Winter Roads Maintenance

Reducing the Use of Chlorides for Snow and Ice Control
(Utilizing Smart Salting Methods and Technologies)

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Environmental Concerns

- Chlorides, acetates and sand/abrasives, placed on pavements during snow and ice control operations, eventually end up in the natural environment (waterways, soils, vegetation, air, etc.).
- The accumulation of chlorides, acetates and sand/abrasives poses risks to aquatic ecosystems, water quality, vegetation and wildlife.

Products (e.g. Chemicals) used for Snow & Ice Control on Pavements, Sidewalks, etc.

- The most common chemical used is sodium chloride (common rock salt).
- Other chemicals used either alone or in combination with sodium chloride include calcium chloride, magnesium chloride, potassium acetate, calcium magnesium acetate, urea, agricultural products, etc.
- Sand/Abrasives are not chemicals.

Chemicals, con't.

- In the United States, approximately 10 million tons of sodium chloride is used annually (source National Research Council).
- Studies have shown that 55% of road salts end up in our drainage systems and waterways. The remaining 45 percent infiltrates through soils into groundwater aquifers.

Sand/Abrasives

- The use of dry sand/abrasives for snow and ice control, has very little value in providing **lasting** friction enhancement and they do not melt snow/ice. There benefit is very temporary.
- Sand/Abrasives- although not a chemical, sand/abrasives have a negative impact on the environment.
- An Oregon DOT study found that 50 to 90 percent of applied sand/abrasives remains in the environment even after a cleanup (e.g. machine sweeping, etc.).
- Sand/Abrasive use contributes to sedimentation in streams, air quality, water quality and impacts fish and other aquatic resources. It also contributes to air pollution.

What Can We Do Minimize our use of Snow and Ice Control Chemicals and Materials?

- Establish a Level of Service for Various Roadways and communicate those expectations to all personnel.
- Adopt an anti-icing policy
- Use pre-wetted solid chemicals instead of dry solid chemicals
  - A Michigan Study showed that approximately 30% of solid chemicals applied to roadways are displaced due to bounce or turbulence from wind and vehicles
  - By pre-wetting, you can reduce chemical application rates because more material is staying on the road.

Minimizing the Use of Snow and Ice Control Chemicals (con't)

- Apply the appropriate products when needed and at the right application rate (right application at the right time)
  - Use pavement temperature and pavement temperature forecasts
  - Use State of the Art spreader controls
- Develop a Winter Operations Maintenance Management Plan which includes establishing levels of service and specific route by route snow and ice control spreading plan
    - Consider the use of GPS/AVL systems and Geographic Information Systems to monitor application rates, etc.

Minimizing the Use of Snow and Ice Control Chemicals (con't)

- **CALIBRATE and RE-CALIBRATE equipment**
- Covered salt storage
- Train Staff

Anti-icing

- What is anti-icing
  - Anti-icing is the application of a chemical freezing point depressant to a roadway before or at the start of a winter event. The chemical inhibits the formation of the snow/ice bond to the pavement. Abrasives (sand) are not anti-icers or deicers.

Anti-icing versus Deicing

- Anti-icing prevents the snow and ice from bonding to the pavement. (Proactive)
- Deicing is designed to melt through ice and snowpack, and to break its bond with the road surface. (Reactive)
  - Studies have shown that it can take 4 to 8 times more salt to deice than to anti-ice.

Why Anti-ice?

- Anti-icing can provide a higher level of service throughout a storm
  - Keeps snow in a plowable condition
  - Can provide bare Pavement during the storm

- **At a minimum, anti-icing results in achieving bare pavement at the fastest possible rate at the end of a storm.**

Components of A Successful Anti-Icing Program

- Operation's Toolbox
- Choice of Chemicals
- Equipment
- Decision Making Tools
- Personnel
- Planning, Scheduling and Monitoring Progress

Operation's Toolbox

- Operations Toolbox
  - Liquid Chemical Applications
  - Solid Chemical Applications
  - Prewetted Solid Chemical Applications
  - Abrasives/Sand
  - Plowing

Liquid Chemical Applications

- Liquid Chemical Applications allow users to pre-treat roadways well ahead of the onset of frozen precipitation.
  - Roadways
  - Bridges
  - Hills
  - Critical Intersections

Liquid Chemicals (con't)

