

Ice & Snow

<https://www.youtube.com/watch?v=4MJv6b0q6WI>

The competing interests of snow removal

- › Cost
- › Safety
- › Environment

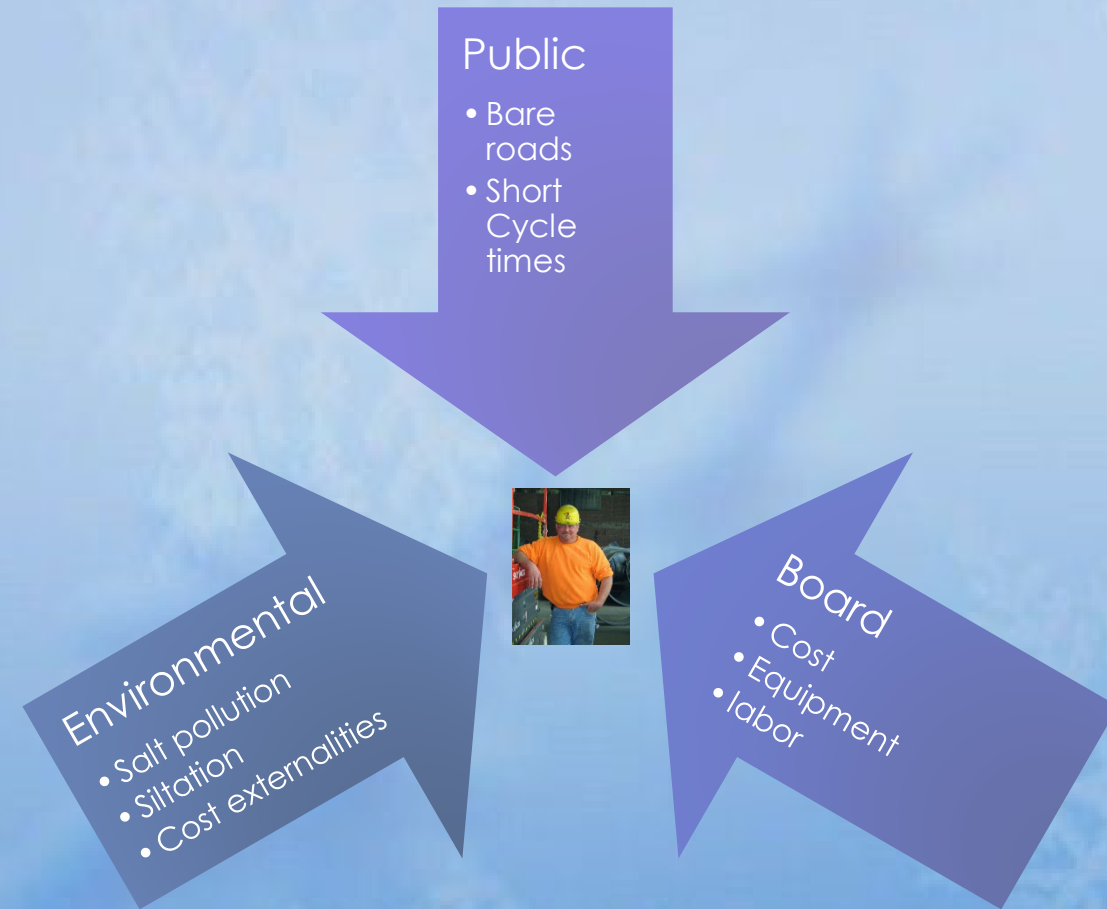
The use of **sand** will cause buildup of sediment and turbidity in waterways impacting aquatic ecosystems negatively. There have been studies by **ecological** experts that have concluded that the detrimental **environmental effects of sand** generally outweigh those of ice melting chemicals.

<https://www.cargill.com> › salt-vs.-sand-for-winter-road-sa... ⋮

What are the environmental impacts of road salt? ^

But it can also have serious, negative effects on aquatic ecosystems. At high concentrations, salt can be fatal to some aquatic animals. Salt can also change the way the **water** mixes and lead to the formation of salty pockets near the bottom of lakes, creating biological dead zones.

