Salt Reduction Plan

City of Portsmouth, NH

Department of Public Works

PREPARED FOR

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Introduction

The City of Portsmouth has prepared this Salt Reduction Plan to address the Appendix H requirements included in the 2017 NH Municipal Separate Storm Sewer System (MS4) Permit for areas draining to water bodies listed as chloride impaired. This Plan describes current and future planned Best Management Practices (BMPs) designed to increase the effectiveness and efficiency of winter road maintenance practices and ultimately reduce the amount of chloride discharged from City-maintained and privately-maintained, commercial properties that drain to inland water bodies considered to be impaired due to elevated chloride levels. This Salt Reduction Plan (SRP) was based on the information and practices contained in the SRP template developed for the Seacoast Stormwater Coalition by the NH Department of Environmental Services (NHDES) and posted on their web site NHDES MS4 Blog.

1.1 MS4 Permit Requirements

Part IV of Appendix H of the 2017 NH MS4 permit requires regulated municipalities to develop a Salt Reduction Plan (SRP) that identifies measures and activities that the City will adopt to reduce chloride inputs associated with winter maintenance operations to waters listed as chloride-impaired. The permit requires the SRP be completed by the end of Year 3 (June 2021) and be fully implemented by the end of Year 5 (June 2023). The Plan must describe current deicing practices and planned future efficiency measures to be used on municipally maintained roadways and parking lots.

Specifically, Part IV of Appendix H requires the following actions:

1. Track and report the amount of salt applied to all municipally owned and maintained surfaces a using the University of New Hampshire (UNH) Technology Transfer Center online tool (http://www.roadsalt.unh.edu/Salt/) beginning in the Year 2 Annual Report. See Instructional Video: Filing Annual Salt Usage Reports in the New Hampshire Salt Management System Tutorial - YouTube
2. Identify and develop a schedule for implementing any planned activities for salt reduction on municipally owned and maintained surfaces, which may include but are not limited to:
   a) Operational changes such as pre-wetting, pre-treating, increasing plowing prior to de-icing, monitoring of road surface temperature, etc.
   b) Implementation of new or modified equipment to enhance pre-wetting capability, improve calibration procedures, or other capability for minimizing salt use.
   c) Enhanced training for municipal staff and contractors engaged in winter maintenance activities.
   d) Improved calibration of spreading equipment.
   e) Designation of no-salt and/or low salt zones, as appropriate.
   f) Adoption of guidelines for application rates for roads and parking lots based on relevant approved guidance manuals

g) Enhanced public education messages to discuss impacts of salt use, methods to reduce salt use on private property and driving behavior in winter weather.

h) Enhanced measures to prevent exposure of salt stockpiles (if any) to precipitation and runoff (may include private property as well)

The MS4 Permit does not impose specific salt reduction targets but instead requires municipalities to adopt operational Best Practices and implement equipment upgrades that will result in more efficient use of salt use that would lead to salt use reductions in watersheds of chloride impaired water bodies.

Measuring the effect that future operational and/or equipment changes may have on salt use can be challenging given how variable weather can be from one year to the next. A key first step is having a thorough understanding of the typical baseline usage under a variety of winter weather conditions with the current equipment and operational practices used by the City to maintain its roads, parking lots and sidewalks. Recently, the New Hampshire Department of Transportation (NHDOT) has been using a Winter Severity Index (WSI) to assess the relative severity of each winter season and how annual salt use changes with the relatively severity from year to year. The WSI accounts for various weather-related factors such as snowfall depth and maximum and minimum daily temperatures. Depending on how closely the annual salt usage correlates to the seasonal WSI value over a long-term period, the WSI can then be used to assess the effects of various efficiency measures may have on annual salt use going forward in future years as opposed to the effects of winter weather. This is discussed in more detail in Section 2.0 herein.

1.2 Chloride Impaired Waters in Portsmouth

Table 1.1 identifies six (6) stream assessment units within the City that are listed as chloride-impaired according to the state's 2018 303(d) impaired water list. See Attachment 1 to review maps prepared by NH Department of Environmental Services (NHDES) that show City roads that are located within 500 feet and are assumed drain to each of the listed chloride impaired stream segments or Assessment Units.

Table 1.1 Chloride Impaired Streams within the City of Portsmouth

Stream Name	Assessment Unit #	Stream Length (miles)
Sagamore Creek	NHRIV600031001-03	1.0
Lower Hodgson Brook	NHRIV600031001-04	0.9
Upper Hodgson Brook	NHRIV600031001-05	1.5
Pickering Brook	NHRIV600030904-06	6.4
Borthwick Ave Tributary	NHRIV600031001-09	1.3
Newfields Ditch	NHRIV600031001-10	1.3

It is important to note that each of these impaired stream segments, except Sagamore Creek, have a considerable amount of state-maintained roadway and/or extensive commercial parking areas within their watershed areas. This is especially true for Lower Hodgson Brook, Pickering Brook and the Borthwick Ave tributary where segments of the Interstate 95 (an 8 to 10 lane roadway), traverses through their watersheds.

2

Current Operational Practices and Maintained Areas

2.1 Roadway Network/City Parking Lots

Table 2.1 provides a summary of the estimated amount of City road miles and lane-miles that drain to estuarine brackish water and those that drain to inland freshwater streams as well as streams listed as chloride impaired. Of the 242 lane-miles of roadway that the City maintains, slightly more than half (~54%) drain to estuarine brackish waters while the remaining 46% of the roadway lane-miles drain to freshwater streams. Approximately 85 lane-miles or 35% of the City's total roadway lane-miles are in watershed areas that drain to a chloride-impaired water. The City also maintains 77 miles of sidewalks and 15 acres of parking lots that are mostly within the downtown area that drain to estuarine waters.

Table 2.1 Estimated City Winter Maintained Road Miles and Lane-Miles Draining to Various Water Bodies

	Waterbody Name		City Roads		
Assessment Unit_ID	Estuary	Chloride Impaired	Centerline (mi)	Lane Miles	% of Total
TIDAL/ESTUARY					
NHEST600031001-02	Lower Piscataqua River		10.1	19.4	
NHEST600031001-03	Upper Sagamore Creek*		19.1	39.0	
NHEST600031001-04	Lower Sagamore Creek		3.0	6.0	
NHEST600031001-05	Back Channel		7.5	15.2	
NHEST600031001-09	South Mill Pond		6.5	12.9	
NHEST600031001-10	North Mill Pond		19.4	39.0	
	Estuary Subtotal:		**65.6**	**131.5**	**54%**
FRESHWATER					
NHRIV600030904-06	Pickering Brook*	x	5.2	10.6	
NHRIV600031001-02	Unnamed Brook-Piscataqua		7.1	14.8	
NHRIV600031001-04	Lower Hodgson Brook*	x	4.0	8.1	
NHRIV600031001-05	Upper Hodgson Brook*	x	7.9	16.0	
NHRIV600031001-06	Grafton Ditch		4.6	9.2	
NHRIV600031001-10	Newfields Ditch*	x	4.0	7.7	
NHRIV600031002-01	Berry's Brook		5.7	11.0	
NHRIV600031001-09	Borthwick Ave. Tributary*	x	16.6	33.2	
	Freshwater Subtotal:		**55.2**	**110.7**	**46%**
		Total:	**120.8**	**242.1**	
		Chloride Impaired Lane-Miles:		**84.8**	**35%**

Source: Lane-mile estimates were provided by City DPW based on City mapping data. *Indicates a chloride-impaired water body

Most of the roadway area that drains to chloride-impaired waters is in the western portions of the City near or within the Pease International Tradeport and near the Town of Greenland (see watershed maps in Attachment 1). NHDOT has a considerable amount of roadway area associated with I-95 and the Spaulding Turnpike (Route 16) that are located upgradient of these freshwater streams.

2.2 City Snow and Ice Control Policy

The City relies on plowing as the primary means of clearing roads and parking lots. The City has 27 plow routes with the higher priority areas centered around the roadways near schools and the main travel ways to the hospital. However, plowing alone is not always enough to maintain reasonably safe travel conditions. Often the application of road salt or other deicing chemicals is needed to prevent the snow and ice from bonding to the pavement and creating hazardous travel conditions. The timing and frequency of deicing applications depends on many weather-related factors including snowfall intensity, storm duration, temperatures as well as other factors such as the time of day and traffic volumes. The City has recently begun using salt brine to pretreat roads along the higher priority routes to help prevent ice pack from building up on the road surface.

2.3 Deicing Material Usage

The amount of salt used year to year is primarily depends on the severity of winter weather that occurs each year. However, the ability to use salt most efficiently, meaning using just the right amount at the right time, is influenced by various equipment and operational factors including the type, age and condition of equipment used, type of spreader control mechanisms, calibration methods, extent of operator training application policies, use of weather forecast and road surface monitoring data, and use of liquid deicing material. Automated spreader controls that adjust application rates based on truck speed and spreader settings and the use of liquid deicers to prewet salt and/or pretreat roads are perhaps the two of the more effective operational factors for using road salt more efficiently. Having access to real-time weather and road condition data is also an important operational aspect to minimizing salt usage. The City has purchased hand-held temperature sensors to monitor air and pavement temperatures. Access to real-time weather forecast and road condition data is essential for determining when deicing material is and is not needed. Needless to say, the amount of road salt used each winter can be highly variable from year to year depending on air and pavement temperatures, precipitation type and amount, freeze and thaw cycles, the number, duration and timing of snow events, and the overall snowfall totals.

Several state transportation agencies, including the NHDOT, have used a Winter Severity Index (WSI) to compare and explain differences in annual salt usage from year to year as well as to assess salt use efficiency relative to the severity of winter weather. The WSI methodology accounts for daily snowfall and maximum and minimum air temperatures. The same methodology was used to calculate an annual WSI value for Portsmouth over the last 8 years using daily weather data recorded at the National Weather Service (NWS) weather station located in nearby Greenland, NH. This daily weather was accessed and downloaded from the Northeast Regional Climate Center's (NRCC) online portal from November thru March for fiscal years 2014 to 2020.

Table 2.2 provides a comparison of the seasonal WSI and annual salt usage in Portsmouth for the last 8 years based on salt purchasing records. Purchasing records may not always accurately reflect the actual salt usage for that particular season since some of the purchased salt may be carried forward into the next year especially when purchased late in the season. In review of the data, certain late-season purchases were assumed to be carried into the following winter. Some of the purchased salt may also be used to manufacture salt brine and not be applied as regular road salt on roadways.

In the last 8 years going back to FY14, the City's average annual salt usage ranged from approximately 3,500 tons during mild winters with about 40 inches of snow to approximately 5,000 tons during a more severe winters with more than 60 inches of snow. Last winter (FY21), which was the 2nd mildest winter in the last 8 years, the City used approximately 3,200 tons of road salt, which results in an annual seasonal application rate of approximately 14.8 tons per lane mile, assuming that all of this salt was applied to roadways and not accounting for material usage on parking lots and sidewalks. The City recently began using salt brine to pretreat select roads prior to or at early onset of a winter storm.

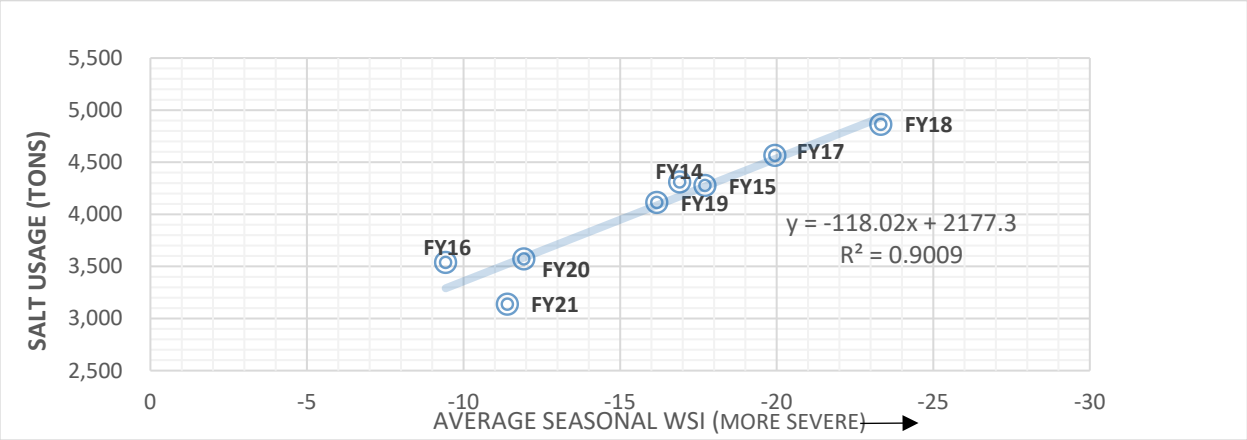
Table 2.2 Summary of Adjusted Annual Salt Use (tons) by Snowfall and WSI

Fiscal Year	Purchased Salt (tons)	Adjusted Salt Usage (tons)	Annual Snowfall (inches)	Annual WSI	WSI Rank
FY21	--	3,139	41.7	-11.40	7
FY20	3,955	3,573	39.8	-11.93	6
FY19	4,121	4,325	43.6	-16.17	5
FY18	5,069	5,069	69.4	-23.32	1
FY17	4,567	4,567	67.3	-19.94	2
FY16	3,538	3,538	42.3	-9.43	8
FY15	3,585	4,391	47.1	-16.90	4
FY14	5,084	4,278	65.5	-17.71	3
Average	**4,274**	**4,249**	**54.0**	**-16.50**	**--**

Notes: Annual salt use totals were adjusted higher in FY15 and lower in FY14 and FY20 to account for late season salt purchases in March-April to the next season; Winters with lower or more negative WSI values represnet more severe winters: WSI Rank = 1 means most severe winter while highest rank means least severe winter

Figure 2.1 illustrates how the City's annual salt usage correlates to the severity of winter weather as indicated by the WSI value for the last eight (8) years. The regression analysis shows that the City's annual salt use closely tracks and correlates with WSI values from year to year. In fact, based on the correlation coefficient (R2) value of 0.90, approximately 90% of the year to year variability in annual salt usage can be explained by differences in the WSI values. The correlation between salt use and WSI appears strongest in the more severe winters when WSI values are below -15 and weakest or more variable in milder winters when WSI values are around -10 such as in FY16, FY20 and FY21. This is most likely due the fact that the winter severity calculation is influenced more by daily snowfall values and not as sensitive or influenced by freezing rain events that often occur during milder winters. Thus, any salt applications in response to freezing rain events may not be reflected in the WSI value.

Figure 2.1 Regression Analysis of Annual Salt Use (tons) to Winter Severity Index (WSI) for FY14 to FY21



Prior to FY21, annual salt use totals were based on purchasing records with some minor adjustments for fiscal years FY20, FY15 and FY14 where late season (April) purchases were added into next season's total. These adjustments improved the correlation with the relative winter severity values for each of these years. The annual salt usage for FY21 was based on recorded usage data provided by the DPW, which should be the preferred method for recorded future salt usage going forward.

It is worth noting that FY21 had a similar WSI value as FY20, however, the salt use in FY21 was about 340 tons or approximately 10% lower than that used in FY20 and was lower than that used in FY16 which was even milder. This reduced amount could be in part due to the newly established use of salt brine to pretreat many of the City roads prior to storms as well as other efficiency measures or it could be due to other winter weather related factors not adequately included in the WSI value. Salt use in future years should continue to be monitored relative to the WSI value and compared to previous years with similar WSI values. Lower salt use for similar WSI values would suggest that the recent efficiency measures are having a positive effect that have led to salt reductions.

2.4 Current Snow and Ice Control Equipment and Related Measures

The City primarily uses its own equipment and drivers to plow and apply deicing materials. The City relies mostly on plowing for clearing roads. The City currently has 32 plow trucks, 10 salt spreaders and 5 sidewalk tractors that are equipped with both plow and material spreader apparatus. During unusual severe storms, City may seek additional assistance from hired contractors to mostly plow or provide snow removal and hauling services.

As mentioned above, the City recently acquired two (2) brine trucks to enable pretreatment of roads with salt brine prior to or at the onset of a winter storm. Pretreating roads can help prevent snow and ice from bonding to the pavement and thus allowing more time to plow and potentially delay the first road salt application. As indicated in Table 2.2, pretreating roads with salt brine can potentially reduce salt use by as much as 20% compared to conventionally treated roads. The City currently has three (3) brine trucks for pretreatment which provides capacity to pretreat several of the larger and more heavily traveled roads. Due to the pretreatment applications, the road surface conditions on these

roads have been shown to visibly improve at least in the early stages of the storm, which lowers the demand for more late storm deicing applications.

2.4.1 Spreader Calibration

The City's material spreaders are calibrated at the beginning of each winter season and spreader controller settings are set to achieve a targeted material application rate. NHDES has developed calibration instructions and a calibration recording chart that can be kept with each vehicle following calibration (see Attachment 3), Material spreaders should be rechecked periodically throughout the season to assess whether controller settings or gate openings have been modified, which would warrant recalibration.

2.4.2 Ground Speed Controllers

The City's spreader trucks are equipped with either open-loop and closed-loop ground speed controllers to maintain consistent application rates regardless of truck speeds. Open-loop controllers have been around much longer, are generally simpler and can be set to maintain a desired application rate that adjusts to truck speed. Closed-loop ground speed controllers are more advanced and adjust the spreader application rate based on truck speed and auger or belt speed to maintain a more consistent application rate. The closed-loop controllers have become more standard with newer equipment upgrades. The City recently purchased two new spreader trucks with closed-loop ground-speed controllers.

2.4.3 Pavement Temperature Sensors

Pavement temperature sensors have been installed on most of the City's patrol vehicles to help monitor pavement temperatures, which is more critical than air temperatures in determining when deicing applications may be needed and when they may not. The risk of ice development is more dependent on pavement temperatures as compared to air temperatures.

2.4.4 Employee Training

Training municipal personnel on best winter maintenance and salt reduction practices may be the most effective practice you can employ to ensure your team is successful in reducing salt usage. The City conducts both in-house training and allows City snow and ice personnel to attend Green SnowPro™ Training as well.