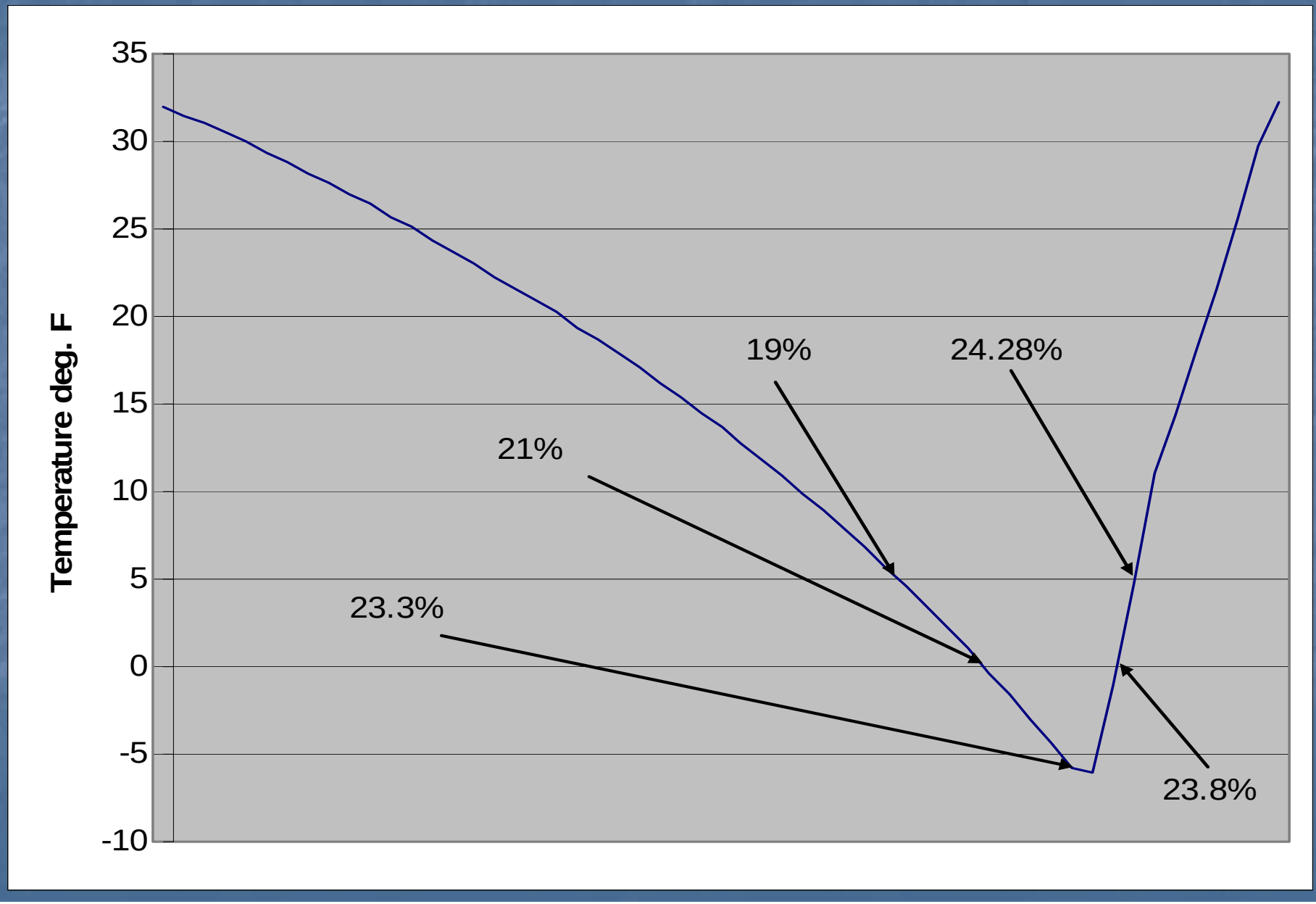
- Sodium Chloride, Calcium Chloride, Magnesium Chloride, Potassium Acetate and Agricultural Byproducts are the liquid chemicals most commonly used.

- Sodium Chloride (salt brine) is usually the liquid (brine) of choice for pre-treating highways and roads due to availability and cost. Recently, there has been interest in mixing other chemicals/products with brine to further lower the freezing point. Agricultural Byproducts, such as Beet Juice, Corn Syrups and other sugars, are becoming very popular.

Liquid Chemicals (con't)