<https://www.queensu.ca> › gazette › alumnireview › stories



Current issues

- › Fund for lake George doing research on road salt
 - Since 2015, The **FUND** has invested over \$550,000 in reducing **road salt** use. This includes investments in training, application rate assessment, and other studies informing **salt** reduction.
- › The Hidden Dangers of Road Salt, Smithsonian 2017
- › Paul Smiths college studying the impact winter highway maintenance has in the Adirondacks
- › Some studies show the outbreak of harmful algae bloom's linked to road salt.
- › 2021 NYS passes the salt reduction act
- › 2022 Salt task force starts meeting

History

- › Originally
 - Remove drifts
 - Pack down remaining snow
- › Plow trucks only plowed
 - Cinders were often provided in barrels at hills
 - They only plowed after a storm
 - Never during a storm
- › 1970's converted to trucks that plowed and sanded at the same time
- › 1980 olympics in lake placid



Communicating: Ice & Snow Plan

- › Document to create discussion
 - Mutually agreed upon expectations

Current theory and practice

› Today

- Mechanically remove snow
 - › When and how often (whenever it is accumulating on road 4am to 8pm)
 - › Cycle times (3.5 hours)
 - › Efficiencies of the plow (equipment)
- Treat the remaining snow (treatment material and application rate)
 - › Abrasives for traction
 - Quality and Quantity of Sand
 - › Chemically remove snow
 - Salt
 - Brine
 - Mag chloride
 - Calcium chloride
 - Ag Products

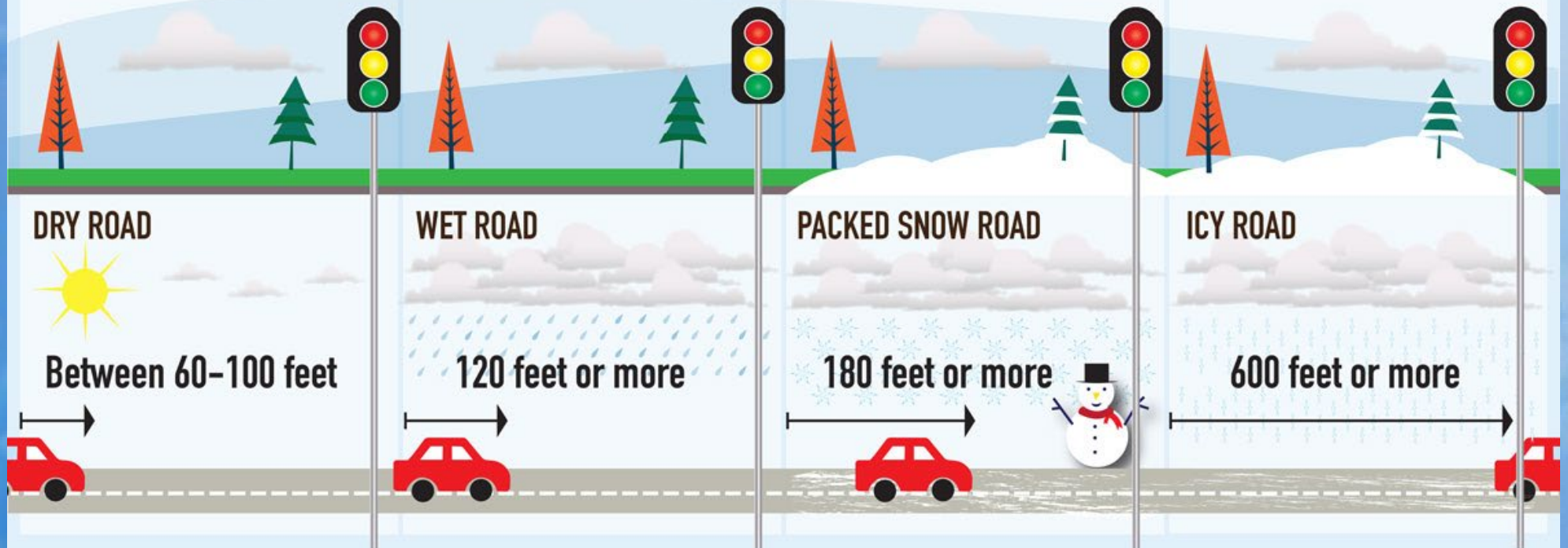
Each year, the **state** generates some 17 billion pounds of **salt** worth about \$600 million. The **salt is used** for all kinds of things, not just **roads**. The proximity of large **salt** supplies to **New York highways** may **have** made it easier for **salt** to become the **road** chemical of choice two centuries later. Dec 21, 2020

<https://www.adirondackexplorer.org> › stories › curbing... ▼

What do you think your goals should be

STOPPING DISTANCE IN DIFFERENT WEATHER

For a car traveling 35 mph, the thinking and braking distance increases as weather worsens.