The Green SnowPro™ training is managed by NHDES and involves both a full course and a refresher course. The full course is a 4-hour course with an exam. The refresher course is 2 hours, and reviews basic practices, with a focus on key salt use efficiency measures such as pretreatment and prewetting using brine, equipment calibration, and adjusting application rates. The Green SnowPro™ certification is currently targeted to commercial applicators but the training aspects are similarly relevant to municipal operations. More information can be found at the NHDES web site NHDES Green SnowPro Program

Employee training attendance should be documented using the Training Log template included in **Attachment 2.**

As discussed more below, municipalities and commercial salt applicators are asked to independently track their salt use as measured in tons of salt per acre per year and establish a voluntary system for and provide information annually to the salt accounting system.

2.4.5 Salt Storage/Snow Removal/Snow Storage

2.4.5.1 Snow Removal: The City routinely removes snow from sidewalks and parking areas in the downtown area as soon after major snowstorms as feasibly possible. The snow is stored at a designated snow dump area located behind the DPW facility. This snow dump area has several stormwater treatment BMPs to collect and treat snow melt during warmer weather and eventually drains to Berry's Brook.

2.4.5.2 Salt Storage: **The City maintains a salt storage facility at the DPW site and generally uses the following best practices:**

- Road salt is under cover in a 3-sided enclosed shed on impervious surface with a storage capacity of approximately 3,000 tons.
- Material purchases should be timed to avoid excess material and ensure all salt material can stored under the roof enclosure.
- The unloading/loading of trucks is performed on a paved surface in front of the storage shed that ultimately drains to a catch basin that leads to the City storm drain system that outlets to Berry Brook behind the DPW facility.
- Equipment operators should avoid overfilling spreader trucks to prevent material spillage during vehicle travel.
- Storage/loading areas should be frequently swept after loading activities to reduce the amount of salt, sand, or other materials that are tracked out onto the pavement and could potentially drain to the nearby catch basin. (**Refer to NHDES Deicing Material Storage Fact Sheet in Attachment 3**).

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3

Future Planned Operational Changes

The City plans to implement following measures and improvements over the next 2 to 5 years, contingent on available funding. Given budget planning considerations, some of the larger planned equipment upgrades such as a new brine manufacturing facility may not be fully implemented until after June 2023 or Permit Year 5 as required by the MS4 permit, and the City plans to evaluate and pilot test different materials or equipment over the next two winter seasons to identify best options to improve the efficiency and effectiveness of the winter maintenance program.

As shown in Table 3.1, the NHDES has identified several operational practices and equipment upgrades that others have found to be effective in reducing salt usage. These practices include, but are not limited to, conducting enhanced or more frequent equipment calibration checks, enhanced or expanded operator training, using sensors to more closely monitor pavement and weather conditions to allow fewer or lower application rates when pavement and weather conditions allow, using prewetted salt, and expanding the use of brine or liquid deicer to pretreat roads ahead storm events.

3.1 Tracking and Reporting Deicing Material Usage

Starting in FY22, the City intends to use the UNH Technology Transfer Center online reporting system to report its salt and other deicing material usage along with its an internal reporting system. The current internal tracking system is sufficient to enable staff to submit the annual material usage information to T2 Center as required by the permit The reporting web site can be found at UNH T2 Salt Use Database.

3.2 Planned Future Operational Measures

The following provides a brief description of the various operational measures that the City currently plans to implement in the future to improve road salt use efficiencies and effectiveness that ultimately results in a reduction in road salt usage. The actual timing and extent of the implementation of these measures will be contingent on available funding, priorities and capacity within the DPW Department.

3.2.1 Enhanced/Extended Spreader Calibration

The City plans to improve its equipment calibration procedures and conduct additional mid-season calibration checks to ensure the material spreader settings and applications are within the desired thresholds. During the winter season, spreader controller settings and chute gate openings should be periodically rechecked to make sure material applications are still within the desired application rates. Based on NHDES guidance information, enhanced calibration checks at the beginning and during the winter season, could result in an estimated salt use reduction of 5% or more on an annual basis depending on the current calibration practices (see additional calibration resources in **Attachment 3).**

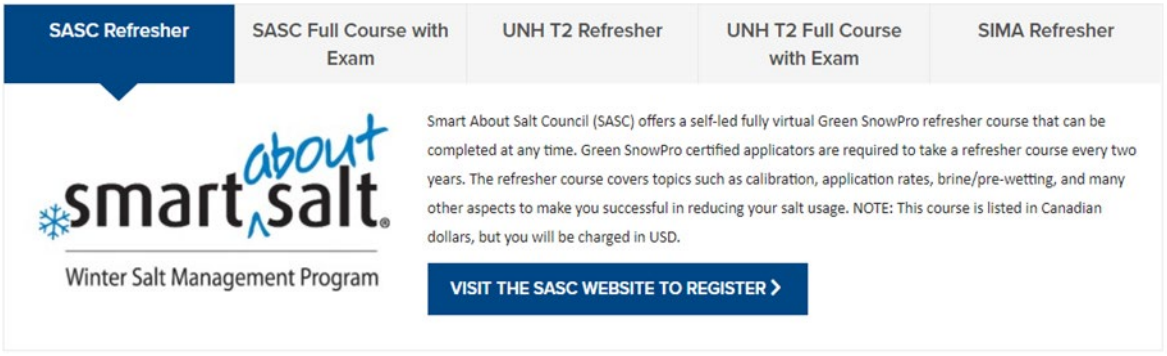
3.2.2 Enhanced Employee Training

The City plans to expand or enhance its current employee training program through a combination of adding additional in-house annual training resources and allowing more staff to attend the Green SnowPro™ Certification training. Enhanced in-house training could involve making existing online training videos more available and scheduling time to view these resources.

Additional Training Information:

Training courses are available through the services of several entities that work with the NHDES and are experts within the industry. These include the Smart About Salt Council (SASC), and Snow and Ice Management Association (SIMA). Both SASC and UNH T2 offer online courses for your convenience. All courses can be found on the NHDES Green Snow Pro Program website at Green SnowPro Training

Currently municipalities and other governing bodies are unable to be certified under this Program. During the 2020 New Hampshire legislation period, the NHDES proposed a bill to create a municipal salt reduction and certification program. The legislation has been delayed until the 2021 session as a result of the COVID-19 pandemic.



A winter maintenance personnel training log template can be found in **Attachment 2** and at https://www4.des.state.nh.us/nh-ms4/wp-content/uploads/2020/11/Winter-Maintenance-Personnel-Training-Log.docx

3.3 Planned Future Equipment Upgrades

3.3.1 Increased Brine Production and Storage Capacity

The City plans to expand its salt brine production and storage to have more brine available to pretreat roadways ahead of winter storms events. This will involve acquiring an additional brine maker and additional storage tanks to increase storage capacity and possibly acquiring an additional brine tanker truck. The City anticipates that through these equipment upgrades could increase the amount of roadway and parking lot area typically pretreated from approximately 50% to 75%. This could result in salt reductions of 5% to 20% depending on current practices and the extent of expansion.

3.3.2 Other Equipment Upgrades: AVL/GPS, Closed-loop Controllers, etc.

As funding is available, other potential equipment upgrades should be used to increase salt use efficiency and could include the use of flexible or multi-segmented plow blades to improve road surface contact and plowing efficiency and use of closed-loop controllers, which adjust application rates not only just by truck speed but by the spreader auger speed as well to improve application consistency and accuracy. The use of AVL/GPS controllers are also effective in optimizing spreader routes and eliminating unnecessary applications due to overlaps with other spreaders and other jurisdictions that maintain the same roadway. Each of these measures alone could result in potential salt reductions in the range of 5 to 10% depending on current practices, equipment, and the potential for overlaps in routes.

3.3.3 Use of Pretreated or Prewetted Salt

Using prewetted salt is much more effective than using regular dry granular salt because the added liquid makes the salt stick to the road better and minimizes the amount of loss due to scatter and bounce of salt particles off the road surface at the time of application. The prewetted or pretreated salt is also partially dissolved and activates more quickly to prevent snow and ice from bonding to pavement more effectively. Reports posted on NHDES's web site suggest that use of pre-wetted road salt could result in 20 to 30% less salt applied compared to traditional road salt.

Pretreated salt can be purchased directly from suppliers or can be prewetted with liquids at the time of application by purchasing additional equipment such as saddle tanks with nozzle attachments that apply liquids upon application. Additional storage tanks are also needed to store liquid deicers to fill the saddle tanks prior to each application. No additional application equipment is needed when using purchased pretreated salt with the liquid already added.

As shown in Table 3.1, NHDES suggests that pretreated salt may cost $10 to $20 more per ton compared to regular salt. The cost differential likely depends on where the material is sourced and how it is shipped, and prices could fluctuate depending on availability. Based on this cost differential, this could add approximately $42,000 to $84,000 in annual material costs if the City was to fully convert to using pretreated salt, based on an average usage of 4,200 tons of salt per year. However, if pretreated salt reduces salt use by 10% to 20% or approximately 400 to 800 tons a year, the added costs could be offset by a savings of $24,000 to $48,000 based on an average cost of $60 per ton for

regular salt. Additional savings in labor costs could also be realized if fewer applications are needed during or at the end of each storm as a result of the added effectiveness.

Additional research is likely needed to assess the availability and pricing of pretreated salt and the potential cost implications of paying the cost differential to purchase pretreated salt each year vs. the cost of acquiring the prewetting equipment and storage tanks to apply the liquid directly to regular salt at the time of application. Over the long terms, the added cumulative annual material costs to purchase pretreated salt each year may exceed the upfront equipment costs to purchase prewetting equipment and storage tanks and the annual cost to purchase liquids to prewet salt. The long-term financial implications of purchasing salt that is already prewetted vs. the overall cost to purchase the equipment and liquids to prewet salt at the application point will need to be investigated further. l

Table 3.1 Estimated Effectiveness, Costs and Potential Savings of Various Salt Reduction BMPs

BMP	Municipal Recommendations	Potential Annual Reduction	Estimated Cost	Estimated Annual Material Savings
Spreader Calibration	Calibrate all spreaders before each season and check at least 50% of the spreaders during season. Monitor gate settings & controller settings during season	5-20% (20% reduction assumes limited existing calibration)	2 Staff@ 1 hr/ spreader ($200/ spreader) For 20 trucks $4,000	At 5% savings ~$10,000 At 20% savings ~$40,000
Enhanced Operator Training	Allow more City staff to attend Green SnowPro training and/or customize internal training using available training resources			
Add Pavement Temp. Sensors	Monitor pavement temps and utilize lower application rates when pavement temps are >30F and forecasted to rise	5-10% reduction	Hand-held Temp. $100/per unit $1,000 for 10 staff truck mounted sensor $500/Per truck $5,000 for 10 trucks	At 5% savings ~$10,000 At 10% savings ~$20,000
Ground-Speed Controls - AVL/GPS	Equip all trucks with ground speed controllers[1]	5-10% reduction	$700 per spreader For 10 trucks $7,000	At 5% savings ~$10,000
Pre-Treated or Pre-Wetted Salt	Purchase pretreated salt or pre-wet with liquid deicer at time of application	10-20% reduction	$10-$20 in additional cost per ton increases material cost by approx. $40,000-$80,000	at 20% savings ~ $40,000
Expand Pretreatment Capacity[2]	Purchase an Additional Brine Manufacturing Unit & Add'l Storage Tanks	10-20% reduction	$15,000 storage tanks $150,000 brine production $185,000 total investment	At 10% savings $20,000 At 20% savings ~$40,000 (possible

NOTE: Excerpted from NHDES's Draft Salt Reduction Plan template (Note: the potential % reductions and savings estimates were provided by NHDES and are only approximations for planning purposes should be adjusted to current City specific pricing/cost information)

1 Depending on age and equipment not all trucks can be equipped with ground-speed controllers.

2 Estimated annual savings do not account for reduced staff time due to less application of de-icing chemicals outside of normal operating hours. Material cost of brine is considered in the % reduction of salt used.

3.4 Planned Implementation Schedule for Future BMPs and Operational Changes

Table 4.1 provides a listing of the planned operational changes and equipment upgrades and proposed implementation schedule for the measures discussed above, consistent with Section IV.3.A.i.iv of Appendix H of the MS4 permit. The planned implementation dates are subject to change and the completion dates for these measures will be documented in the future these measures are completed.

Table 4.1 Summary of Future Planned BMPs

BMP or Activity	Estimated % Salt Use Reduction	Date(s) Planned:	Date(s) Completed:
Expand/Enhance Equipment Calibration	5%	2022	
Expanded Operator Training	5%	2022	
Additional Pavement Temperature Sensors & Closed-loop Controllers	5-10%	2022	
Expanded Pretreatment Program	10-20%	2023	
Use of Pre-Wetted Salt	10-20%	2023	

3.5 Monitoring Salt Use Efficiency to Demonstrate Improvements

The planned measures, described above, are anticipated to enhance the City salt use efficiency and effectiveness and potentially reduce the City's average annual salt usage by approximately 5% to 20% or approximately 200 to 800 tons on an average annual basis, and perhaps even more as existing equipment continues to be upgraded and replaced and new technologies and practices are adopted over time.

The City will use the regression equation that correlates the estimated WSI value to annual salt usage for the last 7 years as shown in Section 2.3 to estimate salt usage in future years based on the WSI value of that year. This estimated usage will reflect the expected usage under current practices prior to the implementation of any new measures. The effect of the new measures will be reflected in any difference between this expected usage and the actual usage with the new measures in place assuming the actual usage is less than the expected. If the actual usage is higher than the expected than it would be concluded that the new measures had no measurable effect on salt usage.

As shown in Figure 2.1, the correlation between WSI and salt usage appears to explain 95% of the year to year variability in annual salt usage, and thus, the anticipated salt use reductions that are 5% or more should be evident under most instances using this method ,especially for the expected higher removals based on the cumulative effect of these measures. In milder winters, the benefits of these proposed efficiency measures are likely to be more muted and thus the potential reductions are likely to be less evident. The muted effect is primarily due to the fact that the effect of pretreatment or prewetting practices on salt use efficiency is most evident in seasons with prevailing cold temperatures and due to the fact that the WSI value does not always adequately reflect the deicing demands when

salt usage is done in response to freezing rain events rather than snow events. However, this limited ability to achieve salt uses reductions in mild winters is much less important since the potential salt use in mild winters is generally much lower than that used during in an average or more severe winter anyway.

It is worth noting that a 5 to 20% salt use reduction could result in potential annual material cost savings of approximately $10,000 to $40,000 based on an average purchase cost of $50 per ton for regular granular salt. However, these savings may be offset at least in part by any added personnel labor or equipment purchase costs required to implement these measures.

4

Requirements for Privately Maintained Facilities

The following requirements are copied directly from Appendix H. The following are suggested approaches to address these requirements and are anticipated to be discussed further with City staff.

4.1 Identify and Map Commercial Parking Lots

Per Section 3.b.3 (i) of Part IV of Appendix H, the City will plan to identify property owners with 10 or more parking spaces for purposes of targeting property owners for to deliver future public education messages:

Approach

The City plans to utilize parcel data and assessor data to identify property owners for targeting future public education messages to address the requirements in 4.1.1 below.

4.1.1 Existing Property Owners

Per Section 3.b.3 (ii) of Part IV of Appendix H, property owners and operators of private parking lots and private street owners and operators should comply with the following conditions:

1. That any commercial salt applicators used for applications of salt to their parking lots or streets be trained and certified in accordance with Env-Wq. 2203; and
2. Report annual salt usage within the municipal boundaries using the UNH Technology Transfer Center online tool (http://www.roadsalt.unh.edu/Salt/) or report salt usage directly to the permittee, in which case this information should be reported on the permittees annual report.

Approach

Starting in 2021, the City plans to develop, post and distribute public education materials to encourage property owners with at least 10 parking spaces to hire commercial operators that are Green SnowPro™ Certified through the UNH T2 Center. The City will utilize and modify existing public educational resources to distribute an appropriate and targeted message (see Educational Resources at the NHDES link https://www4.des.state.nh.us/nh-ms4/?page_id=1544 in Attachment 4).

4.2 New and Redevelopment

Section 3.b.3 (iii) of Part IV of Appendix H requires municipal permittee to adopt new requirements that require any new development and redevelopment to minimize salt usage, and to track and report amounts used using the UNH Technology Transfer Center online tool (http://www.roadsalt.unh.edu/Salt/).

Approach

Section 7.6.1 of the City's recently updated Site Plan Regulations states that any new and redevelopment of commercial properties requires property owners to adopt various measures to minimize their salt usage during winter maintenance including, but not limited to, hiring Green SnowPro™ Certified operators. This Certification requires operators to report their annual deicing material usage in order to maintain their certification.