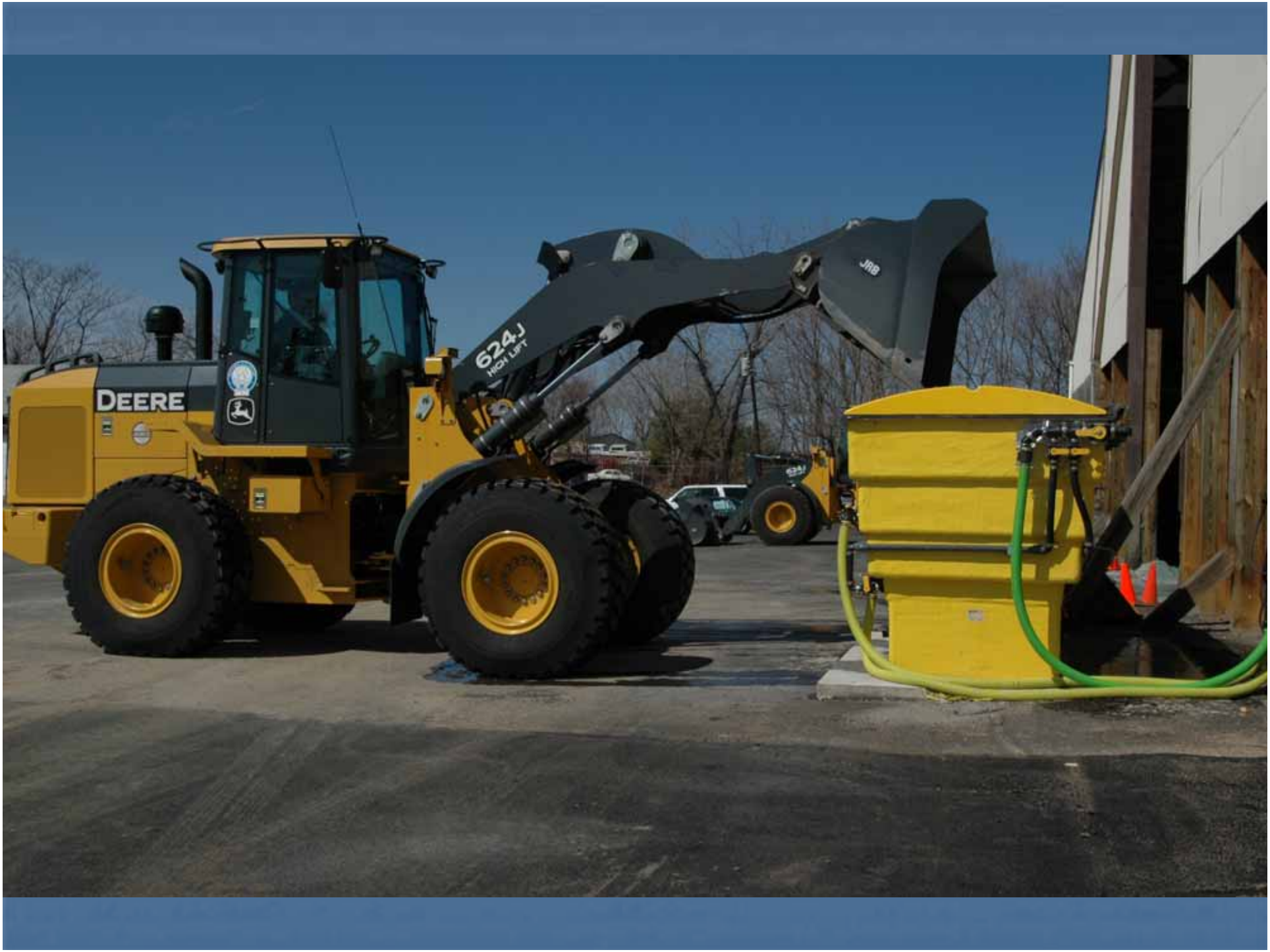
- It takes bout 2.5 lbs of salt to make one gallon (23.3% solution) of liquid sodium chloride (brine)
  - Costs
    - It costs about 6 cents/gallon (using $48/ton for salt) to make a 23.3% salt brine solution.
    - Calcium and Magnesium Chloride costs about 80 cents/gallon for approximately a 28% solution
    - Potassium Acetate costs about 7 dollars per gallon and is used predominantly at airports since it is non-corrosive
    - Agricultural Byproducts usually cost between $1 and $2 per gallon.

Why 23.3% Concentration?



Brine Facts

- Salometer Reading of 88.3 for 23% solution
- Contains .904 gallons of water for 23% solution
- Contains 2.288 Lbs of Salt for 23% solution
- Specific Gravity of 1.179 at 60 degrees Fahrenheit
- Freeze Point of -5.8 degrees Fahrenheit for 23% solution
- One gallon of saturated brine weighs 10.027 pounds.
- One gallon of saturated brine contains 2.647 pounds of salt.
- One gallon of water will produce 1.13 gallons saturated brine.
- One gallon of water will dissolve 2.991 pounds of salt.
- One ton of salt will produce 755.5 gallons of saturated brine.


DEERE
624J
HIGH LIFT
JRB


Telemecanique
Magelis
Winterization Mode
ALARM
ESC
DEL
MOD
ENTER
AUTO O HAND
Emergency
Stop
Start


#1
#2
BRINE
CONTROL
ROOM


KEEP BACK
300 FEET
ANTI-ICING
IN PROGRESS

Loading Brine

Typical Brine Application Pattern

Solid and Pre-wetted Solid Chemicals

- Sodium Chloride is the most commonly used chemical for anti-icing and deicing
- Sodium Chloride is endothermic and hydroscopic.
  - Draws heat from the atmosphere and pavement
  - Draws water from the atmosphere or other sources but not very well.
- Solid Sodium Chloride loses it effectiveness (has difficulty going into solution) when temperatures fall below 26 degrees Fahrenheit; therefore, at lower temperatures, solid sodium chloride should be pre-wetted. Pre-wetting will also help keep material from bouncing off the pavement.

