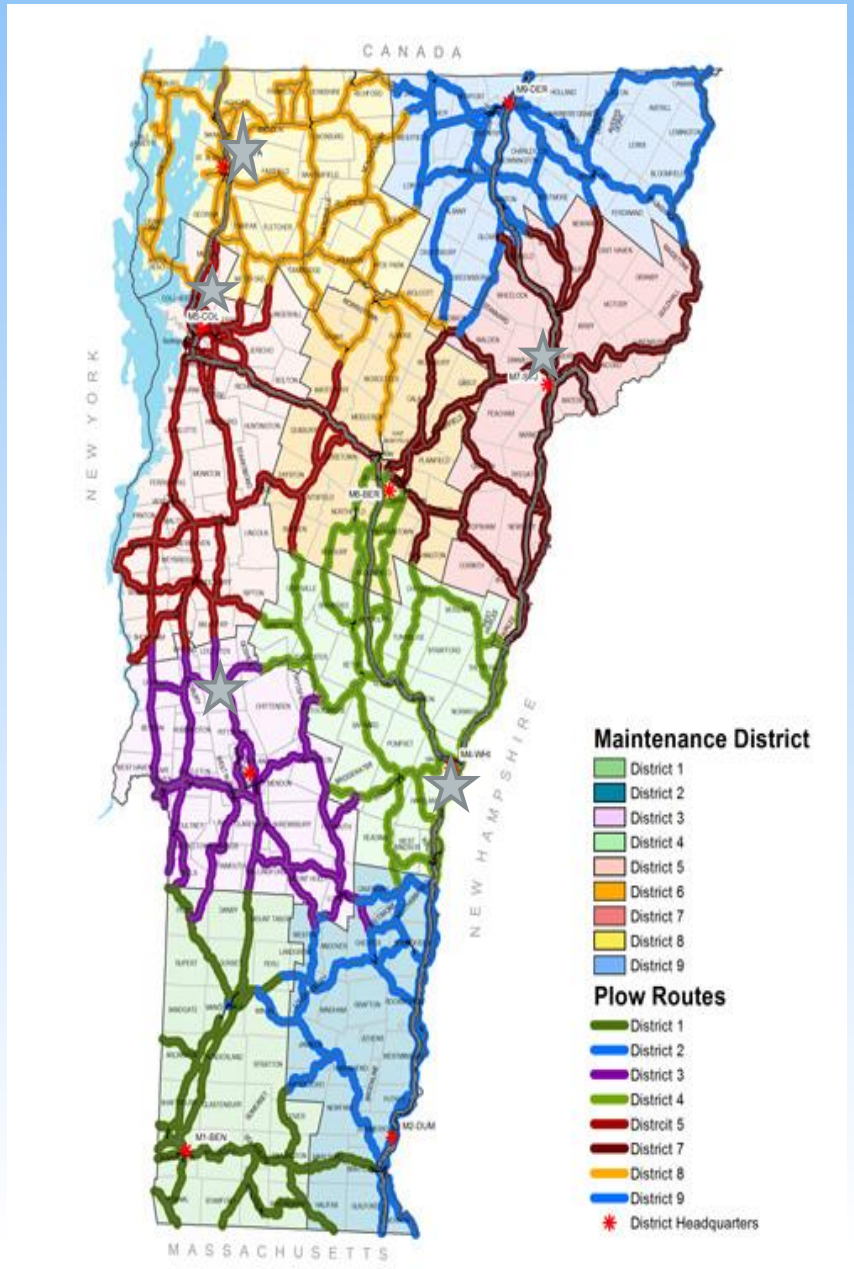
There are Currently 6 Brine Makers with in the State. More to be added with in the coming years.




1 - St. Albans

2 – Milton

3 – Brandon

4 – Windsor

5 – St. Johnsbury

6 – East Dorset

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# Salt Brine Additives

VTrans blend Ice-B-Gone with Salt Brine from a ratio of 5 : 95 to 30 : 70 (IBG : SB)

These blends have proven to work well, at reasonable cost, and may also help reduce the corrosive effects of the chlorides.