Attachment 1: Chloride-Impaired Watershed Maps

Attachment 2: Employee Snow and Ice Training Log

Attachment 3: NHDES Fact Sheets and Resources

Attachment 4: Public Education Resources for Commercial Property Owners

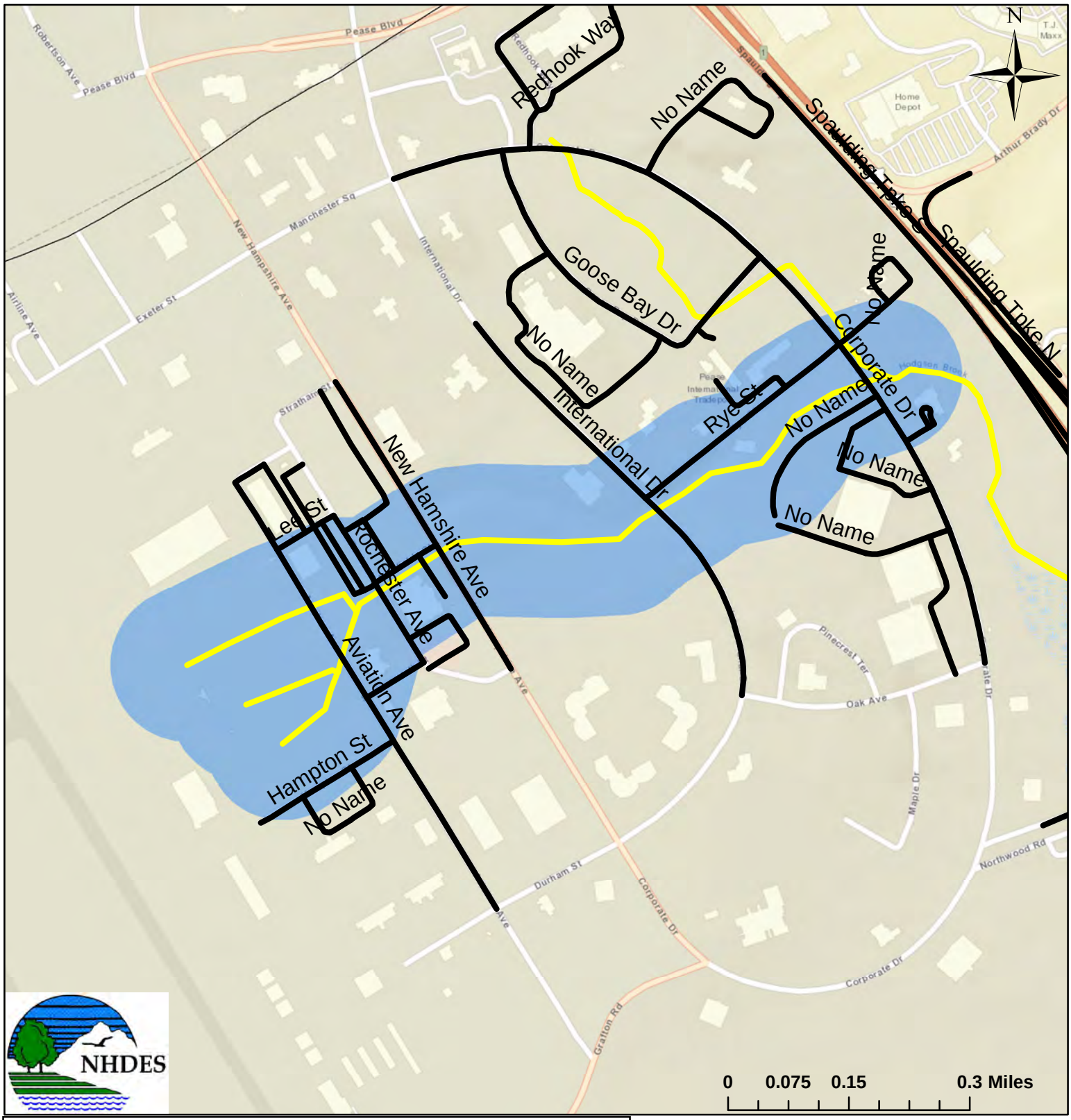
Attachment 1:

Chloride Impaired Stream Maps

500 Foot Salt Buffer Zones

NEWFILEDS DITCH (NHRIV600031001-10)

PORTSMOUTH



NHDES

Road/highway segments within 500 feet of the impaired waterbody

500 foot buffers

- Impaired with TMDL
- Impaired without a TMDL

Waterbodies

- Approved TMDL
- Impaired Waterbody

The data presented is under constant revision, and may not depict the most up to date information. The New Hampshire Department of Environmental Information (NHDES) is not responsible for the use or interpretation of this information by third parties. Not for legal use.

500 Foot Salt Buffer Zones

UPPER HODGSON BROOK (NHRIV600031001-05)

PORTSMOUTH

NHDES

Road/highway segments within 500 feet of the impaired waterbody

500 foot buffers

- Impaired with TMDL
- Impaired without a TMDL

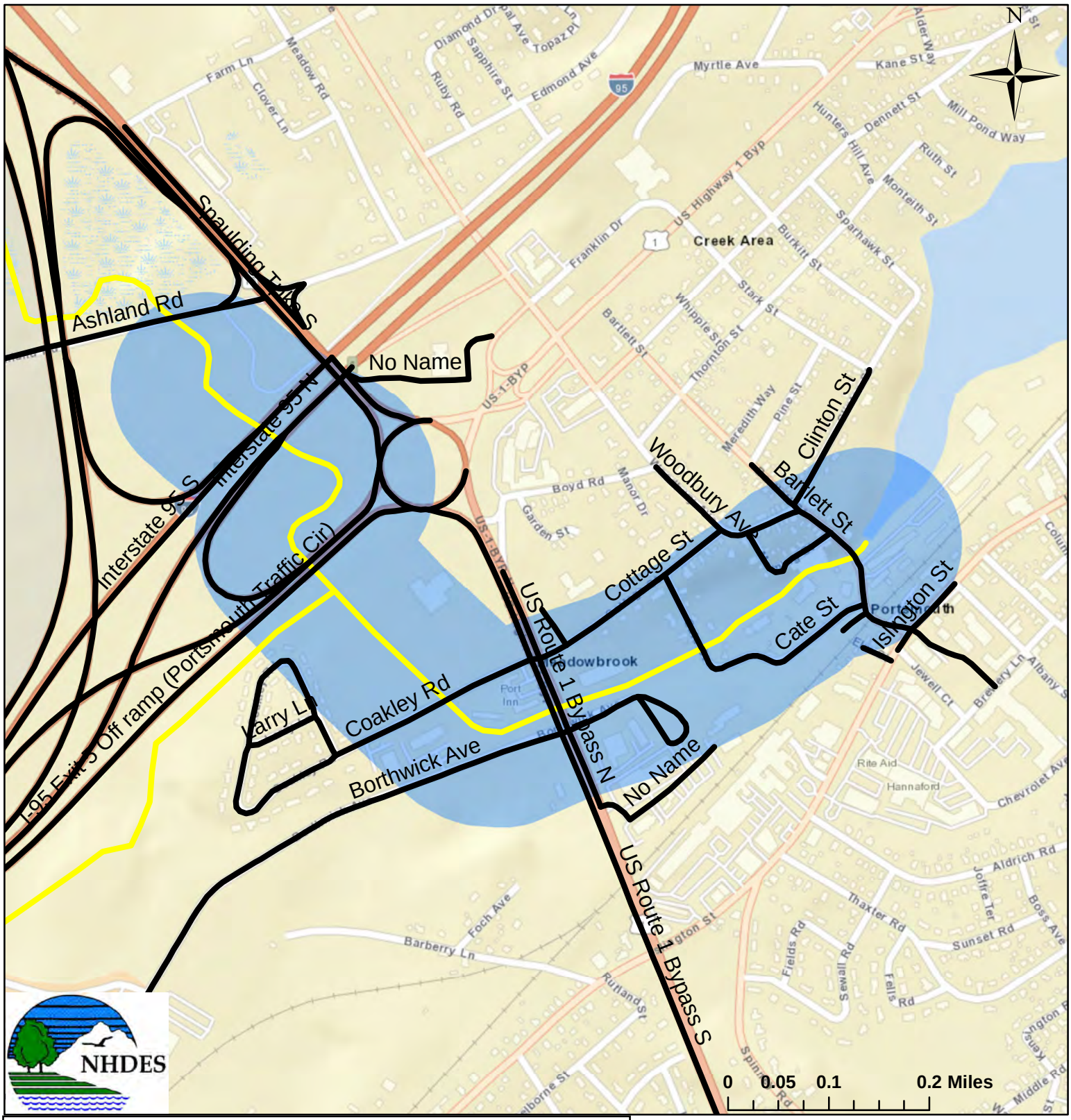
Waterbodies

- Approved TMDL
- Impaired Waterbody

500 Foot Salt Buffer Zones

LOWER HODGSON BROOK (NHRIV600031001-04)

PORTSMOUTH



Road/highway segments within 500 feet of the impaired waterbody

500 foot buffers

- Impaired with TMDL
- Impaired without a TMDL

Waterbodies

- Approved TMDL
- Impaired Waterbody

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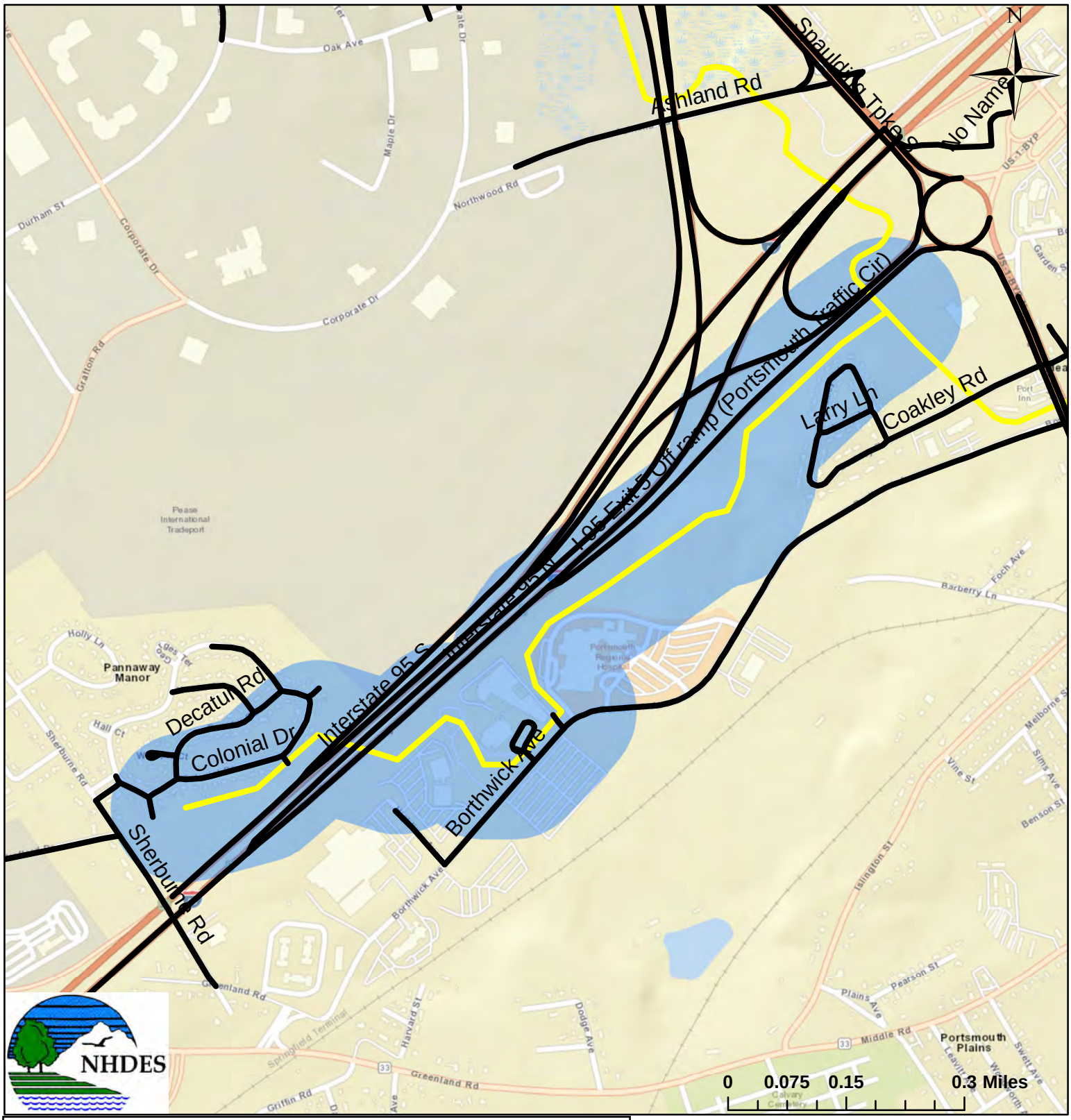
500 Foot Salt Buffer Zones

BORTHWICK AVE TRIBUTARY (NHRIV600031001-09)

PORTSMOUTH



NHDES

Road/highway segments within 500 feet of the impaired waterbody

500 foot buffers

- Impaired with TMDL
- Impaired without a TMDL

Waterbodies

- Approved TMDL
- Impaired Waterbody

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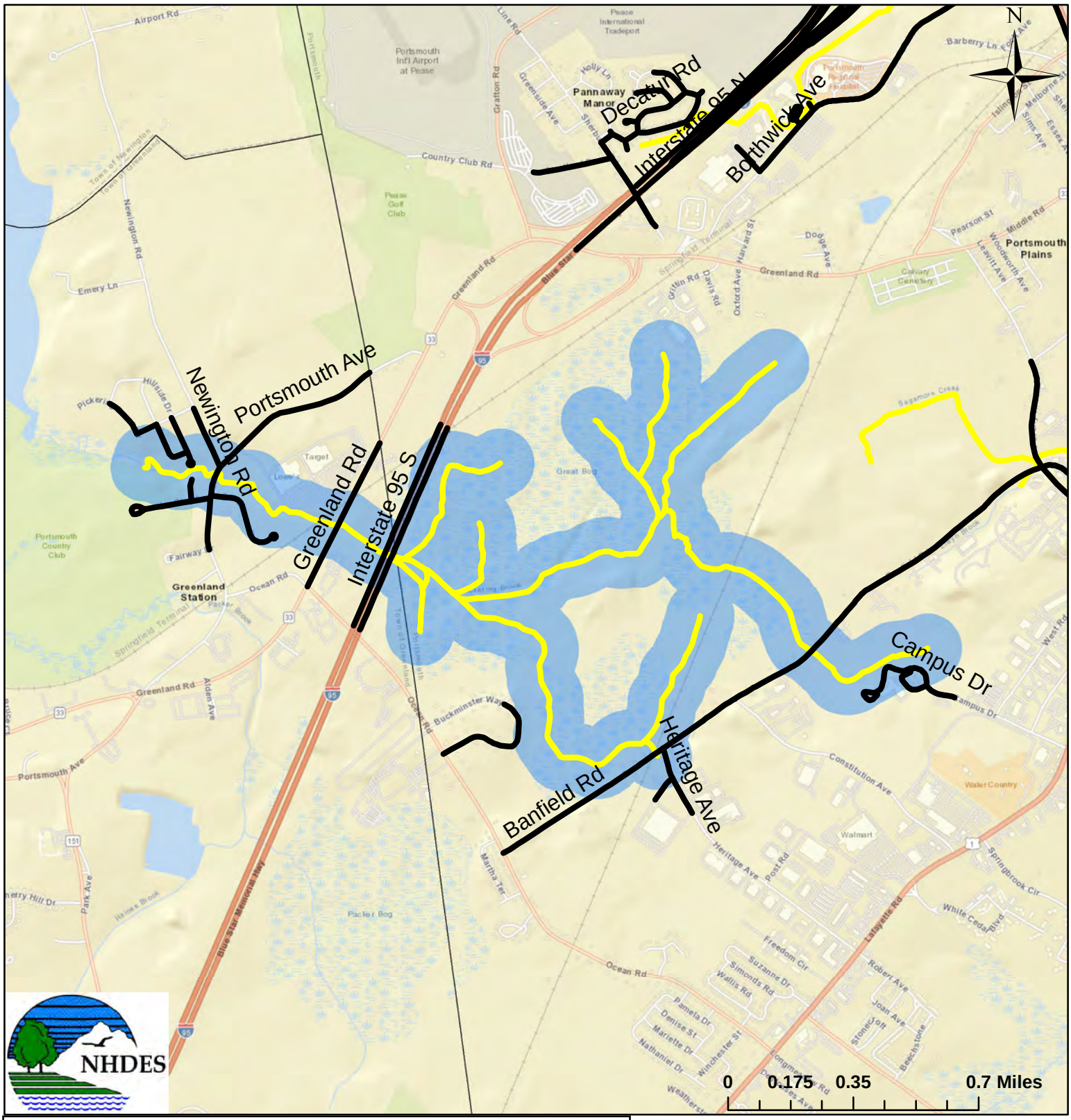
500 Foot Salt Buffer Zones

PICKERING BROOK (NHRIV600030904-06)

PORTSMOUTH, GREENLAND



NHDES

Road/highway segments within 500 feet of the impaired waterbody

500 foot buffers

- Impaired with TMDL
- Impaired without a TMDL

Waterbodies

- Approved TMDL
- Impaired Waterbody

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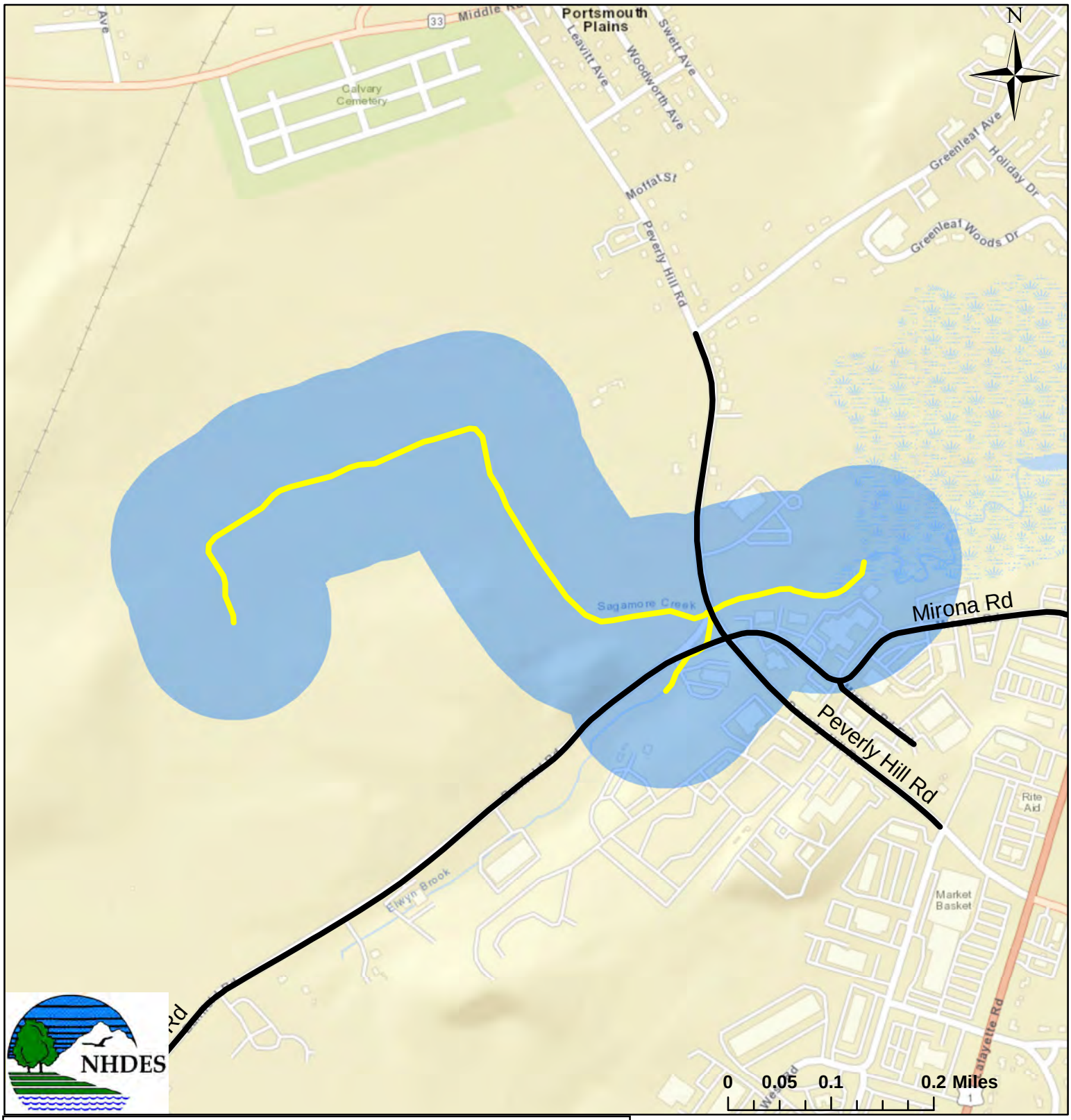
500 Foot Salt Buffer Zones

SAGAMORE CREEK (NHRIV600031001-03)

PORTSMOUTH



NHDES

Road/highway segments within 500 feet of the impaired waterbody

500 foot buffers

- Impaired with TMDL
- Impaired without a TMDL

Waterbodies

- Approved TMDL
- Impaired Waterbody

The data presented is under constant revision, and may not depict the most up to date information. The New Hampshire Department of Environmental Information (NHDES) is not responsible for the use or interpretation of this information by third parties. Not for legal use.