Solid and Prewetted Solid Chemicals (con't)

- Solid Sodium Chloride is often pre-wetted with liquid calcium chloride or magnesium chloride in colder temperatures
  - Calcium and Magnesium Chlorides are exothermic and hygroscopic
    - They give off heat
    - They easily absorb and shed moisture
- Can be pre-wetted with brine (liquid salt) at higher temperatures to lessen bounce

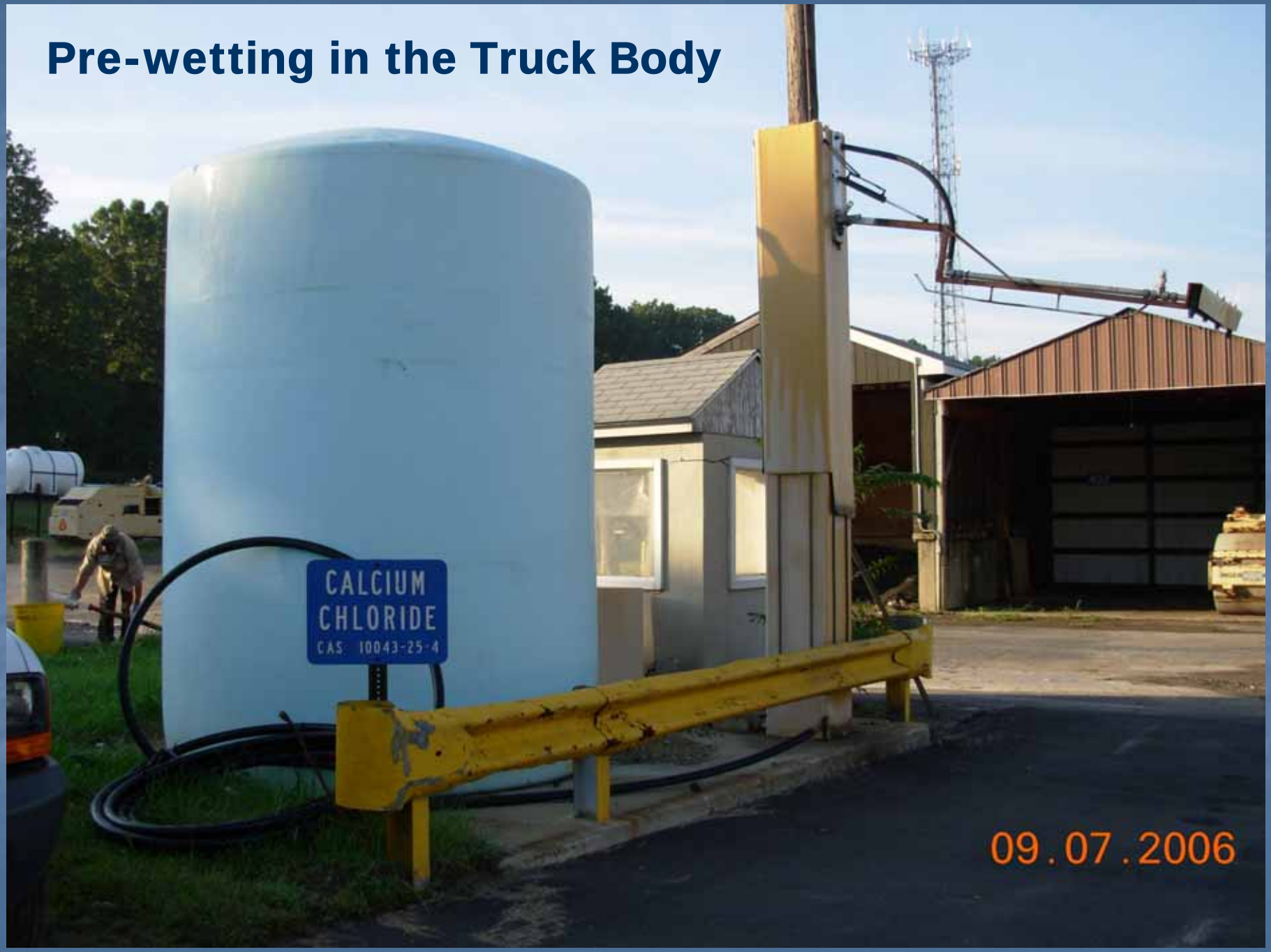
Prewetted Solid Chemicals

- accelerates solids going into solution
- results in less bounce and loss of material from the roadway when spreading solids
- is generally accomplished by applying liquids to the solid material at the spinner, in the auger, in the body of the truck or to the stockpile
- Typical Solutions are sodium chloride, calcium chloride, magnesium chloride, potassium acetate, calcium magnesium acetate, agricultural products & water

Agricultural Byproducts

- There is a difference between a chemicals ice melting performance and its ability to stay liquid
  - Agricultural Byproducts are not good at melting ice; however, they do slow down the formation of ice crystals. This makes some good for anti-icing and pre-treating
  - Some Agricultural Byproducts have freezing points near -30 degrees Fahrenheit
  - They are known to be Cryoprotectants