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# Salt Brine Applications

- **Pre-Treating**: Applied to roadway using Brine distribution equipment prior to the start of the storm.
  - **At rates of 50 gallons per lane mile**

- **Pre-Wetting**: Used in saddle tanks to pre-wet sold materials at the spinner.

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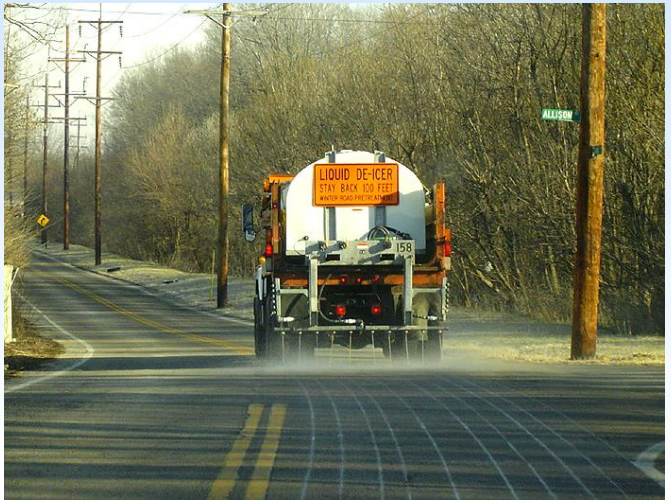
# Pre-Treating

**Q: Why do we Pre-Treat?**

**A: To help prevent the bond of snow and ice to the pavement.**

- ✓ Gives upward of two hours lead time to respond.
- ✓ More liquid material stays on the pavement than dry material would.

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# Pre-Treating Advantages

- **Consistent Application –** Salt is distributed evenly across the lanes
- **Efficient application – Very little material lost due to application process, so there is less waste.**
- **Treats Anticipated Frost Conditions**

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# Pre-Treating ……

- **When do we pre-treat?**
  - ✓ **Roughly 6 hours before a storm.**
    - ❑ **Allow time for the material to dry**
    - ❑ **High traffic volumes can remove a significant amount of material if applied too soon.**

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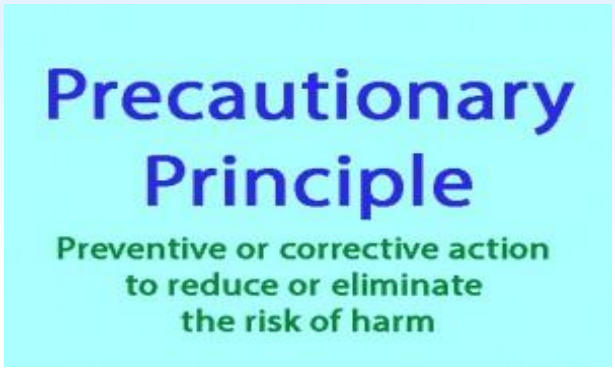
# Pre-Treating Precautions

- Should **NOT** be applied at temperatures **lower than 20** degrees Fahrenheit**.**
- Can **NOT** be used on **HARD PACK** (*can become slippery*) – **Generally Hard Pack is treated during De-Icing.**
- Do **NOT** spray in **oncoming or adjacent lanes** when traffic is present.

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# How do we pre-treat?




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# Pre-Wetting

**Definition: Applying liquid deicer to solid material at the spinner.**

**Q: Why do we Pre-Wet?**

**A: For all of the following reasons:**

- ✓ Keep solid material on the pavement.
- ✓ Get the salt acting quicker. (The BRINE does the work)
- ✓ Melt snow and ice at lower working temperatures
- ✓ Melt more ice with less salt.