Attachment 2: Employee Snow and Ice Training Log

PORTSMOUTH, NH DPW

Winter Maintenance Personnel Training Log			
Name of Employee	**Date of Training**	**Title of Training**	**Person/Entity Who Conducted the Training**

Attachment 3:

NHDES Fact Sheets and Resources

Anti-Icing

NH Best Management Practices

GET OUT EARLY

Typically anti-icing is most effective if applied 1-2 hours before the precipitation begins however it can be applied up to 24 hours in advance.

TRY IT FIRST

Trying anti-icing for the first time? Make a 23.3% brine solution and before a storm spray pavement on your own property using a masonry/ plant sprayer. Use this experiment to determine how best to use it with your clients.

LEAVE SOME PAVEMENT BARE

It's always best to use stream nozzles instead of fan tip to avoid creating a slippery condition. If the anti-icing liquid freezes the bare pavement will still provide a traction surface.

USE A FILTER

Having a filter in your liquid dispensing system will reduce clogs in your nozzle. Automotive in line fuel filters work quiet well. If your liquid dispenser is not functioning properly be sure to check the filter first.

A Proactive Treatment

Anti-Icing before a storm is very similar to using a non-stick spray on a pan before cooking. Just like a non-stick spray prevents food from bonding to the pan, anti-icing prevents snow and ice from bonding to the pavement so that it can be plowed away. Anti-icing can save you money as it costs 50% less than reactive deicing.

Make Your Own Salt Brine

When making brine it is important to add enough salt to produce a 23.3% solution which freezes around 0°F. Roughly 2.5lb per gallon of water will produce a 23.3% solution. You can verify using a salometer (~$20) a 23.3% solution will have a specific gravity of 1.176, or 85% salinity. Consult the Brine Making BMP sheet for more info.

How Much Should I Use and When?

You can apply brine up to 24 hours in advance of the storm. Typical application rates range from 0.5 to 0.75 gallon per 1000 sq.ft. (10' x 100' area). Other chemicals such as magnesium are also available—consult your supplier for application rates. Anti-icing is not advised prior to freezing rain events.

Getting Started

Try making your own salt brine by putting 13 lb of salt in 5 gallons of water to get a 23.3% salt brine solution. Mix the brine until all of the salt is dissolved. Using a masonry sprayer apply the liquid several hours before a storm. Start by applying about 0.25—0.5 gallons to a 10' x 50' area. Adjust the application rates based on your experience. Being careful not to over apply and cause a slippery condition.

Produced in partnership with:

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

New Hampshire DOT

T2 New Hampshire Technology Transfer Center

Brine Making

NH Best Management Practices

GET THE LOWEST FREEZE POINT

When salt brine is 23% salt (measured with a hydrometer: 1.176, or with a salimeter: 85%) it has the lowest freeze point possible (about 0°F).

BRINE STORAGE

23% brine solution may be stored outside, however if temperatures get below 0°F the brine may freeze. A circulator pump will reduce the risk of freezing. If possible store brine indoors to eliminate risk of freezing.

COST OF BRINE

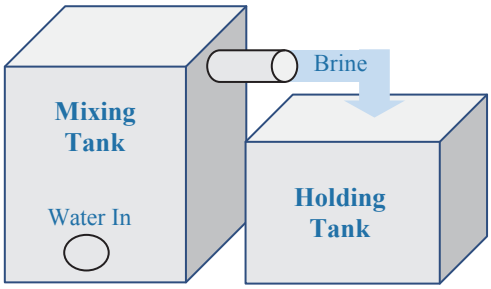
Calcium chloride brine costs about 7¢ / gallon (assuming $58/ton for salt) after you have your equipment setup.

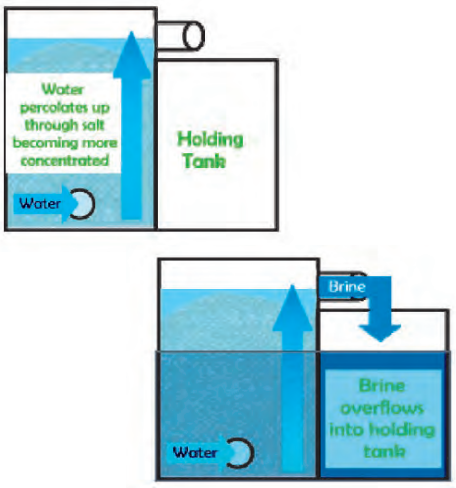
MULTIPLE USES

Brine can be used directly for anti-icing, for prewetting salt as it is dispensed from your truck, or to pretreat salt before it is loaded into your truck. Brine can be safely stored for up to a year, however, the concentration should be tested before use.

What Do You Need?

Brine making is a fairly simple process—the only ingredients are salt and water, and the only equipment you'll need is an open top mixing tank, a holding tank, a small pump, and a salimeter.



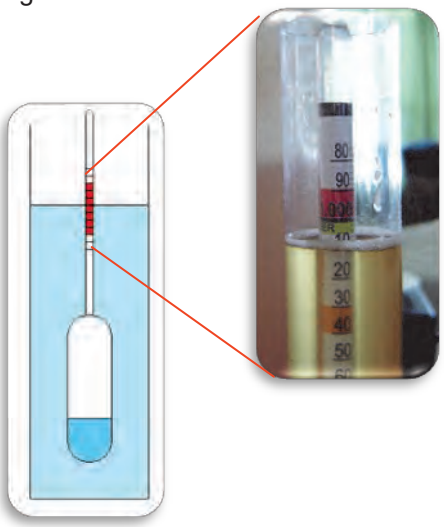


Images courtesy of Iowa DOT

Step 1: Fill Mixing Tank

Add Salt: Add about 2.5 lb of salt per gallon of water you plan to add. Make sure your mixing tank has a large opening to make adding salt easy.

Add Water: Slowly add water from the bottom of your brine mixing tank. This will allow it to percolate up through the salt and overflow into the holding tank.



Step 2: Check Concentration

Float a hydrometer or salimeter directly in your holding tank and read the value at the surface of the water. The number should be either 85% or 1.176 depending on the units of your device.

If the values are too low, pump some brine from your holding tank back into the mixing tank and allow it to overflow. If values are too high simply add some fresh water

Quality Control & Documentation

Make sure that you record the date when you create each batch of brine and document who mixed it and checked the concentration. It is also a good idea to note the final concentration. These records should be kept for at least two years to protect your group in the event of litigation.

Produced in partnership with:

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

New Hampshire DOT

T2 New Hampshire Technology Transfer Center

9 ANTI-ICING

A relatively new weapon in the sustainable snowfighting arsenal in North America is anti-icing. But it has a long history of keeping European roads safe and passable.

Anti-icing differs significantly from deicing because brine is applied before precipitation to prevent the formation or development of bonded snow and ice on the road surface. It is a proactive approach to snowfighting and is often the first in a series of strategies employed for a winter storm. By applying freezing point depressant materials before a storm it is possible to prevent the bond from forming between the pavement and snow or ice. Research has shown that timely applications of anti-icing materials can cut the cost of maintaining a safe road surface by 90% compared to traditional deicing. Liquid sodium chloride (NaCl) is the most effective choice for anti-icing above 15°F.

Anti-icing has many advantages.

- Anti-icing returns road surfaces to normal faster, resulting in fewer accidents and delays.
- Anti-icing can reduce airborne dust and salt particulates.
- Salt needs moisture to be effective. Applying brine jumpstarts the melting process.
- Brine sticks to the road surface. It will not be as easily blown off the road by wind or traffic, so material is more efficiently used.
- If the storm is delayed, salt residue remains on the road ready to begin work when precipitation begins.
- Crews can begin treatment in advance of a storm. Because anti-icing prevents the bonding of snow and ice to pavement, snowfighters have less work to maintain safe roadways as the storm progresses.
- Increased efficiency results in use of less deicer and manpower, therefore lowering the cost of maintaining safe road conditions. The use of less deicing materials also minimizes environmental concerns.

Products available for use in an anti-icing program are sodium chloride, calcium chloride, magnesium chloride, potassium acetate, and calcium magnesium acetate.

Each product has its own advantages and disadvantages. The most common material in use is sodium chloride (salt) in the form of a brine made from a mixture of rock salt and water. Salt brine is effective to -6°F and is a proven anti-icing agent in use throughout the snowbelt.

Some agencies use calcium or magnesium chloride in a brine solution which is effective down to -6° F, but is more than six times more expensive than salt, and is more difficult to handle. Also, calcium and magnesium chloride residue on road surfaces can attract moisture at lower relative humidity than salt resulting in dangerous, slippery conditions under certain circumstances.

Salt Brine Manufacture

Salt brine is made by mixing rock salt or solar salt with water. The process is simple: the resulting brine should be approximately 23% NaCl.

The proportion of salt to water is critical to the effectiveness of the brine. Too much or too little salt affects the freeze point depressing qualities of the brine. The proper brine mixture is 23.3% salt content by weight. This is the concentration at which salt brine has the lowest freezing point, -6° F. Can we keep adding salt to water until the freezing point goes down much further? No. The solubility of salt in water decreases with decreasing temperature. We eventually reach what is called the eutectic point. This is the point at which a solution achieves a maximum salt concentration. Any colder and salt will begin to leave the solution and raise the freezing point. At the eutectic temperature, ice, saltwater, and solid salt exist in equilibrium. For water, the eutectic temperature is -6° F. The percentage of salt is measured with a salometer, a specialized hydrometer, until a 88.3% measurement on the salometer is obtained. This results in the proper 23.3% salt content.

Commercial brine makers are available at a cost of approximately $5,000. Many agencies have made their own brine makers using water tanks and PVC pipe for substantially lower cost. Brine is usually made at the local maintenance facility sites and stored in large tanks in locations convenient for loading into saddle tanks on the sides of the V-box or anti-icing equipment. It is essential to clean out brine makers after brine is prepared to reduce the potential for corrosion.

Application Equipment

Brine applicators are commercially available for about $1,500. Some agencies have manufactured their own application equipment using large tanks and PVC piping. Some equipment is designed to be

Hydrometer/Salometer Chart for Salt Brine

% Salt	Hydrometer Specific Gravity	Salometer Using 0-100%
0	1.000	0
1	1.007	4
2	1.014	7
3	1.021	11
4	1.028	15
5	1.036	19
6	1.043	22
7	1.051	26
8	1.059	30
9	1.067	33
10	1.074	37
11	1.082	41
12	1.089	44
13	1.097	48
14	1.104	52
15	1.112	56
16	1.119	59
17	1.127	63
18	1.135	67
19	1.143	70
20	1.152	74
21	1.159	78
22	1.168	81
23	1.176	85
24	1.184	89
25	1.193	93
26	1.201	96
27	-	100

loaded onto the bed of spreading trucks, towed behind maintenance equipment or permanently mounted on truck beds. It can be as simple as a gravity fed spraying system with a operator controlled cut-off valve or a more complex (and more controllable) pump driven sprayer system. Fan sprayers are not recommended. Control should be available to vary spreading rates from 25 to 60 gallons per lane mile.

If large, horizontal tanks are used in the design, consider installing baffles inside the tanks to help prevent the liquid from suddenly shifting in the tank, creating a hazardous control situation for the operator.

Application

Accurate weather and road surface information are critical for the efficient use of anti-icing materials. Road surface temperatures, precipitation amounts and form, wind conditions, and road environment (sunlight exposure, surface condition, bridges, etc.) all affect the use and application of anti-icing measures.

Understanding the freeze point depressing qualities of brine is important to its use and application as an anti-icing agent. (See the Phase diagram below.) As you can see from the chart, the minimum freeze point of salt brine is -6°F at a concentration of 23.3%. Road surface temperatures are indicated on the side of the chart, solution concentrations along the bottom. The line represents the freeze point of the solution at a given temperature. The colored portion in the center of the chart shows the melting range of brine solutions. The area to the left shows the results of a solution with too little salt, the road surface will refreeze unless more salt brine or deicing salt is applied. The area to the right shows the results with too much salt, with a resultant non-functional loss of material to the environment. As you can see, additional precipitation and heavy traffic can dilute the brine solution allowing the road to refreeze.

ADDITIONAL PRECIPITATION ALWAYS RESULTS IN A DILUTION OF BRINE AT THE ROAD SURFACE.

Weather information is getting better with everything from air temperature, dew point, optical weather identifiers, to pavement temperature, surface status, and compound information being available. Some agencies utilize remote television cameras to monitor traffic and bridge conditions. This information will help agencies accurately determine the appropriate application of anti-icers.

Do not apply anti-icer under blowing conditions, particularly in areas prone to drifting and anywhere else that might be problematic for salt, such as all areas subject to wind issues.

Don't apply too much or the roadway may become slippery. Always follow application recommendations.

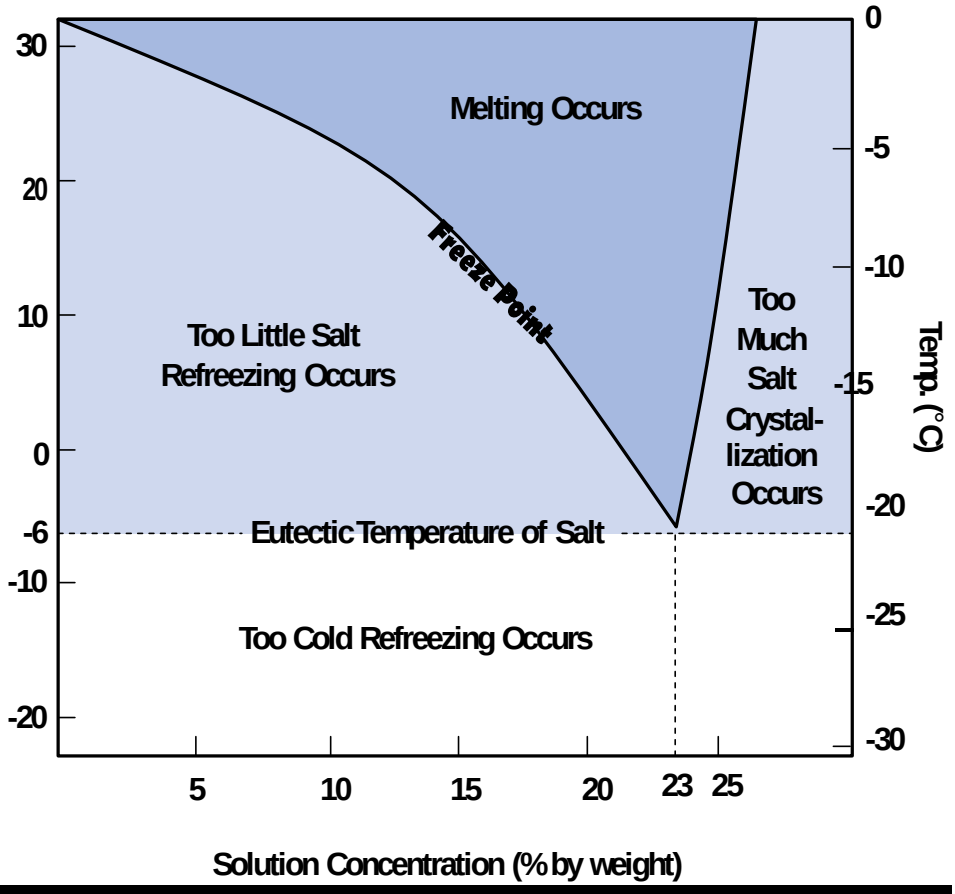
Don't apply CaCl2 or MgCl2 to a warm road (above 28°F pavement temperature). It can become very slippery and cause crashes!