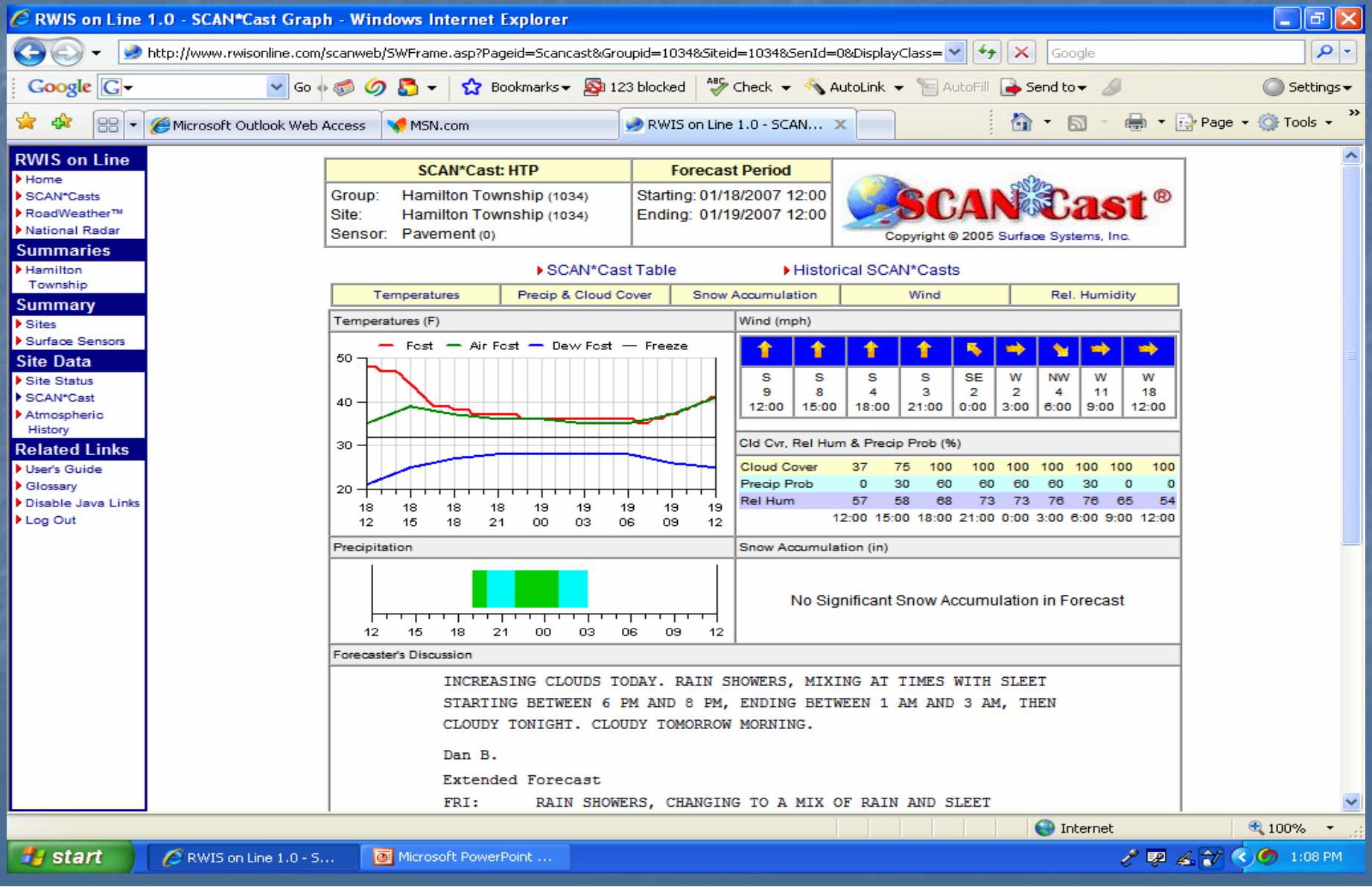
Pre-wetting in the Truck Body



Decision Making

- Without the proper Decision Making tools, decision makers must rely on experience and intuition. There are many tools available to assist decision makers.
- Weather Forecasts
  - Start and End times of precipitation
  - Pavement, Ambient and Dew Point Temps
  - Intensity of precipitation
  - Type of precipitation
  - Wind
  - Forecast of what temperatures, etc. to expect after an event
- Monitoring Tools (RWIS, mobile pavement temperature sensors, refractometers, driver reports, etc.)
- Pre-Storm Strategy Meetings and Post Storm Assessments

Weather Forecasts



Road Weather Information Systems (RWIS)