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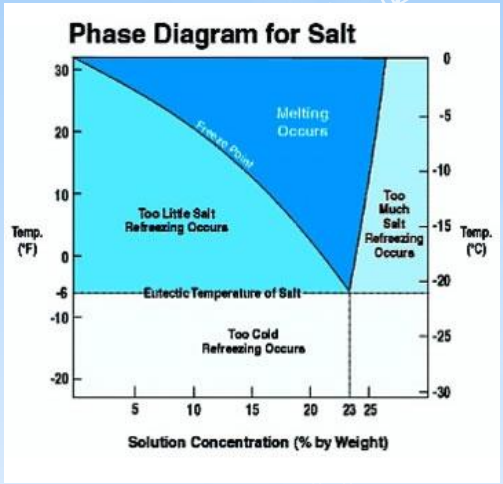
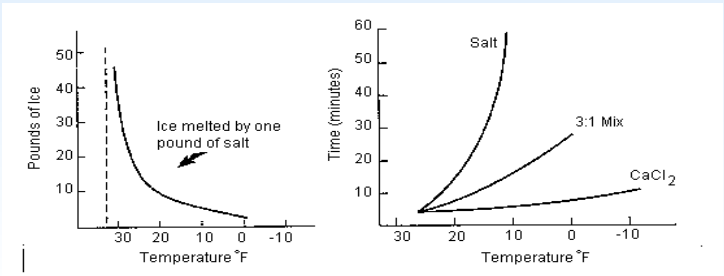
# Pre-Wetting Salt with Salt Brine (NaC1)

- Salt needs moisture to work.
- Salt needs heat
- Needs help at certain temperatures

- Salt Brine Provides Moisture!
- Salt Brine is used when Temperature conditions meet requirements.
- Ice B Gone Salt Brine Blends “Jump Start” Salt in order to work FASTER




**The graph on the left shows that salt melts more ice per pound at higher temperatures. The graph at right shows the comparative time for different compounds to melt 1/8" of glare ice.**

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# The Right Material…….

**Salt (NaC1)**

Melts Snow & ice and prevents bonding

(15 degrees +/- & up)

**Sand**

Provides Traction

(All Temps)

**SALT BRINE**

Consistent, early corridor treatment

(15 degrees +/- & up)

**Ice-B-Gone**

Lower working Temperatures

(-25 / +5 degrees and up)


## …. For the Right Job!!!

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# How Much salt is Working???

| | Dry Application (No Pre-wet) | Pre-wet Application |
|---|---|---|
| **Initial Application** | 500 lbs/lm | 500 lbs/lm |
| **Retained** | 46% = 230lbs | 78% = 390lbs |
| **5 cars @ 38mph** | 30% = 69lbs | 93 % = 363lbs |
| **Total remaining after 100 cars @ 38mph** | 15% = **10.5 lbs** | 80% = **290 lbs** |