Summary

Anti-icing measures are an important weapon in the snowfighter's arsenal. The appropriate use of anti-icing techniques results in:

- Returning to bare pavement conditions more quickly, saving lives and reducing property damage due to fewer accidents, as well as the reduction of traffic delays and the resulting reduction of losses to local economies;
- Reduction in the quantity of deicer use, resulting in cost savings and less environmental concerns; and
- Reduction in the manpower necessary to maintain safe road conditions, resulting in less overtime costs, less operator fatigue and safer working conditions. ❄

Phase Diagram for Salt



5.4 Action: Application Rates and Practices

The goal of winter operations is to maintain the specified Level of Service while using the minimum practical amount of chemical. Spreading rates and the timing of application are decisions that need to be made based on variables in weather conditions.

Although there are no firmly set application rates due to these variables, it is feasible for guidelines to be established based on known data. With continued data collection and by performing application rate studies these recommendations can be modified based on experience.

The approach to snow and ice control should be proactive. Therefore, it is recommended that anti-icing be the preferred method of operations when conditions permit. Mechanical removal of snow with proper plow types and cutting edges should be used to ensure adequate cleaning of the roadway prior to secondary chemical application. When applying chemical it is best managed by the use of ground speed oriented spreaders.

Appendix I contains application rate guidelines established by for roads and Appendix J contains application rate guidelines established for parking lots. The recommendations are based on data issued in Appendix B of the New Hampshire DOT Salt Management Plan and are derived from recommendations set by New York State Department of Transportation (NYDOT). They are in chart form with various winter conditions, temperatures, and treatment options for dry rock salt and pre-wet rock salt.

Application rate guidelines for straight liquid salt brine (23 percent concentration of NaCl) chemical are provided in Appendix M. They are based on data issued by the City of Hamilton, New Jersey and are recommended as a starting point, to be adjusted as experience dictates. Caution should be used as over-application of salt brine may cause slippery road conditions.

The following chart is a range of application rates for a variety of treatment options. Data sources are identified next to the recommended rates. The rates should be adjusted depending on various weather conditions and temperatures. In general lower rates are used at warmer temperatures around 28° F - 32° F and higher application rates are used at temperatures below 28° F. For temperatures below 15°F liquid chemical, salt, and prewet may not be beneficial due to chemical inactivity, increased chance of rapid freeze, and application rates that would be too high to be cost effective. Verify your products effective melting temperature prior to application and as a general rule use less chemical if the temperature is rising and more chemical if the temperature is falling.

Table 8. General Application Rates

	Dry Salt (lb.)	Salt prewet with Brine (lb.)	23% Salt Brine NaCl (gal.)	27% Mg Chloride MgCl (gal.)	32% Ca Chloride Mg/Cl (gal.)	Potassium Acetate (Ka)	Calcium magnesium Acetate (CMA) (gal.) / (lb.)	Sand (lb.)
Roads (per/lane mile)	100-450 NYDOT 250-300 NHDOT 100-400 MN05/ UNH T2 100 WI up to 250 FHWA	80-350 NYDOT 80-320 MN05 up to 250 FHWA	30-40 NYDOT 40-60 NHDOT/ UNH T2 20-50 MN05 44 WI 25-80 NJ 25 FHWA	28-30 NYDOT 15-25 MN05 15-35 UNH T2 26-33 WI (74-94 dry per lb.) WI	33-36 NYDOT 15-60 UNH T2 25-32 WI (89-111 dry per lb.) WI	10-30 UNH T2	15-25 / 200-400 UNH T2	500-800 NH DOT 400-800 UNH T2
Parking lots (per/1000 sq.ft.)	3-14 T2 0.75-3 MN06	3-11 T2 0.75-2.5 MN06	0.5-0.75 T2 0.2-0.4 MN06	0.1-0.2 MN06				

NYDOT- Highway Maintenance Guidelines Snow and Ice Control 2006
NHDOT – Winter Maintenance Snow Removal and Ice Control Policy 2001
MN05- Minnesota Snow and Ice Control Field Handbook for Snowplow Operators 2005
MN06- Minnesota Winter Parking Lot and Sidewalk Maintenance Manual 2006
NJ- Hamilton, New Jersey- Implementing an Anti-Icing Policy at the Municipal Level 2007
T2- University of New Hampshire Technology Transfer Center, Guidelines for Parking Lots 2010
UNH T2 – Technology Transfer Center Salt Reduction Workshop for Supervisors 2010
WI- Wisconsin Transportation Bulletin, Pre-Wetting and Anti-Icing, No. 22
FHWA – Federal Highway Administration, Manual of Practices for an Effective Anti-Icing Program

The most efficient and effective tool for reducing chloride levels without decreasing the level of service is selecting the appropriate time and method of snow and ice removal for each storm.

NH Road Salt Application Rates for Deicing Parking Lots
(Pounds per 1000 sq.ft.)

Pavement Temp. (°F) and Trend (↑ ↓)	Weather Condition	Maintenance Actions	Application Rate (lbs/per 1000 sq.ft.)			
			Salt Prewet/ Pretreated with salt brine	Salt Prewet/ Pretreated with other blends	Dry salt	Winter sand
>30 ↑	Snow	Plow, treat intersections only	4.5	4	4.5	Not recommended
	Frz. Rain	Apply chemical	5.75	5.25	6.5	Not recommended
30 ↓	Snow	Plow and apply chemical	5.75	5.25	6.5	Not recommended
	Frz. Rain	Apply chemical	6.5	5.75	7	Not recommended
25 - 30 ↑	Snow	Plow and apply chemical	5.75	5.25	6.5	Not recommended
	Frz. Rain	Apply chemical	6.5	5.75	7	Not recommended
25 - 30 ↓	Snow	Plow and apply chemical	5.75	5.25	6.5	Not recommended
	Frz. Rain	Apply chemical	7	6.5	8.25	10.5
20 - 25 ↑	Snow or frz. Rain	Plow and Apply chemical	7	6.5	8.25	10.5 for frz. Rain
20 - 25 ↓	Snow	Plow and apply chemical	5.75	7.5	9.5	Not recommended
	Frz. Rain	Apply chemical	7	7.5	10	10.5
15 - 20 ↑	Snow	Plow and apply chemical	7.5	7.5	9.5	Not recommended
	Frz. Rain	Apply chemical	8.75	7.5	10	10.5
15 - 20 ↓	Snow or Frz. Rain	Plow and apply chemical	8.25	7.5	10	10.5 for frz. Rain
0 to 15 ↑↓	Snow	Plow, treat with blends, sand hazardous areas	Not recommended	10	Not recommended	13 and spot-treat as needed
< 0	Snow	Plow, treat with blends, sand hazardous areas	Not recommended	23	Not recommended	13 and spot-treat as needed

Table 19. Application Rates for Deicing

These rates are based on road application guidelines (Mn Snow & Ice Control Field Handbook, Manual 2005-1). Develop your own application rates by adjusting your current rates incrementally downward toward these guidelines. Where temperature categories overlap, select the rate most applicable to your situation.

NH Road Salt Application Rates for Deicing Roads
(Pounds per Lane Mile)

Pavement Temp. (°F) and Trend (↑ ↓)	Weather Condition	Maintenance Actions	Application Rate (lbs/per lane mile)			
			Salt Prewet/ Pretreated with salt brine	Salt Prewet/ Pretreated with other blends	Dry salt	Winter sand
>30 ↑	Snow	Plow, treat intersections only	150	125	150	Not recommended
	Frz. Rain	Apply chemical	175	150	200	Not recommended
30 ↓	Snow	Plow and apply chemical	175	150	200	Not recommended
	Frz. Rain	Apply chemical	200	175	225	Not recommended
25 - 30 ↑	Snow	Plow and apply chemical	200	175	225	Not recommended
	Frz. Rain	Apply chemical	225	200	225-275	Not recommended
25 - 30 ↓	Snow	Plow and apply chemical	250	200	275	Not recommended
	Frz. Rain	Apply chemical	275	250	275-300	450
20 - 25 ↑	Snow or frz. Rain	Plow and Apply chemical	275	275	275-300	450 for frz. Rain
20 - 25 ↓	Snow	Plow and apply chemical	275	250	300-325	Not recommended
	Frz. Rain	Apply chemical	300	275	325-400	450
15 - 20 ↑	Snow	Plow and apply chemical	300	275	325	Not recommended
	Frz. Rain	Apply chemical	300-375	275-350	325-400	450
15 - 20 ↓	Snow or Frz. Rain	Plow and apply chemical	325	300	350	450 for frz. Rain
0 to 15 ↑↓	Snow	Plow, treat with blends, sand hazardous areas	Not recommended	300-350	Not recommended	600 and spot-treat as needed
< 0	Snow	Plow, treat with blends, sand hazardous areas	Not recommended	350-500	Not recommended	600 and spot-treat as needed

Table 19. Application Rates for Deicing

These rates are based on road application guidelines (Mn Snow & Ice Control Field Handbook, Manual 2005-1). Develop your own application rates by adjusting your current rates incrementally downward toward these guidelines. Where temperature categories overlap, select the rate most applicable to your situation.

Pony Motor-Run Spreader Calibration

NH Best Management Practices

WHY CALIBRATE?

You can't reduce your salt use if you don't know how much salt you actually use! The goal of calibrating is to know how much material you are putting down on a roadway or parking lot for every setting on your truck that you use. This is why calibrating your equipment is the first step to reducing salt use and saving money!

REMEMBER:

Each truck must be independently calibrated for each material it will be used to spread (the salt calibration card *will* be different than the sand calibration card).

Calibrations should be preformed annually, or after a spreader is serviced.

CALCULATIONS:

There are a few simple calculations you must perform in order to complete the calibration. Once all of the necessary data is recorded, head back inside and warm up! Refer to the reverse side of this fact sheet for calculation instructions.

Step 1: Load the Truck

Partially load the truck. Half of a full load should be more than adequate for calibration purposes.

Step 2: Set Your Controls

Gate Height: Set the gate height to its lowest practical setting to start (approximately 1" to 1.5"). After the truck is calibrated for the lowest gate setting, calibrate for each 1/2" increment greater than the lowest setting. Continue until all gate settings you use are calibrated.

Engine Speed: Set the pony motor speed to the maximum setting, or to the setting you would normally use.

Step 3: Measure Spread Width

Measure the width that the material covers during spreading. Do this for each gate setting you are calibrating. Round your numbers to the nearest half foot and record them in column "**W**" of the calibration chart (see reverse side).

Step 4: Collect & Weigh Material

You will need either a sheet of canvas, a tarp, or a bucket to collect the material that is dispensed from the spreader, as well as a scale. Weight the object you are using to collect the material in, and record that value in the purple box above the discharge rate column. Collect material for 1 minute. Weigh the collected material and subtract the weight of the tarp/canvas/bucket. Record this value in the first purple column of the calibration chart. Do this 3 times for each gate opening that is typically used. Average these three values together and record in the orange column in the calibration chart.

Step 5: Perform Calculations

Go inside and calculate your discharge rate using the calibration chart for each truck speed and gate setting you normally use. Refer to the reverse side of this fact sheet for calculation instructions. The formula you will be using is shown below:

$$D = \frac{B \times C}{A}$$

Step 6: Distribute Completed Calibration Cards!

Put a copy of the calibration card in the truck you just calibrated. Also, leave a copy of the calibration card in the office so you have a copy incase the original is damaged.

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NEW HAMPSHIRE DEPARTMENT OF Environmental Services

New Hampshire DOT

T2 New Hampshire Technology Transfer Center

Hydraulic-Run Spreader Calibration

NH Best Management Practices

WHY CALIBRATE?

You can't reduce your salt use if you don't know how much salt you actually use! The goal of calibrating is to know how much material you are putting down on a roadway or parking lot for every setting on your truck that you use. This is why calibrating your equipment is the first step to reducing salt use and saving money!

REMEMBER:

Each truck must be independently calibrated for each material it will be used to spread (the salt calibration chart *will* be different than the sand calibration chart).

Calibrations should be preformed annually, or after a spreader is serviced.

CALCULATIONS:

There are a few simple calculations you must perform in order to complete the calibration. Once all of the necessary data is recorded, head back inside and warm up! Refer to the reverse side of this fact sheet for calculation instructions.

Step 1: Load the Truck

Partially load the truck. Half of a full load should be more than adequate for calibration purposes.

Step 2: Set Your Controls

Gate Height: Set the gate height to its lowest practical setting (~ 2"). This should be kept constant throughout the calibration process. If you find that not enough material is dispensed with this setting, try 2.5" to 3".

Engine Speed: Warm the truck up and run the engine at the typical rate seen during spreading (approximately 2000 rpm).

Step 3: Measure Spread Width

Measure the width that the material covers during spreading. Do this for each conveyor/auger setting you are calibrating. Round your numbers to the nearest half foot and record them in column "**W**" of the calibration chart (see reverse side).

Step 4: Collect & Weigh Material

You will need either a sheet of canvas, a tarp, or a bucket to collect the material that is dispensed from the spreader, as well as a scale. Weight the object you are using to collect the material in, and record that value in the purple box above the discharge rate column. Collect material for 1 minute. Weigh the collected material and subtract the weight of the tarp/canvas/bucket. Record this value in the first purple column of the calibration chart. Do this 3 times for each conveyor/auger setting that is typically used. Average these three values together and record in the orange column in the calibration chart.

Step 5: Perform Calculations

Go inside and calculate your discharge rate using the calibration chart for each truck speed and conveyor/auger setting you normally use. Refer to the reverse side of this fact sheet for calculation instructions. The formula you will be using is shown below:

$$D = \frac{B \times C}{A}$$

Step 6: Distribute Completed Calibration Cards!

Put a copy of the calibration chart in the truck you just calibrated. Also, leave a copy of the calibration chart in the office so you have a copy incase the original is damaged.

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New Hampshire DOT

New Hampshire Technology Transfer Center

Calibration Chart (Hydraulic Type)

Material: _____ Truck/Spreader ID: _____

Date: _____ Performed by: _____

Tarp/Canvas/Bucket Weight: _____

Conveyor or Auger Setting	W	A	Discharge Rate (lb/min.)			B	D					
	Spread Width (ft.)	5.28 × W	Run 1	Run 2	Run 3	Average Discharge Rate *((Run1 + Run2 + Run3)/3)*	Pounds of Material Discharged per 1000 square ft. *(D = B × C ÷ A)*					
							5 mph (C = 12)	10 mph (C = 6)	15 mph (C = 4)	20 mph (C = 3)	25 mph (C = 2.4)	30 mph (C = 2)
1												
2												
3												
4												
5												
EX	14	5.28 × 14= **73.92**	87	92	93	(87+92+93)÷3= **90.67**	12 × 90.67 ÷ 73.92= **14.72**	6 × 90.67 ÷ 73.92= **7.36**	4 × 90.67 ÷ 73.92= **4.91**	3 × 90.67 ÷ 73.92= **3.68**	2.4 × 90.67 ÷ 73.92= **2.94**	2 × 90.67 ÷ 73.92= **2.45**

Calculation Instructions: Multiply the spread width from column **W** by **5.28** and record the answer in column **A**. For each conveyor/auger setting, add **Run 1**, **Run 2**, and **Run 3** together. Divide the result by **3** and record in column **B** to get the average discharge rate. To find the pounds of material discharge per 1000 square feet, you must know the number of minutes it takes to travel one mile at every truck speed you intend to calibrate for. These numbers are designated as variable "**C**". The "**C**" value for each travel speed is shown in red under that given speed. Multiply column **B** by the "**C**" value for that speed and divide by the **A** column to find the number of pounds of material discharged per 1000 square feet for the given speed. Record these numbers in the **D** columns. The full equation is shown here:

$$D = \frac{B \times C}{A}$$

Calibration Chart (Pony Motor Type)

Material: _____ Truck/Spreader ID: _____

Date: _____ Performed by: _____

Tarp/Canvas/Bucket Weight: _____

Gate Opening	W	A	Discharge Rate (lb/min.)			B	D					
	Spread Width (ft.)	5.28 × W	Run 1	Run 2	Run 3	Average Discharge Rate *((Run1 + Run2 + Run3)/3)*	Pounds of Material Discharged per 1000 square ft. *(D = B × C ÷ A)*					
							5 mph (C = 12)	10 mph (C = 6)	15 mph (C = 4)	20 mph (C = 3)	25 mph (C = 2.4)	30 mph (C = 2)
1”												
1.5”												
2”												
2.5”												
3”												
EX	14	5.28 × 14= **73.92**	87	92	93	(87+92+93)÷3= **90.67**	12 × 90.67 ÷ 73.92= **14.72**	6 × 90.67 ÷ 73.92= **7.36**	4 × 90.67 ÷ 73.92= **4.91**	3 × 90.67 ÷ 73.92= **3.68**	2.4 × 90.67 ÷ 73.92= **2.94**	2 × 90.67 ÷ 73.92= **2.45**

Calculation Instructions: Multiply the spread width from column **W** by **5.28** and record the answer in column **A**. For each gate setting, add **Run 1**, **Run 2**, and **Run 3** together. Divide the result by **3** and record in column **B** to get the average discharge rate. To find the pounds of material discharge per 1000 square feet, you must know the number of minutes it takes to travel one mile at every truck speed you intend to calibrate for. These numbers are designated as variable “**C**”. The “**C**” value for each travel speed is shown in red under that given speed. Multiply column **B** by the “**C**” value for that speed and divide by the **A** column to find the number of pounds of material discharged per 1000 square feet for the given speed. Record these numbers in the **D** columns. The full equation is shown here:

$$D = \frac{B \times C}{A}$$

Pre-wetting

NH Best Management Practices

PRE-WETTING?

Pre wetting is the process of coating a solid de icer with a liquid before it is spread on a roadway.

WHY PRE-WET?