Pavement Temperature
Pavement Moisture

WIRELESS

Mobile Pavement Temperature Sensor

Measuring Brine Salinity & Freezing Point

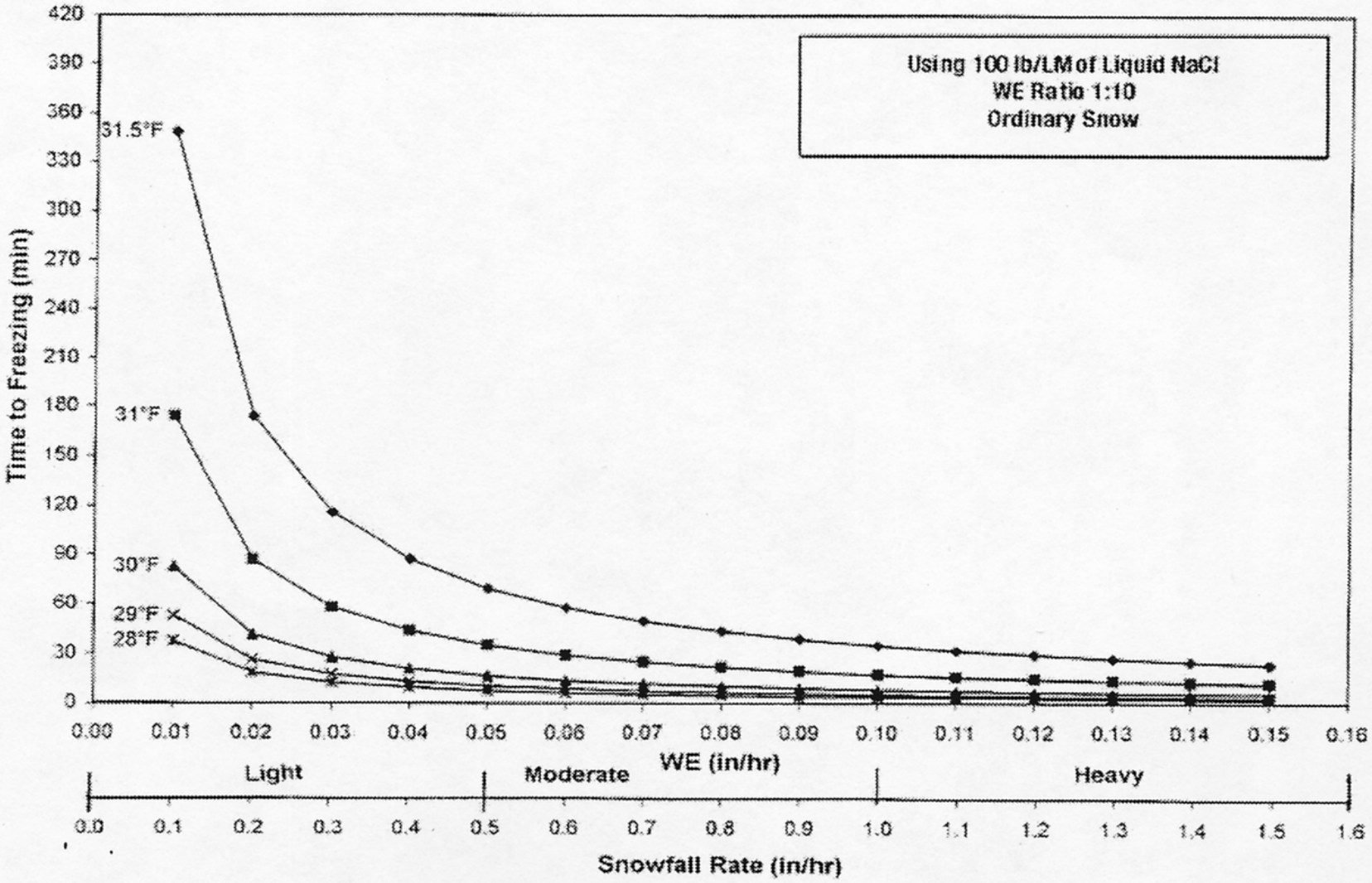
Mobile Freeze Point/Salinity Sensor

Mobile Frensor®

System for mobile freezingpoint logging

AerotechTelub
A SAAB GROUP COMPANY

Graph For Predicting Dilution of Solution (DOS)



Salt Brine Application Guidelines (23.3% Solution) for Effective Anti-icing

(as modified from the Manual of Practice for an Effective Anti-Icing Program prepared by FHWA, US Army cold Regions Research and Engineering Laboratory, Corps of Engineers-1996)

Township of Hamilton
Winter Maintenance Program
September 14, 2005

Table 1. Weather event: frost or black ice

PAVEMENT TEMPERATURE RANGE AND TREND, AND RELATION TO DEW POINT	INITIAL OPERATION			SUBSEQUENT OPERATIONS		COMMENTS
	Pavement surface at time of initial operation	**Maintenance action**	**Brine application rate in Gallons per Lane Mile**	**Maintenance action**	**Brine application rate in Gallons per Lane Mile**	
Above 32 degrees Fahrenheit. Steady or rising	Frost or black ice or forecast for frost or black ice.	See comments		See comments		1)Monitor pavement temperature closely. Begin treatment if temperatures to fall to 32 32 degrees Fahrenheit or and is at or below the dew point. Apply brine at 25 gallons per lane mile.
28 to 32 degrees Fahrenheit Remaining in that range or falling to 32 degrees Fahrenheit or below, and equal to or below the dew point.		Apply brine	25 gallons per lane mile	Reapply brine when needed.	40 gallons per lane mile	1)Monitor pavement closely. If pavement becomes wet or if thin ice forms, reapply brine at a higher application rate. 2)Do not apply brine on ice so thick that the pavement can not be seen.
20 to 28 degrees Fahrenheit Remaining in that range and equal to or below the dew point.		Apply brine	50 gallons per lane mile	Apply brine	50 gallons per lane mile	1)Monitor pavement closely. If thin ice forms, reapply brine at higher application rates. 2)Applications will need to be more frequent at higher levels of condensation if traffic volumes are not enough to disperse condensation. 3)It is not advisable to apply brine at the indicated application rate when the pavement temperature drops below 20 degrees Fahrenheit.