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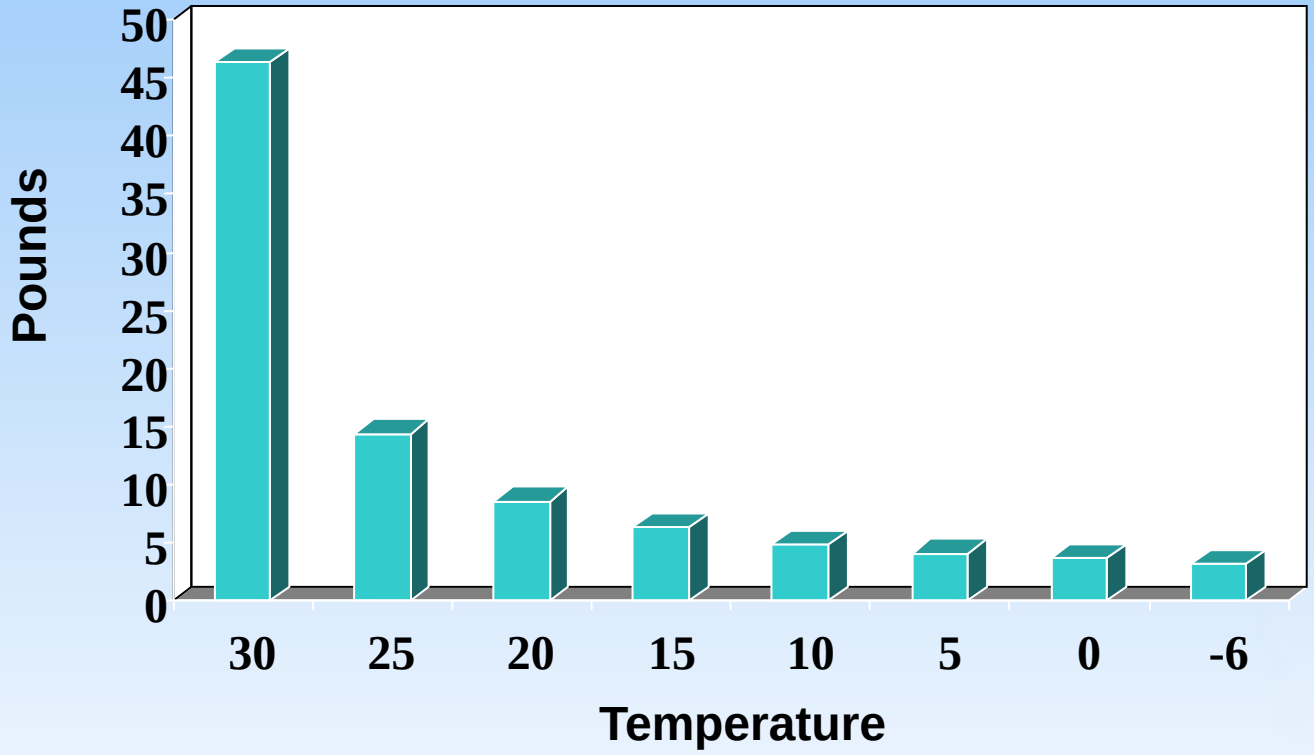
# Pounds of Ice Melted per Pound of Salt




It takes over **5 times** more salt at 20 degrees than it does at 30 degrees to melt the same amount of ice!!!