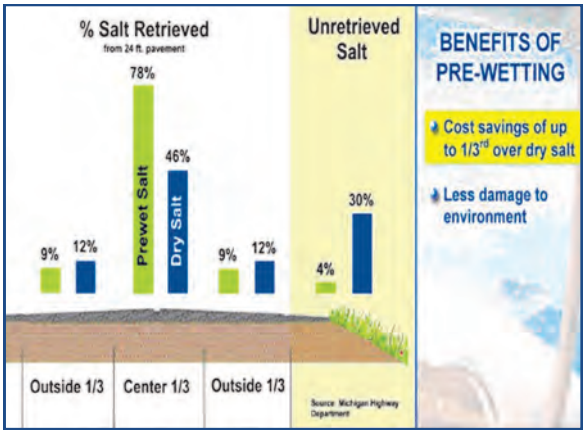
De icing chemicals must form a brine before they can begin melting ice. Pre wetting your chemicals accelerates the brine making process, which improves the melting action of the material. Pre wetting also reduces bounce and scatter of material during spreading, and reduces the total amount of de icer needed to obtain the desired results.

REDUCED RATES

If you are pre wetting, don t forget to reduce your application rates accordingly. Reduc tions in the range of 15 20% are typical.

HOW MUCH LIQUID?

A good rule of thumb is to use 8 10 gallons of pre wetting liquid for every ton of de icer. For other chemicals, such as magnesium chloride, consult your supplier for application rates

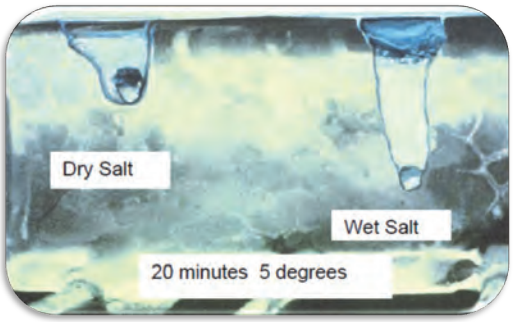


Pre-wetting Liquids

You have a few options for pre-wetting liquids. The most commonly used is a 23% sodium chloride brine solution. Calcium chloride at 32% solution is also used, as well as Magic Minus Zero™ and other patented products.

Getting Started

Wet the pile! There are two ways to pre-wet your de-icing chemicals. The easiest way to get started with pre-wetting is to spread your salt pile, spray it with pre-wetting liquid, mix it around, and re-pile it. More advanced truck mounted pre-wet systems can be installed on your trucks if you decide to make the investment.



Source: Wisconsin DOT Transportation Bulletin

Spraying the Pile

This is the easiest and most cost effective way to get started in pre-wetting. The first step is to spread your salt pile on a flat, impermeable surface. Next, spray the salt while it is spread out, and mix it around to ensure adequate and consistent liquid coverage. After the salt is sufficiently covered, re-stack the salt in your storage shed for later use.

Truck Mounted Systems

These systems are mounted in the truck bed and coat the de-icer with liquid as it comes off the conveyor/auger onto the spinner. These systems have the benefit of applying liquid only to the material you use as you use it. However, these systems must be installed on every truck that will be used to spread pre-wetted material.

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The basic equipment used in brine making is a mixing tank, a holding tank, a pump, and a salometer. It is recommended that brine mixing and storage be indoors to reduce the risk of freezing when temperatures are below 0^{o} F; a circulatory pump may be used to reduce this risk if outdoor storage is the only option. If a mixing facility is not available or desired brine may be purchased from an independent vendor. DOT is currently willing to sell brine to the town of Windham for a pre-wetting trial period.

Figure 35. Salometer

Use the following guidelines for working with brine:

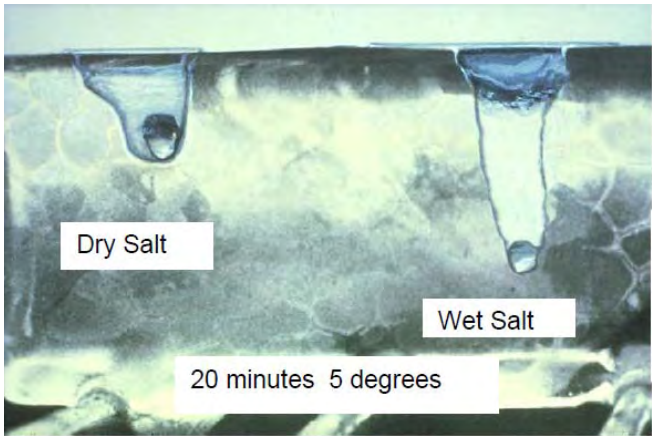
- Salometer reading should be 88.3 for 23% solution
- Specific gravity of 1.179 at 60° F
- Freeze point of -5.8° F for 23% solution
- One gallon of saturated brine contains 2.647 pounds of salt and weighs 10.027 poumds.
- One gallon of water dissolves 2.991 pounds of salt to produce 1.13 gallons of saturated brine.
- One ton of salt will produce 755.5 gallons of saturated brine.
- Chemical additives can be mixed with brine to further lower the freeze point.

For information about the proper storage of brine, see the Brine Storage and Management section. Refer to Appendix G for the New Hampshire Best Management Practices fact sheet on making brine**.**

Pre-Wetting

Pre-wetting is a term referred to a liquid deicer that is applied to a solid-based deicer in order to create a quicker reaction time for the solid deicer to begin melting snow and ice. Salt doesn't work until it is in solution, so it is recommended that all dry salt be pre-wetted regardless of the temperature. By introducing moisture into salt prior to application, the results are a quicker melting action, reduced bounce and scatter of material, and a reduced application rate.

Figure 36. Ice Melting



With a quicker melting action the application rate of pre-wet salt can be decreased by approximately 20 percent over dry salt, which saves money, increases level of service, and reduces chloride in the environment.

Pre-wetting decreases the amount of material that resides outside the target application area due to bounce and scatter. In a Michigan Highway Department study it was found that 20 percent to 30 percent of dry salt applied was immediately removed from the target pavement area. With pre-wet salt already beginning to produce a brine it tends to "stick" to the pavement surface and is worked in by vehicle and pedestrian traffic. Pre-wetting has shown to increase the performance of solid chemicals and their longevity on the roadway surface, thereby reducing the amount of materials required. (O'Keefe and Shi, 2005)

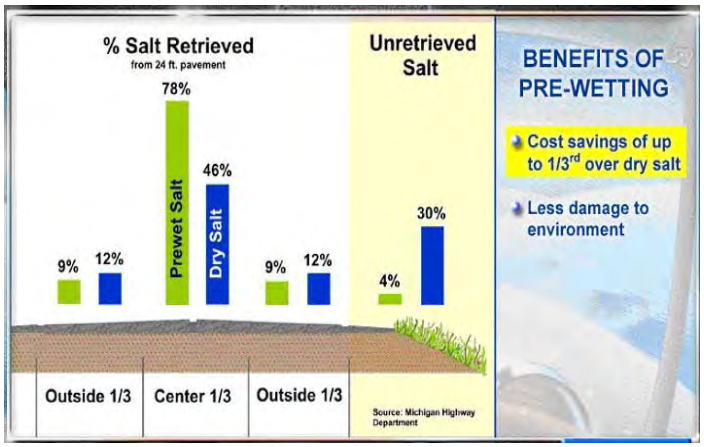


Figure 37. Bounce and Scatter of Salt

Pre-wetting can be accomplished at the stockpile, in the body of a truck, at the spinner, and at the auger.

Wetting stockpiles can be done with a liquid injector that uses special nozzles that inject deep into the pile, but this method is not readily used due to the level of management required. The degree of coating on dry salt is highly dependant on the skill of the operator

and frequent reworking of the pile is needed. Because of leaching risks, all stockpiles should be covered and on an impervious pad.

Another method of pre-wetting at the pile is to move the needed amount of dry salt into an area for mixing. Spray liquid deicer onto the smaller pile at the desired rate, mix, and then load into the truck.

Figure 38. Overhead Pre-Wet Spray System

Spraying truckloads is accomplished by spraying liquid chemical onto a loaded truck, or while material is being loaded to the truck with an overhead spray-bar system. Spraying stockpiles and truck loads is not as practical since granules are not uniformly coated and liquid may drain out of the solid material. Performance on the road may not be consistent throughout the route.

The most efficient method is to pre-wet while salt is being discharged from the chute or at the spinner.

Solutions for pre-wetting can include sodium chloride brine, calcium chloride, magnesium chloride, potassium acetate, calcium magnesium acetate and various agricultural products.

For the UNH T2 best management practices fact sheet on Pre-wetting please refer to Appendix H.

If pre-wetting salt is not an option then pretreated salt may be available for purchase from your local supplier. It is important that the pre-wetted salt be stored in a covered area or within a building to reduce leachate and material waste.

Abrasives

Abrasives (sand and fine mineral aggregates) provide temporary traction on roads, hills, intersections or other problem areas. Abrasives do not melt ice or snow. They are generally used in very cold temperatures when other materials are not as effective. Abrasives, once applied, are quickly dispersed off the road surface by traffic, therefore they are most beneficial in very low traffic areas.

upcoming weather conditions and storms. For additional information regarding station locations within New Hampshire please visit the DOT informational poster on RWIS at: http://www.nh.gov/dot/org/projectdevelopment/materials/research/projects/documents/12323i_poster.pdf

5.2.2 Pavement Temperature

The two most critical factors that can produce a winter road hazards are pavement temperature and the dew point/precipitation rate. Pavement temperature, not air temperature, is the deciding factor for treatment type and duration. The pavement temperature directly effects the formation, development, and breaking of a bond between fallen or compacted precipitation and the road surface. The pavement temperature also determines the effectiveness of any applied chemicals. Pavement temperatures can be significantly affected by the following:

- Air temperature trends - may indicate what the pavement temperatures are likely to do.
- Subsurface temperatures - warm subsurface temperatures (typically in the fall) will help pavement hold heat and keep the pavement temperature from dropping. During the winter and spring, pavement temperatures will drop quickly because the ground is still cold. Pavement temperatures can be considerably colder then the air temperature in the spring, creating frost and ice conditions.
- Time of day - The amount of sunlight and the angle at which the sunlight hits the road will influence the pavement temperature and the melting effectiveness of any chemical that has been applied.
- Cloud cover - Daytime cloud cover can cause pavement temperatures to cool. During the night, lack of cloud cover causes heat to escape and cooling to occur.
- Wind speed and direction - can have either a warming or cooling effect.
- Precipitation rate - the amount of precipitation; whether it is snow, freezing rain, or sleet that falls within a given time will affect the temperature of the pavement.

Black ice or frost will form on a very cold pavement surface when air has cooled to its dew point. The dew point is the saturation temperature of the air. The higher the dew point, the greater the moisture in the air. The lower the dew point, the drier the air. When the air temperature is cooled to the dew point, water vapor in the air will condense into either a liquid or a solid.

It is essential to know the current pavement temperature, dew point, and weather forecast to accurately treat snow and ice problems.

5.2.3 Traffic, Road Surface, Beat

Vehicles can affect the pavement surface in many ways. Vehicles can compact the snow, abrade it, displace it or disperse. Heat from tire friction, engines, and exhaust can add measurable heat to the pavement surface. Vehicle action and road surface can influence, both positively and negatively, the effectiveness of snow and ice control. The volume of vehicle traffic should be considered when establishing levels of response.

Road surfaces such as asphalt, porous pavement, or gravel and locations such as intersections, bridges, shaded areas, steep grades, sharp curves, on/off ramps, and areas near high traffic facilities should be given special consideration along with areas prone to snow drifting or that experience sudden icing.

Have efficient and effective beats planned for your staff and prepare procedures for call outs and call backs. Have a description of beat length, the average time to run the beat along with the amount of chemical needed to complete it.

Road variables to take into consideration include:

- Geometrics – bridge decks, steep grades or sharp curves will influence the application rate required.
- Cold Spots – Cold spots at higher elevations or in shaded areas may require application and treatment techniques that are different from the rest of the route.
- Pavement Surface – surface consistency and variation will affect the types of equipment and techniques used.
- Lanes – the number of lanes being treated will effect the cycle time of the beat.
- Speed – truck speed will vary considerably due to traffic, buildings, pedestrians, and road type.
- Time of day – The amount of sunlight and the angle at which the sunlight hits the road.

NH Road Salt Application Rates for Deicing Parking Lots
(Pounds per 1000 sq.ft.)

Pavement Temp. (°F) and Trend (↑ ↓)	Weather Condition	Maintenance Actions	Application Rate (lbs/per 1000 sq.ft.)			
			Salt Prewet/ Pretreated with salt brine	Salt Prewet/ Pretreated with other blends	Dry salt	Winter sand
>30 ↑	Snow	Plow, treat intersections only	4.5	4	4.5	Not recommended
	Frz. Rain	Apply chemical	5.75	5.25	6.5	Not recommended
30 ↓	Snow	Plow and apply chemical	5.75	5.25	6.5	Not recommended
	Frz. Rain	Apply chemical	6.5	5.75	7	Not recommended
25 - 30 ↑	Snow	Plow and apply chemical	5.75	5.25	6.5	Not recommended
	Frz. Rain	Apply chemical	6.5	5.75	7	Not recommended
25 - 30 ↓	Snow	Plow and apply chemical	5.75	5.25	6.5	Not recommended
	Frz. Rain	Apply chemical	7	6.5	8.25	10.5
20 - 25 ↑	Snow or frz. Rain	Plow and Apply chemical	7	6.5	8.25	10.5 for frz. Rain
20 - 25 ↓	Snow	Plow and apply chemical	5.75	7.5	9.5	Not recommended
	Frz. Rain	Apply chemical	7	7.5	10	10.5
15 - 20 ↑	Snow	Plow and apply chemical	7.5	7.5	9.5	Not recommended
	Frz. Rain	Apply chemical	8.75	7.5	10	10.5
15 - 20 ↓	Snow or Frz. Rain	Plow and apply chemical	8.25	7.5	10	10.5 for frz. Rain
0 to 15 ↑↓	Snow	Plow, treat with blends, sand hazardous areas	Not recommended	10	Not recommended	13 and spot-treat as needed
< 0	Snow	Plow, treat with blends, sand hazardous areas	Not recommended	23	Not recommended	13 and spot-treat as needed

Table 19. Application Rates for Deicing

These rates are based on road application guidelines (Mn Snow & Ice Control Field Handbook, Manual 2005-1). Develop your own application rates by adjusting your current rates incrementally downward toward these guidelines. Where temperature categories overlap, select the rate most applicable to your situation.

NH Road Salt Application Rates for Deicing Roads
(Pounds per Lane Mile)

Pavement Temp. (°F) and Trend (↑ ↓)	Weather Condition	Maintenance Actions	Application Rate (lbs/per lane mile)			
			Salt Prewet/ Pretreated with salt brine	Salt Prewet/ Pretreated with other blends	Dry salt	Winter sand
>30 ↑	Snow	Plow, treat intersections only	150	125	150	Not recommended
	Frz. Rain	Apply chemical	175	150	200	Not recommended
30 ↓	Snow	Plow and apply chemical	175	150	200	Not recommended
	Frz. Rain	Apply chemical	200	175	225	Not recommended
25 - 30 ↑	Snow	Plow and apply chemical	200	175	225	Not recommended
	Frz. Rain	Apply chemical	225	200	225-275	Not recommended
25 - 30 ↓	Snow	Plow and apply chemical	250	200	275	Not recommended
	Frz. Rain	Apply chemical	275	250	275-300	450
20 - 25 ↑	Snow or frz. Rain	Plow and Apply chemical	275	275	275-300	450 for frz. Rain
20 - 25 ↓	Snow	Plow and apply chemical	275	250	300-325	Not recommended
	Frz. Rain	Apply chemical	300	275	325-400	450
15 - 20 ↑	Snow	Plow and apply chemical	300	275	325	Not recommended
	Frz. Rain	Apply chemical	300-375	275-350	325-400	450
15 - 20 ↓	Snow or Frz. Rain	Plow and apply chemical	325	300	350	450 for frz. Rain
0 to 15 ↑↓	Snow	Plow, treat with blends, sand hazardous areas	Not recommended	300-350	Not recommended	600 and spot-treat as needed
< 0	Snow	Plow, treat with blends, sand hazardous areas	Not recommended	350-500	Not recommended	600 and spot-treat as needed

Table 19. Application Rates for Deicing

These rates are based on road application guidelines (Mn Snow & Ice Control Field Handbook, Manual 2005-1). Develop your own application rates by adjusting your current rates incrementally downward toward these guidelines. Where temperature categories overlap, select the rate most applicable to your situation.

means that when mixed with water, depending on the concentration, it will lower the temperature at which the solution freezes. Solid sodium chloride loses it effectiveness (has difficulty going into solution) when temperatures fall below 15° F. Applications of dry salt below this temperature, even at high rates, will not result in snow or ice melting; therefore, it is critical that salt is applied at the appropriate pavement temperature. The average cost of NaCl is $58/ton or about $0.07 a gallon for 23.3 percent brine solution.

Dry salt that is applied directly to roads does not all remain in the targeted application area. The salt grains bounce and scatter after being applied and are blown off the pavement surface. With less salt retained on the road additional treatments or higher than needed application rates are required. For best effect with the least environmental impact salt should be pre-wetted with brine rather than applied in dry form. Refer to Appendix F for additional information regarding how salt works and Appendix H on pre-wetting salt.

Other Chlorides

Calcium(CaCl) and magnesium chloride(MgCl) are often used as salt alternatives; however, they have the same impact on water quality since they both contain chlorides. These chemicals work differently than salt in that they do not require heat energy to go into a solution; instead they give off heat when they go from a solid into a solution. Their main benefit is having lower eutectic temperatures, providing more melting power at lower temperatures. They are more effective in dry, cold conditions as compared with salt. It is not recommended that they be applied at high application rates or when pavement temperatures are above 28 degrees Fahrenheit due to an increase in slippery road conditions. They are both corrosive and may contain corrosive inhibitors. The cost associated with making brine using Mg chloride averages between $0.45-$0.75/gal and for Ca chloride the cost of brine is around $0.82/gal and $250/ton for flake.