Questions

- › What is your cycle time
- › How often do you plow per year (trips)
- › How many lane miles per trip (miles x 2)
- › What is your application rate
- › What material are you using
 - 3:1 Sand/Salt
 - 7:1 Sand/Salt
 - Salt
 - Straight Sand

Calculating Application Rates

- › Trips x mileage = lane miles / tons = application rate
- › $\frac{200}{\text{trips}} \times 136 \text{ (Lane mile)} = 27,200 \text{ (lane miles plowed)} / 5,440 \text{ tons per year} \times 2000\text{lbs} = 10,880,000\text{lbs} = \underline{400\text{lbs}}$ (application rate)
- › Trips x mileage = lane miles x application rate = tons
- › $\frac{200}{\text{trips}} \times 136 \text{ (Lane mile)} = 27,200 \text{ (lane miles plowed)} \times \underline{400\text{lbs}} = 10,880,000\text{lbs} / 2,000 = 5,440 \text{ tons per year}$

Level of Service

- › We can't control
 - how often we plow (set by level of service & weather)
 - how many miles we plow
- › We can control
 - The equipment (cycle times)
 - the mixture
 - the application rate

Equipment Considerations

› Equipment

- 10-wheel or 6-wheel truck (how many) ($\text{miles} \times \text{avg speed} = \text{cycles}$)
 - › Length of route will determine amount of material needed
- Center discharge or side discharge (material placement)
- Adjustable discharge doors (spread pattern)
- Front or rear spreader (traction vs. truck life)
- Chain or auger (spread pattern & material used)
- Single or dual wing (traffic volume & cycle time)
- One person or two person plowing (single or dual wing)
- Plow controls (cable, air, electric)
- Material application controllers (application rate)
- Weather Sensors (data driven application)

› Cutting edges

- Steel
- Carbide
- Rubber
- Sectional incased in rubber
- Live Edge
- Secondary plow
- Two Stage Plows



Material Selection

- › Salt \$50.00 per ton
 - Are there externalities (other costs)
 - › Environmental
- › Sand \$3.80 per ton
 - Are there externalities (other costs)
 - › Hauling costs
 - › Clean up costs – Sweeping roads
 - › Maintenance costs – Cleaning drainage features
 - › Environmental-Sedimentation

Adirondack Daily Enterprise

Sanding roads may cost more than salting

Last week's article discussed some of the things to consider when deciding whether to sand roads for snow and ice control or abrasives, such as sand. Most people would guess sanding roads with abrasives is far cheaper than using salt. Maybe not!

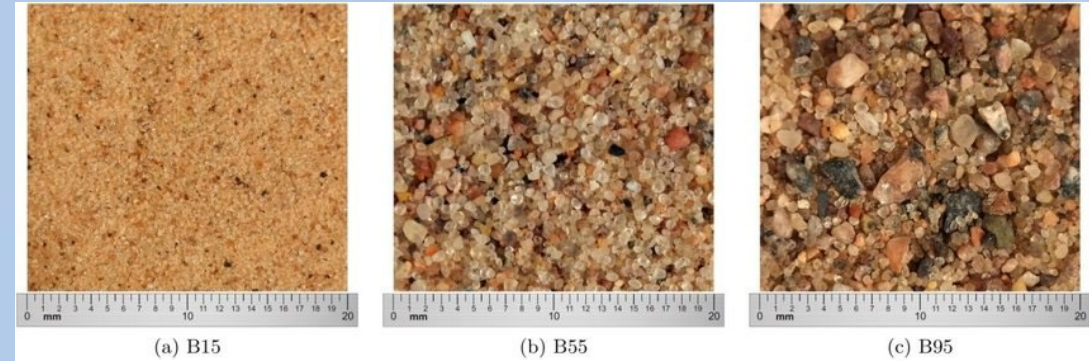
Toolbox

› Sand

- Round or crushed
- Screened...Size
- Washed (No Fines)
- DOT Spec
- Cost of use vs. purchase cost