Table 2. Weather event: light snowstorm

PAVEMENT TEMPERATURE RANGE AND TREND	INITIAL OPERATION			SUBSEQUENT OPERATIONS		COMMENTS
	Pavement surface at time of initial operation	**Maintenance action**	**Brine application rate in Gallons per Lane Mile**	**Maintenance action**	**Brine application rate in Gallons per Lane Mile**	
Above 32 degrees Fahrenheit. Steady or rising	Dry, wet, slush, or light snow cover	None, see comments		None, see comments		1)Monitor pavement temperature closely for drops toward 32 degrees Fahrenheit and below. 2)Treat icy patches if needed with brine at 40 gallons per lane mile. Plow if needed.
Above 32 degrees Fahrenheit 32 degrees Fahrenheit or below is imminent; *ALSO* **20 to 32 degrees Fahrenheit** Remaining in that range	Dry	Apply brine	40 gallons per lane mile	Plow as needed. Reapply brine when needed.	40 gallons per lane mile	1)Application will need to be more frequent at lower temperatures and higher snowfall rates. 2)It is not advisable to apply brine at the indicated spread rate when the pavement temperature drops below 20 degrees Fahrenheit. 3)Do not apply brine onto heavy snow accumulation or packed snow.
	Wet, slush, or light snow cover	Apply brine	40 gallons per lane mile			
15 to 20 degrees Fahrenheit Remaining in that range	Dry, wet, slush or light snow cover	Do not apply liquids	Not applicable	Do not apply liquids	Not applicable	Apply only prewetted solid chemicals (salt) in this temperature range
Below 15 degrees Fahrenheit	Dry or light	Plow as	Not applicable	Plow as needed	Not applicable	It is not recommended that brine be applied

Note:

BRINE APPLICATIONS. (1) Time initial and subsequent brine applications to prevent deteriorating conditions or development of packed and bonded snow. (2) Apply brine ahead of traffic rush periods occurring during storm.

PLOWING. If needed, plow before brine applications so that excess snow, slush, or ice is removed and pavement is wet, slushy, or lightly snow covered when treated

Table 3. Weather event: light snowstorm with periods) of moderate or heavy snow

PAVEMENT TEMPERATURE RANGE AND TREND	INITIAL OPERATION			SUBSEQUENT OPERATIONS			COMMENTS
	Pavement surface at time of initial operation	Maintenance action	Brine application rate in Gallons per Lane Mile	Maintenance action	Brine application rate in Gallons per Lane Mile		
					Light snow	Heavier snow	
Above 32 degrees Fahrenheit. Steady or rising	Dry, wet, slush, or light snow cover	None, see comments		None, see comments			1)Monitor pavement temperature closely for drops toward 32 degrees Fahrenheit and below. 2)Treat icy patches if needed with brine at 40 gallons per lane mile. Plow if needed.
Above 32 degrees Fahrenheit 32 degrees Fahrenheit or below is imminent; *ALSO* **20 to 32 degrees Fahrenheit** Remaining in that range	Dry	Apply brine	40 gallons per lane mile	Plow as needed. Reapply brine when needed.	40 gals/lm	80 gals/lm	1)Application will need to be more frequent at lower temperatures and higher snowfall rates. 2)Do not apply brine onto heavy snow accumulation or packed snow. 3)After heavier snow periods and during light snowfall, reduce brine rate to 40 gallons per lane mile. Continue to plow and apply brine as needed.
	Wet, slush, or light snow cover	Apply brine	40 gallons per lane mile				
15 to 20 degrees Fahrenheit Remaining in that range	Dry, wet, slush or light snow cover	Do not apply liquids	Not applicable	Do not apply liquids			Apply only prewetted solid chemical (salt) in this temperature range

Note:
BRINE APPLICATIONS. (1) Time initial and subsequent brine applications to prevent deteriorating conditions or development of packed and bonded snow. (2) Anticipate increases in snowfall intensity and apply higher application rates prior to or at the beginning of heavier snowfall periods to prevent development of packed and bonded snow. (3) Apply brine ahead of traffic rush periods occurring during storm.

PLOWING. If needed, plow before brine applications so that excess snow, slush, or ice is removed and pavement is wet, slushy, or lightly snow covered when treated.

Table 4. Weather event: moderate or heavy snowstorm

PAVEMENT TEMPERATURE RANGE AND TREND	INITIAL OPERATION			SUBSEQUENT OPERATIONS		COMMENTS
	Pavement surface at time of initial operation	**Maintenance action**	**Brine application rate in Gallons per Lane Mile**	**Maintenance action**	**Brine application rate in Gallons per Lane Mile**	
Above 32 degrees Fahrenheit. Steady or rising	Dry, wet, slush, or light snow cover	None, see comments		None, see comments		1)Monitor pavement temperature closely for drops toward 32 degrees Fahrenheit and below. 2)Treat icy patches if needed with brine at 40 gallons per lane mile. Plow if needed.
Above 32 degrees Fahrenheit 32 degrees Fahrenheit or below is imminent; *ALSO* **30 to 32 degrees Fahrenheit** Remaining in that range	Dry	Apply brine	40 gallons per lane mile	Plow as needed. Reapply brine when needed.	40 gallons per lane mile	1)If the desired plowing/treatment frequency cannot be maintained, the application rate can be increased to 80 gallons per lane mile to accommodate longer operational cycles. 2)Do not apply brine onto heavy snow accumulation or packed snow.
	Wet, slush, or light snow cover	Apply brine	40 gallons per lane mile			
20 to 30 degrees Fahrenheit Remaining in that range	Dry	Apply brine	80 gallons per lane mile	Plow as needed. Reapply brine when needed	80 gallons per lane mile	1)If the desired plowing/treatment frequency cannot be maintained, the application rate can be increased to accommodate longer operational cycles. 2)Do not apply brine onto heavy snow accumulation or packed snow.
	Wet, slush, or light snow cover	Apply brine	80 gallons per lane mile			