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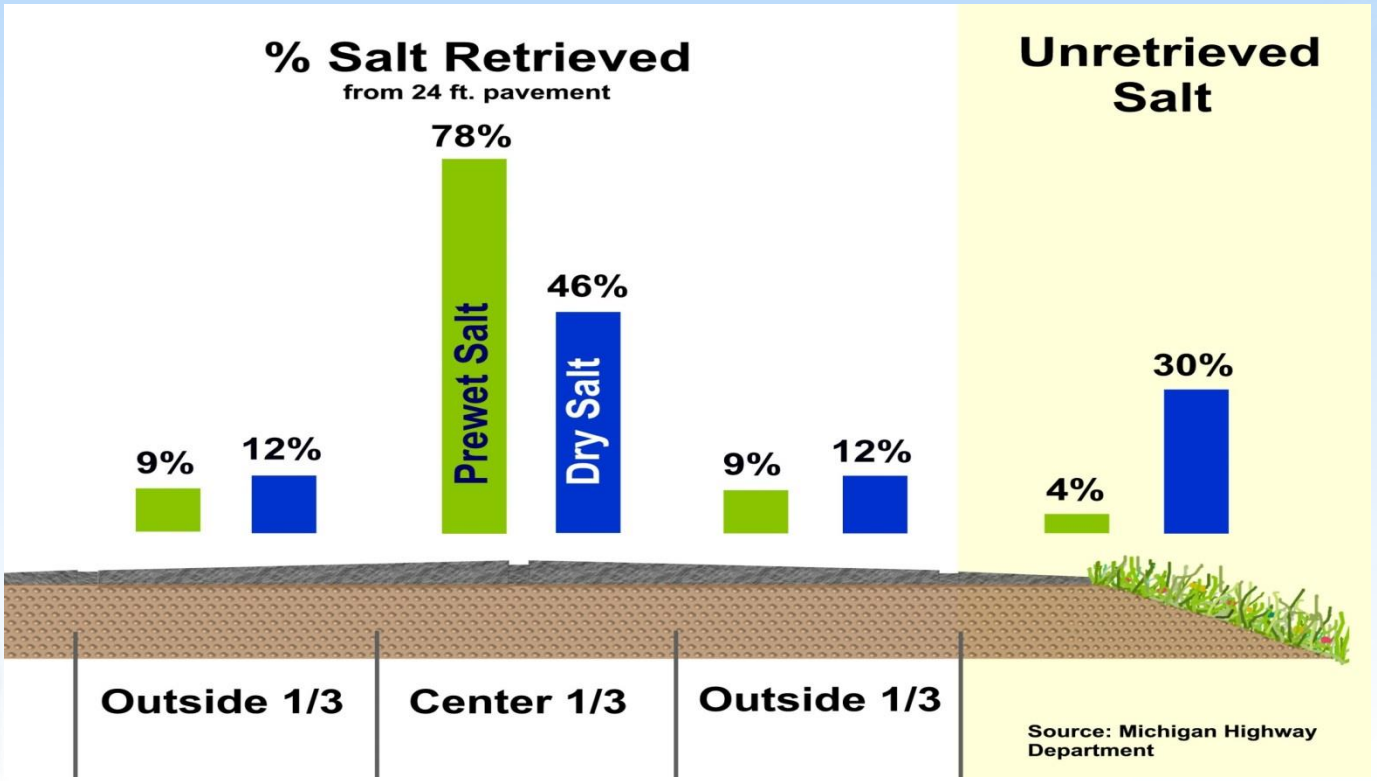
# Bounce and Scatter ……

- Bounce and Scatter at Different Application Speeds
- Bounce and Scatter of Treated Salt vs. UnTreated Salt

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# Bounce and Scatter ….  Discoveries

- Speed is the biggest factor effecting Salt Bounce and Scatter  (25 mph speeds retain the most salt in target zone by far)
  - Just because your truck can put salt out at 50 mph does not mean your should!!!!!
  - Salting at a slower speed keeps more salt on the roadway!!!!
- Treated Salt scatters less then untreated Salt.

❖ A balance between speed and application rate must be used to avoid this!!!!

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# VTrans Salt Application QUICK REFERNCE CHART

***Communication with your Supervisor is the FIRST method of Salt Application. When communication is unavailable please refer to this Quick Reference Chart***

| VTrans Salt Application Quick-Reference Chart | | | |
|---|---|---|---|
| (**Double these rates for centerline applications**) | | | |
| Pavement Temp. Range | Application Rate (#/LM) | Pre-wet Material | Comments |
| Above 32° | 0 to 100 | Salt Brine or Blend | A little salt goes a long way when temperatures are near freezing |
| 25° to 32° | 100 to 200 | Salt Brine or Blend | Salt is very effective here. Pre-wetting with a blend will allow lower application rates. |
| 20° to 25° | 200 to 300 | Salt Brine, Ice-B-Gone, or Blend | Salt effectiveness is dropping off in this range. A Blend or straight IBG will help. |
| 15° to 20° | 300 to 400 | Ice-B-Gone or Blend | Pre-wetting is especially important. Your liquids will provide the extra boost needed. |
| 15° or Below | Snow is usually dry and blowing in this range. If no ice or pack exists, plow only. DO NOT APPLY | | If necessary, Spot treat icy patches with abrasives. If glazing occurs on high-volume, high-speed, P1 corridors, sand will not last and higher salt applications, with Ice-B-Gone pre-wetting, will be necessary. |
| General Notes: | | | |
| (1) Application rates should be on the lower end when temperatures are on the higher side of the range or remaining steady. Falling temperatures, and temperatures on the lower side of the range, will require applications on the higher side, and possibly in the next range if dropping rapidly. | | | |
| (2) High-volume, Priority 1 corridors will often require an additional 50#/LM | | | |
| (3) In any of the ranges, if the snow is dry and blowing off of the roadway, avoid application. | | | |
| (4) Pre-wetting under wet storm conditions is not required. In cases where the only pre-wetting liquid available is a high-performance chemical (i.e. Ice-B-Gone), it is better to save those products for the drier and colder conditions. | | | |