› Salt

- Treated Salt



Road salt is commonly **used** to melt ice on **roads** and sidewalks during the winter, making it safer for people to travel after snowstorms. And **New York uses** a lot of **road salt** – almost 2 billion pounds per year. Sep 25, 2020

<https://nylcv.org> › news › nys-set-to-create-an-adirondack... ⋮

Toolbox

› Salt Brine

- Anti-Icing (pretreat)
- De-Icing (prewet)
- Guide

› Enhancements

- Mag Chloride – (Lower eutectic temp of salt)
 - › More corrosive
 - › Works at lower temp than salt
- Agricultural Sugars – (Tackifier)
 - › Beet Juice
 - › Sugar Cane
 - Salt treated with AG products reduces bounce and scatter by up to 50%
 - Corrosion reduction



Mixes and application rates

3:1 Sand Salt @ 400lbs = 300 lbs. of Sand (traction)
100 lbs. of Salt (chemical removal)

7:1 Sand Salt @ 400lbs = 350 lbs. of Sand (traction)
50 lbs. of Salt (chemical removal)

What is the controlling Factor?

Sand

Salt

Mixes and application rates

3:1 Sand Salt @ 400lbs = 300 lbs. of Sand (traction)
100 lbs. of Salt (chemical removal)

7:1 Sand Salt @ 400lbs = 350 lbs. of Sand (traction)
50 lbs. of Salt (chemical removal)

3:1 Sand Salt @ 200lbs = 150 lbs. of Sand (traction)
50 lbs. of Salt (chemical removal)

LIGHT SNOW
(Less than ½"/hour; visibility > ½ mile)

Surface Temp. Range (° F)	Surface Condition	Initial Maintenance Action	Dry Rock Salt Lbs./lm.	Pre-Wetted Rock Salt Lbs./lm	Follow Up Action	Follow Up Rock Salt Lbs./lm	Follow Up Pre- Wetted Rock Salt Lbs./lm	Comments
Above 32	Wet, slush or light snow covered.	Patrol and spot treat as needed. See comments.			Patrol and spot treat as needed. See comments.			1) Monitor pavement temperature for drops toward 32 F. 2) Blast isolated icy patches with salt, treat slushy areas beginning to freeze with 180 dry/160 pre-wet, lbs./lm and plow as needed
Above 32, but dropping to 32 or below soon.	Dry	Apply pre-wetted rock salt or direct liquids. Patrol and spot treat as needed. See comments.		160	Patrol and spot treat as needed. See comments.			1) Monitor pavement temperature and precipitation and select appropriate follow up as conditions change.
Above 32, but dropping to 32 or below soon.	Wet, slush, or light snow covered.	Apply pre-wetted or dry rock salt, plow as needed.	180	160	Plow and re-apply pre-wetted or dry rock salt as needed.	115	100	1) Application will need to be more frequent at lower temperature and higher snowfall rates. 2) Adjust application rates as surface conditions and precipitation intensities change.
23 to 32	Dry	Apply pre-wetted rock salt or direct liquids.		160	See comments.			1) Monitor pavement temperature and precipitation and use select appropriate follow up as conditions change.
23 to 32	Wet, slush or light snow covered.	Apply pre-wetted or dry rock salt, plow as needed.	200	160	Plow and re-apply pre-wetted or dry rock salt as needed.	115	100	1) Application will need to be more frequent at lower temperature and higher snowfall rates. 2) Adjust application rates as surface conditions and precipitation intensities change.
15 to 23	Wet, slush or light snow covered.	Apply pre-wetted rock salt, plow as needed.	250	200	Plow and re-apply pre-wetted rock salt as needed.	180	160	1) If sufficient moisture is present, dry rock salt can be applied. Dry pavement at these temperatures is better left untreated if snow does not track to surface.
Below 15	Dry or light snow covered. Wet and Snow/ice/slush	Plow as needed. If previous salt applications made, plow and apply pre-wetted rock salt as needed.		200	Plow as needed. If previous salt applications made, plow and re-apply pre-wetted rock salt as needed.		160	1) Abrasives can be applied to enhance traction, a heavy salt mix will create glazing. Refer to Snow & Ice Guidelines Section 5.4406 (B) for abrasive application rates. Apply rock salt in anticipation of rising temperatures. 2) If salt had been applied prior, continue with pre-wet salt as needed.