Note:
BRINE APPLICATIONS. (1) Time initial and subsequent brine applications to prevent deteriorating conditions or development of packed and bonded snow. (2) Apply brine ahead of traffic rush periods occurring during storm.
PLOWING. If needed, plow before brine applications so that excess snow, slush, or ice is removed and pavement is wet, slushy, or lightly snow covered when treated.

Winter Operations Management

- Establish Levels of Service
- Create asset groups (roads, facilities, etc.) based on locations (e.g. region, community, etc.)
- Create work crews and assign asset groups to crews. Equipment Readiness, Staff Training, Policies and Procedures, etc.
- Have the right decision making tools
- Monitor progress using a computerized management system (e.g., GIS, GPS/AVL, etc.)
- Pre-Storm and Post Storm Meetings

Hamilton Township New Jersey

"America's Favorite Hometown"

Snow Plow Routing

Search by Address....

Current Status

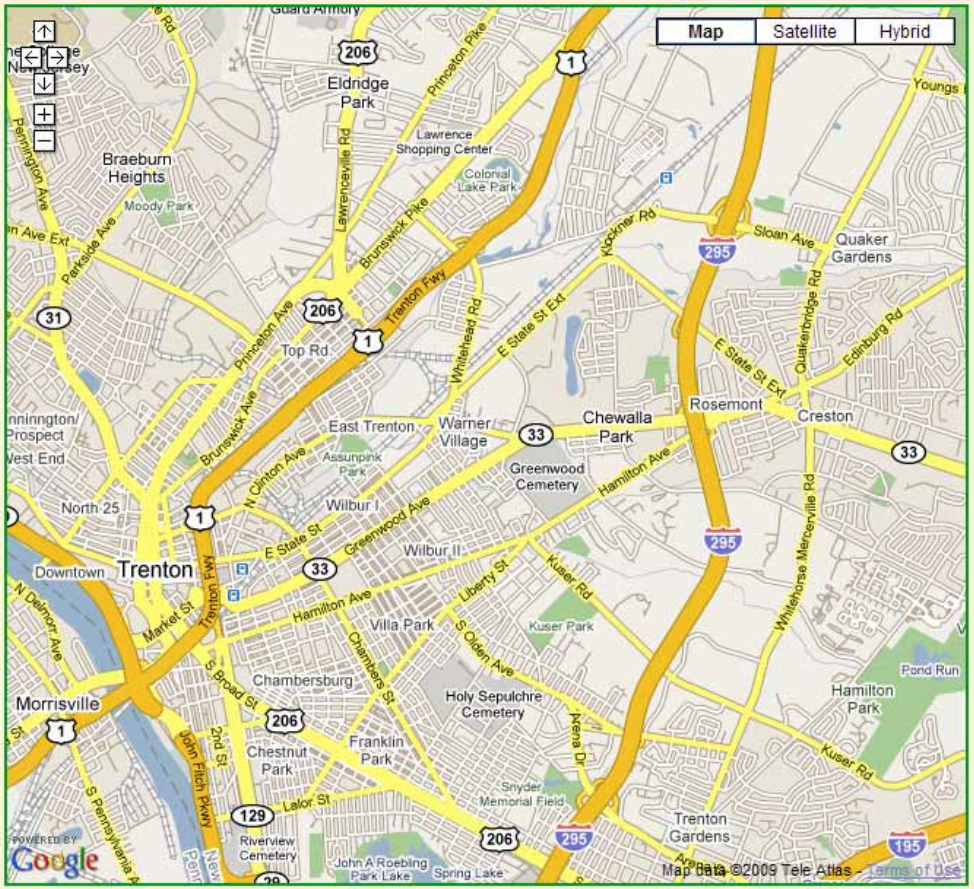
- Plowed
- Salted
- Current Location

Buildings

- Government
- Health
- Educational
- Church
- Fire Company
- Police Department
- Post Office
- Properties

Miscellaneous

- Ballfield
- Basin
- Hill
- Mini Park
- Park
- Playground




Hamilton Township
New Jersey
"America's Favorite Hometown"
Snow Plow Routing
Search by Address....
Current Status
Plowed
Salted
Current Location
Buildings
Government
Health
Educational
Church
Fire Company
Police Department
Post Office
Properties
Miscellaneous
Ballfield
Basin
Hill
Mini Park
Park
Playground

Documented Successes

- Using a Winter Operations Management Plan
  - Prior to implementing a comprehensive Winter Operations Management Plan, Hamilton Township was using about 9,000 tons of salt each winter. For the winter of 2004/2005, after implementing its Winter Operations Management Plan (which included equipment preparedness (calibration), even with more events and 6 inches of additional snowfall, Hamilton reduced its salt usage by approximately 67% from the previous winter.