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# Sand….  Still in our tool Box

## Sand is used When:

- Pure salt will not work fast enough (i.e. accident scenes or other situations that require immediate traction)
- Pavement temperatures are too low.
- Steep hills or curves require additional traction
- Problem areas on lower-speed roads are wet heading into dropping temperatures at night.

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# Disadvantages of Winter Sand


- Build up and drainage problems
- Siltation of waterways
- Air quality issues
- Benefit is temporary
- Little / No melting properties
- Skidding hazard on dry pavement
- High cost of storage & handling

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# ALWAYS REMEMBER…

- We are only **PREVENTING THE BOND** of the ice to the pavement **NOT** burning off all of the snow and ice

- **PLOWING**, not melting, is the **PRIMARY TOOL** for removing snow and ice from travel lanes


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# Safe Material Spreading Practices

- Watch Speed to be Sure Material is being place where desired
- Match speed to Pavement Surface and Traffic Condition
- Watch Revs to be Sure Hydraulics can Function Properly
- Be aware of Potential Material Spreading – Public Vehicle Conflicts
- Verify that Material is being Dispensed

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# THE EFFECTS OF ROAD SALT IN THE ENVIRONMENT


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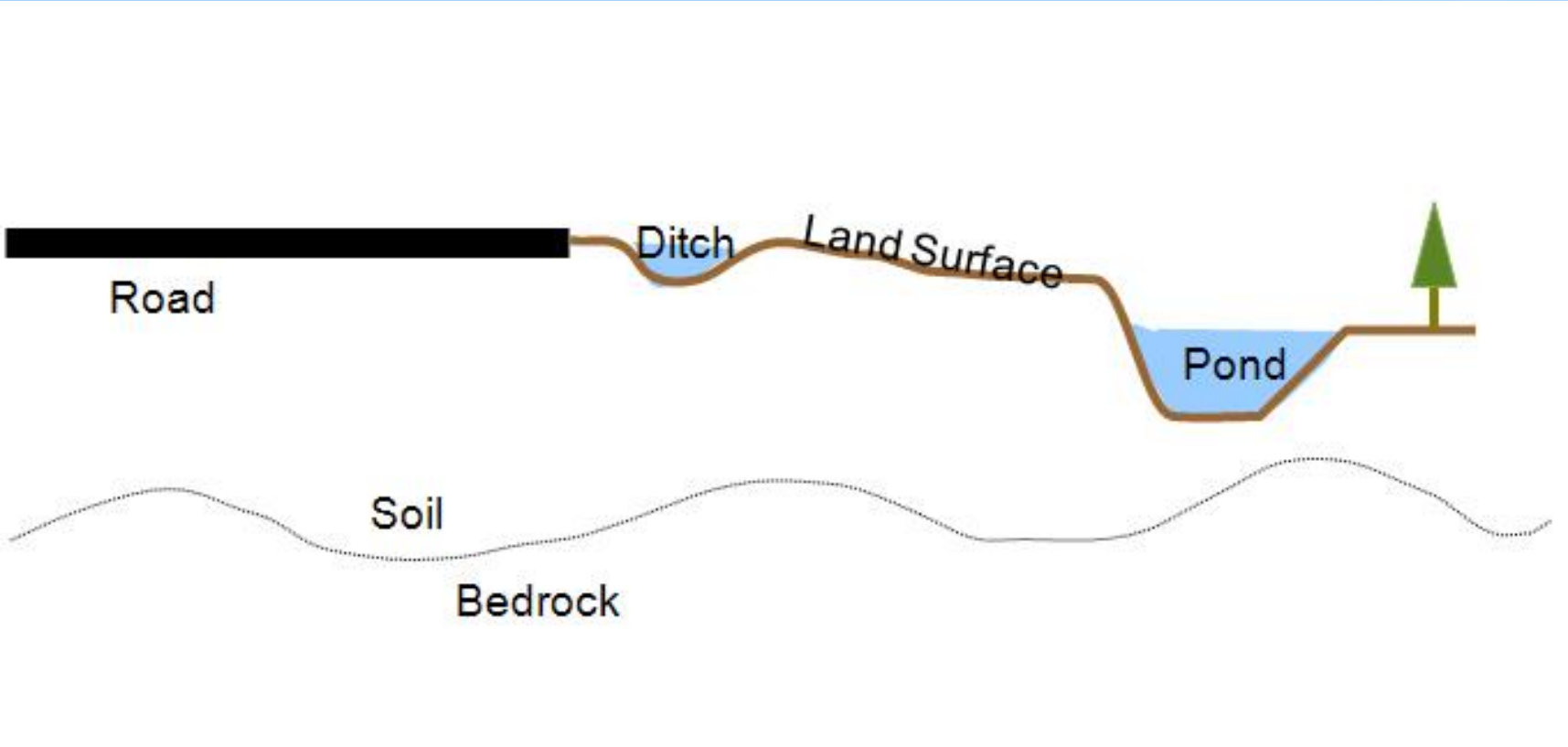
# ENVIRONMENTAL RECEPTORS