Notes: 1) Rush Period Traffic on high volume highways may require more aggressive initial treatments. 2) Use weather information to anticipate changes in storm intensity, precipitation type, and surface temperatures; Use appropriate guideline for heavier intensity or precipitation type change. 3) Rates may need to be increased if cycle times are longer than normal. 4) In the event of hard pack or icing development, adjust application rates as needed. 5) For pre-storm anti-icing operations, refer to direct liquid chemical application guides lines. Consider use of follow-up application rates for initial maintenance action if pre-storm liquid anti-icing is effective.

MODERATE OR HEAVY SNOW

(Moderate: ½" – 1"/hour; visibility ¼ to ½ mile) (Heavy: More than 1"/hour; visibility < ¼ mile)

Surface Temp. Range (° F)	Surface Condition	Initial Maintenance Action	Dry Rock Salt Lbs./lm.	Pre-Wetted Rock Salt Lbs./lm	Follow Up Action	Follow Up Rock Salt Lbs./lm	Follow Up Pre-Wetted Rock Salt Lbs./lm	Comments
Above 32	Wet, slush or light snow covered.	Patrol and spot treat as needed. See comments.			Patrol and spot treat as needed. See comments.			1) Monitor pavement temperature for drops toward 32 F. 2) Blast isolated icy patches with salt, treat slushy areas beginning to freeze with 180 dry/160 pre-wet, lbs./lm and plow as needed.
Above 32, but dropping to 32 or below soon.	Dry	Apply pre-wetted rock salt or direct liquids. Patrol and spot treat as needed. See comments.		160	Patrol and spot treat as needed. See comments.			1) Monitor pavement temperature and precipitation and select appropriate follow up as conditions change.
Above 32, but dropping to 32 or below soon.	Wet, slush, or light snow covered.	Apply pre-wetted or dry rock salt, plow as needed.	180	160	Plow and re-apply pre-wetted or dry rock salt as needed.	180	160	1) If normal cycle times can not be maintained, the application rates can be increased to 220 dry/180 pre-wet, lbs./lm to accommodate longer cycles.
					Slushy Conditions	115	100	
23 to 32	Dry	Apply pre-wetted rock salt or direct liquids.		160	See comments.			1) Monitor pavement temperature and precipitation and use select appropriate follow up as conditions change.
23 to 32	Wet, slush or light snow covered.	Apply pre-wetted or dry rock salt, plow as needed.	200	160	Plow and re-apply pre-wetted or dry rock salt as needed.	200	160	1) If normal cycle times can not be maintained, the application rates can be increased to 250dry/200 pre-wet, lbs./lm to accommodate longer cycles. 2) See notes below.
					Slushy Conditions	115	100	
15 to 23	Wet, slush or light snow covered.	Apply pre-wetted rock salt, plow as needed.	250	200	Plow and re-apply pre-wetted rock salt as needed.	250	200	1) If normal cycle times can not be maintained, the application rates can be increased to 325 dry/250 pre-wet, lbs./lm to accommodate longer cycles. 2) See notes below.
					Slushy Conditions	200	100	
Below 15	Dry or light snow covered.	Plow as needed.			Plow as needed.			1) Abrasives can be applied to enhance traction, a heavy salt mix will create glazing. Refer to Snow & Ice Guidelines Section 5.4406 (B) for abrasive application rates. Apply rock salt in anticipation of rising temperatures.
	Wet and Snow/ice/slush	If previous salt applications made, plow and apply pre-wetted rock salt as needed.		200	If previous salt applications made, plow and re-apply pre-wetted rock salt as needed.		160	2) If salt had been applied prior, continue with pre-wet salt as needed.