Alternative De-Icers

Environmental impacts associated with the selection of alternative deicers should be considered. Road salt alternatives are primarily proprietary and are not well documented in scientific literature. Available data is limited, particularly regarding long-term environmental impacts.

Most agricultural by-products are not as good at melting ice; however, they do slow the formation of ice crystals, making them good for anti-icing and pre-treating. Some agricultural byproducts

have freezing points near -30° F. They are less corrosive than many conventional materials. Most products are derived from the processing of grains or other agricultural products. They have a higher cost associated with them and most often are mixed with products such as magnesium chloride.

Table 7. Generalized Environmental Concerns for Chloride Alternatives

Product	Chemical Formula	General Information	Environmental Concern
Calcium Magnesium Acetate (CMA)	CaMgAc	powder, crystal, pellet or liquid, non-corrosive, cost around $1,000/ton or $1.30/gal	Organic content leading to BOD
Potassium Acetate (KA)	KAc	liquid, non-corrosive, 50% concentration cost around $3.00/gal	Organic content leading to BOD
Agricultural By-Products	N/A	mostly proprietary, can be derived from corn, beet, alfalfa, alcohol, grains, or molasses. Less corrosive, lowers freeze point, generally not good at melting alone. Avg cost $1.00/gal	Organic content leading to BOD, Heavy Metals, nutrient enrichment by phosphorus, nitrogen
Urea (Urea, Ammonia)	Urea, Ammonia	fertilizer with high nitrogen content, corrosive, cost around $350.00/ton	Rapid break down and release of Ammonia, Fertilizer leading to nutrient enrichment, algae blooms and BOD

Since Dinsmore Brook flows into Cobbetts Pond and Cobbetts Pond is impaired for dissolved oxygen saturation and total phosphorus, agricultural by-products are not recommended, except in small quantities to pre-wet salt.

Addition of organic compounds (e.g., acetate or mixed organic matter from biomass) may cause deoxygenation in the water, which in turn could cause the release of potentially harmful substances such as heavy metals into the groundwater and could be a cause of taste and odor problems (NCHRP, 2004).

Brine

Using brine is the most cost effective way to anti-ice or pre-wet. Brine is widely used in other states because it is easy to produce, economical and effective for events occurring at moderate or subfreezing temperatures. There are many types of products that are used to make brine such as sodium chloride (NaCl), magnesium chloride (MgCl), potassium acetate(KA), calcium magnesium acetate(CMA) as well as proprietary blends. Each product has its

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WD-DWGB-22-30 2019

Storage and Management of Deicing Materials

Storage and management of deicing material can be a source of contamination of surface water and groundwater, causing a violation of state water quality standards. These salt-based products dissolve in precipitation and either infiltrate though the ground surface to groundwater, or run off into surface water. Salt that infiltrates the subsurface at significant concentrations can also react with the soils and release metals into groundwater and surface water at concentrations that exceed water quality standards.

The term "deicing material" used here refers to deicing salts, and may include any of the following in either solid or liquid form: sodium chloride (often called rock salt), potassium chloride, calcium chloride, magnesium chloride, and other mixtures that contain salts (chlorides) including mixtures with abrasives, such as sand, cinder, slag, etc.

Need for Proper Management

Due to their high potential for causing groundwater and surface water pollution, salt storage facilities should not be placed in environmentally sensitive areas. The best strategy to prevent pollution from deicing materials and the associated liability is to use and store these materials responsibly. Facilities should develop good housekeeping practices to minimize loss and waste during the delivery, storage, loading and management of deicing materials.

Existing and new facilities that operate without impermeable surfaces and infiltrate brine to the ground or groundwater need to register with the New Hampshire Department of Environmental Services (NHDES) under Env-Wq 402, Groundwater Discharge Permit and Registration Rules. This is a free registration and is a method of tracking potential contaminant sources. If there are sensitive receptors nearby, some sites may be required to monitor drinking water wells and/or the groundwater. The registration form can be found at the Groundwater Discharge Permitting and Registration program page.

Best management practices (BMPs) for locating a new deicing materials storage facility should include the following:

- The facility should be located in an area that is not environmentally sensitive. Avoid areas where there are wells, reservoirs, or within the footprint of stratified-drift aquifers.
- The facility should be located on a flat site away from surface water and wetlands.
- Site drainage should be designed to direct clean stormwater away from the operations and storage areas in order to keep the stockpiles as dry as possible.
- Drainage that is contaminated with salt should be directed to a sewage treatment plant (subject to municipal approval), collected for use in pre-wetting activities or sent for proper disposal.

Structures and Work Areas

Ideally deicing material storage facilities should be completely enclosed, with storage and working areas on impervious surfaces such as asphalt or coated concrete. There should be stormwater drainage controls to prevent runoff water and snow melt from contacting or running through loading and material storage areas. Overhead cover to protect material from exposure to snow and rain should be installed to minimize runoff and inventory loss. A fixed roof is preferred over a tarp, because it is very difficult to keep storage piles completely covered with tarps during winter months and storm events.

Buildings should have concrete foundations and can be designed using dome, barn, or fabric style structures. For more information on constructing salt storage units, calculating how much space is needed for storage, and salting practices, see the Salt Institute's publications at www.saltinstitute.org. *The Salt Storage Handbook* contains tables that indicate how much space is required to cover different height piles, and provides surface areas of exposed salt piles, to help in calculating number and size of tarps for *temporarily* covering salt piles.

The following BMPs should be considered when storing and managing deicing materials.

Storage Structures

- All salt and sand/salt mixtures should be stored on pads of impermeable asphalt or concrete. Storage and loading areas should have an impermeable floor constructed of asphalt, concrete or other suitable material that extends around the buildings and work area exterior. The area should be sloped away to prevent stormwater from entering the loading areas or structure.
- Concrete pads and walls should be treated to prevent concrete deterioration (spalling).
- Structure hardware should be galvanized and concrete block buildings should be waterproofed inside.
- If using a three-sided building, the exposed salt at the open end should be covered.
- Stormwater and snowmelt runoff should be properly controlled. Building floors and storage pads should be sloped to prevent ponding and allow any water to drain away from the storage piles.

On-Site Management: Delivery/Handling/Loading

- All sand and sand/salt mixtures temporarily out in the open should be covered to prevent salt from being washed or blown from the pile.
- If a permanent under-roof work area is not possible, then storage and handling activities should be conducted on impermeable (bituminous) pads. Any deicing materials left outdoors should be completely covered with waterproof tarpaulins.
- All surplus materials must be removed from the site when winter activity is finished.
- Working areas should be bermed and sloped to allow snow melt and stormwater to drain away from the area. In some cases, it may be necessary to channel water to a collection point, such as a sump, holding tank, or lined basin for collection.
- Storage and distribution should only be conducted during the fall/winter season.
- Spreaders should not be overloaded such that material spills off the vehicle. A plan for loading operations to prevent overfilling vehicles and eliminating material spillage during transportation should be developed and implemented.
- Salt spilled at the storage yard and loading areas should be collected and returned to the storage pile.
- Annual inspection and repairs should be carried out prior to the start of each season. Ongoing inspection of storage structures, work areas, and deicing liquid storage tanks should be carried out during the season.
- Solid bagged materials should be stored securely, indoors if possible.

- Spreaders should only be washed at a location where the wash water is properly managed. (See NHDES fact sheet WD-DWGB-22-10 Management of Vehicle Wash Water.)
- Liquid storage tanks should be designed such that a plumbing failure will not result in release of the contents. Backflow prevention may be necessary on some plumbing applications.
- Liquid storage tanks should be protected from impact from vehicles moving about the yard and be located such that spilled material can be contained and retrieved in the event of a tank or piping failure. Secondary containment should be provided around large liquid storage tanks.

Brine Storage and Management

In recent years, brine has been used on roads prior to storms as an effective ice preventative, reducing the amount of deicing materials needed during a storm event. The water that runs off storage and loading areas can be collected into watertight tanks or lined basin(s) and re-used in pre-storm wetting of roads. Any brine storage should be designed with inert materials that are compatible with salt.

Brine stored using holding tanks must be managed so that there are no releases to drains, groundwater or surface waters. If there is a floor drain in a building where brine is stored, it must be connected to a municipal sewer system (with the approval of the local authority), routed to a registered holding tank or permanently sealed. (see fact sheet WD-DWGB-22-8 Holding Tanks for Floor Drains)

Storage ponds or collection basins used for brine storage must be lined and must not receive runoff from areas other than the storage and operations areas. The basin itself must be impermeable to prevent infiltration of the collected water into the ground. The basin may need a roof or cover to reduce the accumulation of snow and rain water. The collection of this runoff water would only be necessary during the winter maintenance months (November through March). During the remaining seven months of the year, the non-brine stormwater can be redirected from the brine storage to a natural discharge point.

The preferred management option for any brine collected is for use as a pre-wetting agent for roads prior to winter storms. The release of this collected water to the ground, groundwater, or a stormwater system during operation or at season's end is not permissible and as a consequence, this type of runoff management may require disposal of the brine by one of the following methods: (1) discharge directly to a publicly owned treatment works (POTW) with local approval; (2) pumping and transporting the salt water to a POTW system by tank truck; (3) evaporation; or (4) treatment to remove salt and on-site discharge under a Nondomestic Wastewater Registration.

References:

Salt Institute
Michigan Department of Environmental Quality Salt and Brine Storage Guidance
Guide to Salt Storage Requirements for Small Commercial Snow Removal Services
Environnent Canada
Best Management Practices for Salt Use on Private Roads, Parking Lots & Sidewalks
SIMA (Snow & Ice Management Assoc.)

For More Information

Please contact the Drinking Water and Groundwater Bureau at (603) 271-2513 or by email at dwgbinfo@des.nh.gov

Note: This fact sheet is accurate as of June 2019. Statutory or regulatory changes, or the availability of additional information after this date may render this information inaccurate or incomplete.

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WMB-3 2015

Snow Disposal Guidelines

Introduction

Each winter, the Department of Environmental Services receives numerous complaints related to snow disposal into and/or near surface water. There are several different concerns regarding disposal of snow cleared from streets and parking lots ranging from aesthetic concerns, such as minimizing the visibility of debris and huge snow piles, to environmental concerns, such as protection of groundwater quality, drinking water supplies, surface water quality and aquatic life.

The environmental impacts of disposed snow result from high levels of salt, sand, debris and trash, along with contaminants from automobiles including oil and exhaust. The debris and contaminants that inevitably end up in plowed snow make it illegal to dump snow directly into water bodies. RSA 485-A:13,I(a) prohibits discharging wastes to surface waters without a permit. In addition to water quality impacts, snow disposed in open water can cause dangerous ice jams.

Manchester NH sign prohibiting snow dumping. Photo: Robert Robinson, City of Manchester

Groundwater is sensitive to snow dumping due to the high levels of chloride and automotive waste in plowed snow. RSA 485-C:12 prohibits the siting or operation of snow dumps within classified wellhead protection areas.

Refer to the following guidelines for siting legal snow dumps and protecting New Hampshire's water.

Recommended Guidelines for Snow Disposal

These guidelines will assist in identifying snow disposal sites that minimize impact to the environment. Please note that snow dumps are kept out of water bodies due to waste materials, such as litter and debris. Waste does not belong on the land surface either; after the snow melts, all waste must be collected and disposed of properly.

- Disposed snow should be stored near flowing surface waters, but at least 25 feet from the high water mark of the surface water and/or top of stream bank. If a site cannot be found near a flowing surface water, then upland sites further from surface waters are acceptable, provided they do not impact water supply sources as described below.
- A silt fence or equivalent barrier should be securely placed between the snow storage area and the high water mark and/or the top of stream bank with care taken not to exceed the barrier with over-piling. This area should also be accessible for post-melt cleanup. Note: silt fence must be installed prior to the ground freezing.

- The snow storage area should be at least 75 feet from any private water supply wells, at least 200 feet from any community water supply wells, and at least 400 feet from any municipal wells. (Note: Snow storage areas are prohibited in wellhead protection areas.)
- All debris in the snow storage area should be cleared from the site prior to snow storage.
- By May 15 of each year, all debris from active snow storage areas should be cleared and properly disposed of.

Snow Disposal Site Selection Procedures

Municipal public works officials should consider consulting with the local health officer and conservation commission to identify sites. Securing sites prior to the winter season will help to alleviate capacity problems during winters with heavy snowfall. NHDES is available to help municipal officials identify appropriate snow disposal sites. The following are guidelines for site selection:

- Estimate how much snow disposal capacity is needed for the season so that an adequate number of sites can be selected and prepared.
- Sites lacking mature tree growth are preferred; trees make collection of debris more difficult after the winter season.
- Identify sites that could potentially be used for snow disposal such as municipal open space, parks, recreation fields and parking areas. If no additional municipal sites are available, consider securing permission from landowners of non-municipally owned sites.

For more information about snow storage contact the NHDES Watershed Management Bureau at (603) 271-3398.

Attachment 4: Public Education Resources for Commercial Property Owners

NH MS4 Salt Reduction Plan Outreach Resources, June 30, 2020

(Provided by Barbara McMillan, NHDES)

Regulations for "Discharges to water qualty limited waterbodies where chloride is the cause of the impairment" Appendix H Section IV. Page 10. "The Salt Reduction Plan shall be completed within three years" and implemented within five years of the "effective date of the permit and include the BMPs in Part IV."

For outreach the plan must include:

1. Public education regarding impacts of salt use,
2. methods to reduce salt use on private property,
3. modifications to driving behavior in winter weather, etc.:

The following resources are available to meet each of the messaging requirements through NHDES Watershed Assistance Section and the Green SnowPro program:

1. **Public education regarding impacts of salt use:**

a) **Environmental Health and Economic Impacts of Road Salt** – Information Sheet and Webpages– Prepared by NHDES for the DES website. Includes: Overview, Water Quality Impacts, Human Health Impacts, Pet Impacts, Wildlife Impacts, Vegetation Impacts, Soil Impacts, and Infrastructure Impacts.

Used to create the NHDES webpages on this topic. A great resource to put on a municipal website and any other outreach methods. Available as one document and broken up into each category.

- File Folder at: ..\..\..\Outreach\Websites\Salt Website\final documents\Salt Environmental impacts
- Online at: https://www.des.nh.gov/organization/divisions/water/wmb/was/salt-reduction-initiative/impacts.htm#

b) **Road Salt and Water Quality -** NHDES Fact Sheet (WMB-4) – Includes: How salt works, what happens to it in the environment, road salt management issues, best management practices, and alternatives to road salt.

- File Folder at: ..\..\..\Outreach\Fact sheets NPS\2020 Fact Sheet updates\2020 Edited Versions\finals\WMB-4.doc (2020 version)
- Online at: https://www.des.nh.gov/organization/commissioner/pip/factsheets/wmb/documents/wmb-4.pdf

c) **Sodium and Chloride in Drinking Water –** NHDES Fact Sheet (DWB-3.17) – Includes: introduction and occurrence; health effects, standards, and advisories; testing: mitigation and treatment.

- File Folder at:
- Online at: https://www.des.nh.gov/organization/commissioner/pip/factsheets/dwgb/documents/dwgb-3-17.pdf

2. **Methods to reduce salt use on private property:**

a) **Green SnowPro Business Flyer** – Prepared by NHDES to promote using Green SnowPro certified winter maintenance professionals with local businesses. Includes: what you can do, why you can benefit, why it's important, the training, and for more information.

- File Folder at:
- Online at: https://www.des.nh.gov/organization/divisions/water/wmb/was/salt-reduction-initiative/documents/green-snowpro-business-flyer.pdf

b) **Green SnowPro Rack-Card** – Prepared by NHDES as shorter 8 ½ by 3 ½ inch rack-card to promote GreenSnow Pro with area businesses. Similar information as the business flyer above.

- File Folder pdf at: ..\..\..\Salt Cert\Outreach and Branding\Fact Sheets\2019_Rack_Card_Business_FINAL.pdf
- File Folder word at: ..\..\..\Salt Cert\Outreach and Branding\Fact Sheets\2019_Rack_Card_Business_Word_FINAL.docx

c) Snow and Ice Removal for the Business Owner: Clean Water and Safe Parking Lots – NHDES Fact Sheet (WMB-24) – Includes: liability protection and snow and ice removal tips.

- File Folder at: ..\..\..\Outreach\Fact sheets NPS\2020 Fact Sheet updates\2020 Edited Versions\finals\WMB-24.doc 2020 version
- Online at: https://www.des.nh.gov/organization/commissioner/pip/factsheets/wmb/documents/wmb-24.pdf

d) **Best Management Practices and Salt Minimization Efforts in Chloride Impaired Watersheds in New Hampshire: A Guidance Document for Private Developers and Contractors** – NHDES Fact Sheet (WD-WMD-26) – Includes: how developers and contractors can reduce salt loading in an impaired watershed.

File Folder at: ..\..\..\Outreach\Fact sheets NPS\2020 Fact Sheet updates\2020 Edited Versions\finals\WMB-26.docx 2020
Online at: https://www.des.nh.gov/organization/divisions/water/wmb/was/salt-reduction-initiative/documents/wmb-26.pdf

3. **Modifications to Driving in Winter Weather:**

a) **Tips for Driving in Snow** – Adapted from Automobile Association of America (AAA) – Includes tips on how to drive safely in snow.