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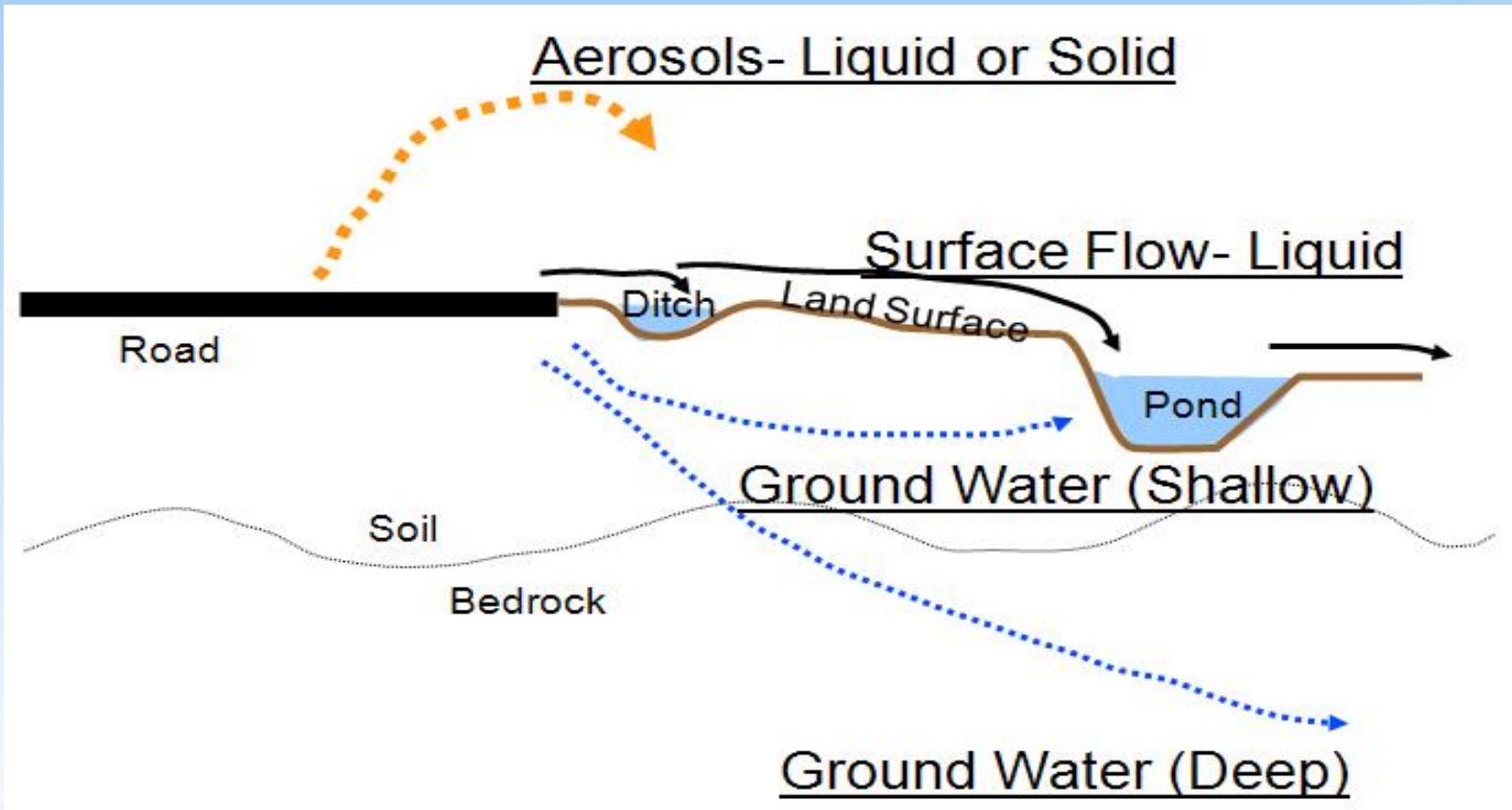
# ROAD SALT – PATHWAYS TO ENVIRONMENTAL RECEPTORS