Notes: 1) Rush Period Traffic on high volume highways may require more aggressive initial treatments. 2) Use weather information to anticipate changes in storm intensity, precipitation type, and surface temperatures; Use appropriate guideline for heavier intensity or precipitation type change. 3) Rates may need to be increased if cycle times are longer than normal. 4) In the event of hard pack or icing development, adjust application rates as needed. 5) For pre-storm anti-icing operations, refer to direct liquid chemical application guides lines. Consider use of follow-up application rates for initial maintenance action if pre-storm liquid anti-icing is effective.

Future of the Industry

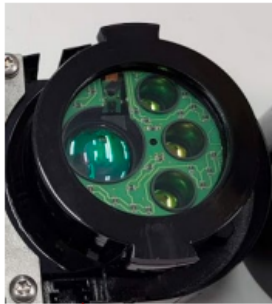
- › A good operator knows:
- › Different applications are needed depending on.....
 - Road Temperature
 - Air Temperature
 - Future Temperature (ie.. Temperature rising or falling)
 - Humidity
 - Intensity of the sun
 - Tree Cover
 - Wind & Drifting
 - Traffic Volume

Future of the Industry

- › All those variables are called Microclimates
 - And better sensors can detect them and more
- › Artificial Intelligence
 - Can Aggregate the experience of great operators
 - › Plus Science
- › Plows can be programmed to be Micro Adjustable

Future of Industry

What does MD30 measure & why it helps in winter maintenance?



“DSC311” (3 lasers + receiver)

- **Grip:** Is road slippery?
 - One easy number to understand if everything ok right now
- **Road state:** What causes it?
 - Wet road needs different treatment than icy/snowy road
- **Layer thickness of water, ice, snow:** Big or small amount?
 - More thickness, more treatment (salt) needed



HMP113 sensor (Humicap + Pt100)

- **Air temperature**
- **Relative humidity**
- **Dew point and frost point**

How cold road can be before dew or frost starts forming to the road?

“MT10” sensor (IR detector like DST)

- **Road temperature:** Is road cold?

If road is colder than dew or frost point, treatment is needed to avoid slippery road

Communicating: Ice & Snow Plan

- › Document to create discussion
 - Mutually agreed upon expectations
- › Resources
 - https://www.clrp.cornell.edu/assistance/all_info/wm.html
- › Template
 - <https://cornell.app.box.com/v/plan1>
- › Start with an inventory of what you currently do!

Communicating: Ice & Snow Plan

- › Start with an inventory of what you currently do!
 - How many lane miles do you plow
 - › Any unimproved (limits material selection)
 - When do you plow
 - › How much snow
 - › What hours
 - How many routes
 - › How much equipment
 - Condition
 - Spares

Ice & Snow Plan

- › What are your objectives
 - Ie... bare roads
 - Hard pack with less then 3" of snow
- › What resources do you need to meet them
 - Trucks
 - Material
 - labor

Ice & Snow Plan

- › What are your cycle times
 - 3.5 hours is Typical for Town and County
- › Do you have inside Storage
- › What Material do you use
 - Sand
 - › What type
 - Sand Salt mix
 - › 3:1
 - › 7:1
 - Salt
 - Brine

Bench Marking

- › Cycle time
- › Salt Application
- › Sand Application



- › Neighboring municipalities
- › State standards
- › Scientific recommendations
- › Common sense

NYS Dot Objectives

5.3201 Snow Control Goals – Regular Level of Service

Highway Class	Recommended Maximum Allowable Accumulation During a Storm (Inches)	Elapsed Time After Event End That Full Width of Pavement Should be Cleared (Hours)
A1	2.0	1.5
A2, B, C	2.5	2.0

5.3202 Snow Control Goals – Modified Level of Service

Highway Class	Recommended Maximum Allowable Accumulation During a Storm (Inches)	Elapsed Time After Event End That Full Width of Pavement Should be Cleared (Hours)
A1	2.5	2.0
A2, B, C	3.5	3.0

Plowing should begin as soon as there is enough snow on the pavement to plow. Do not wait for the Recommended Maximum Allowable amounts to be reached before the plowing operation commences.

Take Aways

- › Don't do it Alone
 - Involve Board
 - Public
- › Don't make it personal
 - It is about education