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# ROAD SALT AND WATER QUALITY

- **SHORT TERM**
  - Elevated spikes of Na and Cl in surface and ground waters (seasonal)
  - Seasonal impacts to shallow water supply wells
- **LONG TERM**
  - Increased salinity of streams, ponds, vernal pools, wetlands and groundwater (1600’ wide)
  - Soil chemistry change through ion exchange (release of Ca and Mg then H (Acidification)
  - Soil “stores” salt and releases it over time
- **TRENDS**
  - Increased concentration of Na and Cl in surface waters
  - High salt in surface water limited to near roads and storage areas
  - Salt in groundwater can extend well beyond

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# ROAD SALT AND Ecosystem Quality

- **SHORT TERM**
  - Increased attraction of salt-loving species (road-kill)
  - Foliar burning
  - Loss of salt sensitive species (plant and animal)
- **LONG TERM**
  - Decrease in surface water diversity (Toxic thresholds exceeded for sensitive species)
  - Dominance by salt-tolerant invasive species.
  - Vernal pool decline
- **TRENDS**
  - Decrease in surface water diversity
  - Increase in invasive species (plants)
  - Ecological footprint ~ 1600 feet wide
  - Loss of high quality ground water

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# THINGS TO AVOID!!!

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# SUMMARY AND CONCLUSIONS

**Road Salt Affects Water Quality and Ecosystems**

- ***Transient Effects- Larger Magnitude, Shorter Duration***
- ***Chronic Effects- Lower Magnitude, Longer Duration***

**•Reversibility**

- ***Transient Effects are mostly reversible***
- ***Chronic Effects- May be reversible on the scale of years to decades***

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# SUMMARY AND CONCLUSIONS

- **Trends**
  - *Increase in Chloride in surface waters & groundwater*
  - *Cation exchange leading to nutrient depletion and acidification of water*
  - *Loss of biodiversity*
  - *Increased prevalence of invasive species*

**VTrans is aware of and developing appropriate strategies to address these trends.**

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# QUESTIONS?????

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