- File Folder at: ..\..\..\Outreach\salt\Salt related outreach\Tips for Driving in the Snow.docx

Topic specific and general outreach social media messaging can also be found at the Green SnowPro Facebook page at: https://www.facebook.com/NHGreenSnowPro/

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WD-WMD-24 2014

Snow and Ice Removal for the Business Owner
Clean Water and Safe Parking Lots

New Snow and Ice Liability Protection in New Hampshire

Under a new law, RSA 489-C, *Salt Applicator Certification Option* (effective November 1, 2013), any business owner who contracts for snowplowing and deicing with a "certified" salt applicator, has liability protection from damages arising from hazards caused solely by snow or ice. The "certified" applicator is a snow removal contractor (contractor) who has undertaken specialized training through the University of New Hampshire "Green SnowPro Program" in the "how to's" of efficient application of road salt (sodium chloride). In addition to providing limited liability protection, hiring a Green SnowPro certified contractor will:

- Increase the efficiency of removing snow and ice while ultimately decreasing the amount of road salt that is applied to the parking areas that they care for.
- Potentially save the business owner money through reduced salt use.
- Reduce impacts to the surrounding environment by protecting our ground water and nearby streams, ponds and lakes from potential chloride contamination from runoff that often originates from parking lot areas.
- Minimize the salt and sand that is often tracked into the lobbies and offices at one's facility.
- Protect the landscape plantings (the trees, shrubs, and grass) and soil that often surround a parking area.

As many business owners have already learned, the level of service (how effectively a parking area can be managed for customer satisfaction) and customer safety, *are actually increased* substantially by more efficient salt use and not compromised as once traditionally thought. In our more urban areas, up to 50 percent of the chloride polluting local waterbodies originates from commercial parking lots. Business owners can minimize their cumulative impact on the environment by engaging certified salt applicators and implementing best management practices for salt reduction. Encourage your current contractor to look into the Green SnowPro program at the University of New Hampshire: http://t2unh.edu/green-snowpro-training-and-certification or by calling Beth Hamilton, the Training Program Manager at 603-862-1362.

NEW HAMPSHIRE CERTIFIED GREEN SnowPro

Snow and Ice Removal Tips

The following additional tips may also improve the success of winter snow and ice removal activities:

1) As stated above, contract for snow removal with a "certified" Green SnowPro contractor. Provide your company with important liability protection and maximize the usefulness and safety of your parking area for your customers during the wintertime by hiring these specially trained individuals.
2) Before the snow season, review the existing building design and layout with your contractor to assist in facilitating "mechanical" snow removal, a preferred method of removing snow and ice (mechanical snow removal is the removal of snow with plow equipment or by hand shoveling without the use of any de-icer). Identify where snow will be piled, and high priority pedestrian and vehicle traffic expectations.
3) Encourage mechanical snow removal as early as possible at the onset of a storm. This helps to prevent snow and ice from adhering to the parking lot pavement initially and normally requires less salt application(s) during the full course of the storm.
4) If possible, consider not maintaining low use areas in the winter. SIMA, a national organization representing the snow and ice removal industry, has observed that in large parking lots, customers routinely park in small, confined areas at the entrances of the respective businesses. After the Holiday rush (where full parking capacity may be required), consider reducing the size of the parking area normally maintained, thus reducing overall plowing cost and application of road salt.
5) Ask important questions. For example, does your contractor calibrate his/her salt spreader each year – this alone can improve efficiency and reduce the amount of salt that is spread by 5 to 7 percent. Involvement by management will improve snow removal activities and should ultimately reduce overall cost.
6) Ask your contractor if they are using infrared thermometers to reduce potential salt applications. It's all about temperature, temperature, temperature…studies show that parking lot pavement temperatures are usually warmer than air temperatures, particularly during the day. This means that there are many times when the pavement temperature will be above freezing even when air temperatures are well below freezing. Understanding this, a follow-up application of salt may not be necessary. At the opposite end, an application of road salt (sodium chloride) is generally not effective under 15 degrees Fahrenheit. It may be better during these periods to apply an abrasive like sand and wait to reapply road salt when the temperature rises again.
7) Direct your contractor to plow snow to the low side of the paved parking area. This will help to concentrate the snow piles away from customer service areas and may help to prevent slippage by customers on ice caused by the daily melting of snow piles.
8) Cover any sand and sand/salt mixtures stored within a parking area for treatment purposes to prevent salt from being washed or blown from the pile (studies have shown where 50 percent of this pile can be carried away).
9) Where possible, direct your contractor to use *drop-type* rather than *broad-cast* spreaders on sidewalks to increase the amount of material retained on the sidewalks to work. This will also help to limit salt damage to vegetated areas adjacent the sidewalks.
10) Encourage your contractor to use *anti-icing* measures before the storm. A concentrated liquid *anti-icing* product (brine) applied before the start of a snow storm has the advantage of preventing snow and ice from bonding to the pavement and accelerates the melting process. This practice can reduce slippery conditions more quickly to begin with, ultimately significantly decreasing the amount of sodium chloride that is applied to parking areas.

11) Encourage your contractor to use *pre-wetting* measures (where brine is used to wet sodium chloride) which increase the efficiency and speed at which the salt melts the ice. *Pre-wetting* through the use of saddle tanks mounted next to the salt hopper on the truck or by pre-wetting a pile of sodium chloride beforehand should also be considered as a worthy alternative and can provide another means of reducing the total application of salt. Both *anti-icing* and *pre-wetting* measures, when compared to other salt reducing efforts, are generally more effective at reducing substantial tonnage of salt.

The success of any salt reduction program requires effective procedures, the introduction of new salt reducing equipment or measures, and specialized training. Success will require the acceptance of these approaches by the business owner, property manager or supervisor, and the contractor; and most importantly a willingness to work together. For more information, please contact Earle Chase at the NHDES Watershed Assistance Section: 603-271-5329 or earle.chase@des.nh.gov or visit the NHDES NH Road Salt Reduction Initiative Website: http://des.nh.gov/organization/divisions/water/wmb/was/salt-reduction-initiative/index.htm

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WMB-26 2020

Best Management Practices and Salt Use Minimization Efforts In Chloride-Impaired Watersheds of New Hampshire:

A Guidance Document for Private Developers and Contractors

Scientific studies in southern New Hampshire have determined that over 40 streams have elevated levels of chloride high enough to be harmful to aquatic life, such as fish. Elevated levels can also be a drinking water health concern for people and animals, can lead to plant death particularly along roadsides, and can cause damage to infrastructure and automobiles. The primary source of these chlorides is salt used for winter snow and ice management. The New Hampshire Department of Environmental Services (NHDES) calculated that a salt use reduction of 25% to 45% was needed in order to meet water quality standards. The studies have also revealed that up to 50% of the chloride load was coming from parking lots, driveways and private roads from salt that is used for de-icing.

NHDES encourages private developers and contractors, particularly those working within chloride-impaired watersheds, to adopt best management practices (BMPs) and salt use reduction methods that will help improve water quality. NHDES also encourages private developers and contractors to consider winter maintenance during project design. Salt use reduction can lead to long-term cost-savings as a result of purchasing less salt and reduced impacts on vegetation (e.g., landscaping) and corrosion of infrastructure and vehicles. This guidance document is directed toward developers and contractors to help them reduce the use of salt, to plan for BMPs and salt reduction methods, to include design considerations relative to snow and ice management BMPs, and to document their snow and ice management plans. Taken together, these are the basic elements of a Salt Minimization Plan.

A REDUCTION IN SALT USE DOES NOT MEAN A REDUCTION IN SAFETY

Liability for damage or personal injury as a result of snow or ice is one of the main reasons that over-salting occurs and many contractors are reluctant to implement salt reduction practices for fear of increased liability. However, recent studies have found there are BMPs that can be used that optimize salt use, reduce the application frequency and amounts applied and, at the same time, achieve safe levels of service. In addition, commercial salt applicators certified by NHDES under RSA 489-C (Green SnowPro Program) and the property owners or managers who hire them are granted limited liability protection against damages and personal injury arising from snow and ice conditions.

WHAT DOES ALL THIS MEAN FOR PRIVATE DEVELOPERS AND CONTRACTORS?

Salt Minimization Plans for chloride reduction have been developed for a number of places in New Hampshire. Some of these plans are required by permits or other regulatory requirements. The New Hampshire Department of Transportation (NHDOT), towns, and private contractors who maintain

parking lots, sidewalks, and roadways will be required to follow the Salt Minimization Plans through certain federal and state permits. In other places, watershed-wide Salt Minimization Plans have not yet been developed. In those areas, especially places that drain to chloride impaired waters, mandates to minimize salt usage are likely to be required of many new commercial and residential developments. Even in places with Salt Minimization Plans, the need to reduce salt may be so extreme that it will require the concerted efforts of the state, municipalities and private landowners to restore water quality.

THE ANNUAL NEW HAMPSHIRE SALT SYMPOSIUM

Every year, NHDES hosts an annual Salt Symposium. Attendees are updated with the latest snow industry technologies and BMPs. The event satisfies the required two-year refresher course for Certified Green SnowPro Applicators and UNH T2 Roads Scholar Program Contact Hours. To learn more about the event, please visit: http://www.sima.org/new-hampshire-salt-symposium.

HOW CAN PRIVATE DEVELOPERS AND CONTRACTORS MINIMIZE SALT LOADING IN CHLORIDE-IMPAIRED WATERSHEDS?

Some of the most effective ways for private developers and contractors to reduce their chloride loading in a watershed are to learn more about snow and ice management BMPs, learn ways to be more effective at winter maintenance activities, and to apply what is learned to current practices and future projects. There are three important ways for that to happen.

- **GET TRAINED AS A GREEN SNOWPRO**
  There are several options available for getting trained as a Green SnowPro snow and ice management professional in New Hampshire. Green SnowPro training courses focus on efficient, more environmentally friendly winter maintenance practices that do not compromise road, parking lot and sidewalk safety. The courses cover the basics of salt reduction methods including equipment calibration and rate applications, pre-treatment methods, effective plowing and planning, salt accounting management and the environmental impacts of salting. The courses are offered several times a year at various locations throughout New Hampshire or online. For more information, search the NHDES webpage for Salt Reduction Program.

- **BECOME A NEW HAMPSHIRE CERTIFIED SALT APPLICATOR**
  Individuals who complete the Green SnowPro Training (Full Course) and pass the exam are eligible to apply for voluntary NHDES Salt Applicator Certification. The NHDES Salt Applicator Certification program (Green SnowPro) aims to improve efficiency in salt use and reduce the amount of salt used by commercial applicators. The NHDES Salt Applicator Certificate carries the responsibility of annually reporting salt use to NHDES, renewing the certification each summer, and attending a refresher training course every two years. The Salt Applicator Certificate has proven valuable to private contractors as well as to their clients and their insurance carriers. To date, over 1,500 individuals have become Certified Salt Applicators. For more information on how to become a New Hampshire Certified Salt Applicator or to find a list of Certified Salt Applicators search the NHDES website for “NH Voluntary Salt Applicator Certification & Liability Protection.”

- **DEVELOP A SALT MINIMIZATION PLAN(s)**
  NHDES encourages developers and contractors to develop a Salt Minimization Plan as part of, or in addition to, their Winter Maintenance Plan or Winter Snow and Ice Control Policy to help reduce and manage the use of salt. Also referred to as Chloride Reduction Plans or Salt Reduction Plans, these plans vary from large, metropolitan city plans to single development plans. Where they exist, the plan should align with the objectives outlined in the town’s or

watershed's chloride reduction implementation plan. A general outline and description of what information goes into a Salt Minimization Plan is included as an attachment to this guidance document.

OTHER WAYS TO REDUCE SALT LOADING IN CHLORIDE IMPAIRED WATERSHEDS
(See Attachment B for a checklist of smart salting practices.)

- Be aware. Find out what the chloride loading reduction goals are within the watershed and town where work generally occurs or where the specific project is located.
- Re-evaluate current practices. Source reduction is identified as the most effective method for reducing chloride loading.
- Consider alternative de-icing materials such as calcium magnesium acetate (CMA) and limited use of abrasives (sand, sawdust, cat litter).
- Pre-wet salt with brine to reduce the loss of salt from bounce and scatter (up to a 30% reduction in loss) and increase melting times.
- Be proactive for storm events and anti-ice by applying a small amount of liquid chemical to pavements and overpasses *before* a storm to prevent ice from bonding with the surface.
- If applicable, keep pavement free of potholes and cracks which increase the ability for water to pond causing more ice to form. In addition, pavement that is in good condition allows for snow and or ice to be mechanically removed much more easily.
- Consider future maintenance needs in project planning.
    - Include development amenities/features such as heated sidewalks or parking garages.
    - Limit the amount of impervious surfaces that require winter maintenance activities. Some options to achieve this are only including sidewalks on one side of the street, the use of porous paving materials and limited use of curb cuts.
    - Design parking lots or designated parking areas with appropriate winter maintenance and snow storage practices in mind. This includes considering where plowed snow will be piled and avoiding melt drainage to flow back across cleared areas (freeze/thaw cycle).
    - Consider landscape vegetation that is more salt tolerant and that doesn't shade out sidewalks or parking areas from the sun during the winter.
- Share information with the municipalities and other landowners in the watershed to help track where salt is being applied, what quantities, and how often or the level of service based on the winter management plan. Track what BMPs are being applied to help determine effectiveness.
- Spread the word and encourage co-workers and colleagues to become a New Hampshire Certified Green SnowPro. Educate clients about the benefits of hiring a New Hampshire Certified Green SnowPro. The NHDES has developed a flyer for businesses to share with their colleagues or clients relative to the Green SnowPro Program and it can be found by following the link below.
- Attend the annual New Hampshire Salt Symposium. The event satisfies the two-year Refresher Course requirement of the Green SnowPro Program.

OTHER RESOURCES AND REFERENCES:

For the complete list of NHDES resources including links to training and certification application materials available, please visit the NHDES Road Salt Reduction webpage.

Assessing the Efficacy of Current Road Salt Management Programs, University of Waterloo (2010)

Environment and Climate Change Canada – technical documents, BMPs and general information.

NHDES Green SnowPro Business Flyer

Pre-wetting and Anti-icing – Techniques for Winter Road Maintenance, a Wisconsin Transportation Bulletin - No. 22.

NH Salt Reduction Best Management Practices (several Fact Sheet links available)

Snow and Ice Management for the Business Owner – Clean Water and Safe Parking Lots, NHDES (2020)

Snow Disposal Guidelines, NHDES (2020)

Road Salt and Water Quality, NHDES (2020)

Winter Parking Lot and Sidewalk Maintenance Manual, Minnesota Pollution Control Agency (2015)

ATTACHMENT A - DEVELOPING A SALT MINIMIZATION PLAN

Developing a Salt Minimization Plan will go a long way towards reducing salt use, i.e., chloride loading, within the watershed. The development of this plan will help private developers and contractors to hone in on how much salt is needed, when it should be applied, where it needs to be applied, etc. with the ultimate goal of reducing salt use without compromising safety. Salt use reduction also leads to long-term cost-savings as a result of purchasing less salt and reduced impacts on vegetation (e.g., landscaping) and corrosion of infrastructure and vehicles, and a reduction in well replacements. Reduction in the use of salt does not mean a reduction in level of service or public safety; in fact, many contractors who complete the Green SnowPro training course, pass the exam, and become a certified salt applicator have been able to provide the same level of service while reducing their salt use by 30%.

It is important to anticipate that a Salt Minimization Plan will be a living document that will likely need to be updated at some point. Reduction goals may fluctuate from year to year due to improvements in technology and BMPs, a municipality's requirements, or state and federal permit conditions that require private developers or contractors to alter practices, particularly as more development occurs. It is good practice to review and update the plan(s) annually, early in advance of the winter season so that there is time to make any necessary adjustments.

In general, NHDES recommends that the plan include:

- **Introduction/Background** – Identify the purpose and need for the plan. This section should describe any current chloride impairments and salt reduction goals within the watershed and municipality. If there is a Winter Maintenance Plan or Winter Snow and Ice Control Policy already in place, this section should briefly describe how this Salt Minimization Plan fits in with the more general winter maintenance approach and BMP practices. It may be that many of the items below are already adequately covered in the broader Winter Maintenance Plan.
- **Development or Project Area Description** – Describe the development. How many linear feet of roadways or sidewalks are there? Discuss the main features and layout of the site including stormwater runoff /topography, as well as vegetation and shaded areas. Including a general map of the development that identifies these features is helpful.
- **Operational Guidelines** – Identify who the responsible party is for winter maintenance activities and list out contracting requirements and minimum specifications for de-icing, anti-icing, pretreatment practices, and equipment. This guideline should describe the level of service required by the development which directly impacts maintenance operation plans.
    - **Winter Operator Certification Requirements** – This section outlines employee or contractor training and certification requirements relative to winter snow and ice management of the property (Green SnowPro training and certification is recommended).
    - **Weather Monitoring** – Outline where weather information will be acquired and how it is used to ensure that winter operators are making informed decisions as to when and to what extent materials are applied to private roadways, sidewalks and parking lots. An important part of this will be developing a good communication plan that identifies key personnel responsible for weather monitoring.
    - **Equipment Calibration Requirements** – Outline all winter equipment calibration requirements. Typically, a 25% reduction in salt use can be achieved simply by calibrating equipment, and is the single most important aspect to achieving salt use reductions.

- **Mechanical Removal** – Describe mechanical removal practices such as where snow should be stored and how often plowing should occur. Include goals, such as practices that minimize snow- and ice-pack to reduce the need for abrasives, salt and or brine applicants.

- **Salt Usage Evaluation and Monitoring** – Describe how salt usage will be documented and how salt use will be monitored and evaluated in conjunction with the municipality's or watershed organization's salt reduction plan (if applicable). Monitoring salt usage as well as winter maintenance actions are keys to determining what works, how much salt and other winter maintenance materials were used and estimating what is needed for the next winter season, and if salt minimization plan goals contributed to chloride load reductions in the watershed. It is recommended that a report be developed annually following the winter season and provided to the municipality in which the development or work is occurring for use in documenting private contractor salt use and allocations in the watershed. A schedule for how often the Salt Minimization Plan is updated should be included and tracked within this section as well.

  Salt Evaluation and Monitoring Elements:
  - ✓ Where the maintenance is occurring.
  - ✓ What the activity being performed is and/or what equipment is being used.
  - ✓ What the weather conditions are - include:
  - Event timing (pre-storm, during, post-weather event)
  - Air and ground temperatures
  - ✓ Time of activity
  - ✓ Application rates
  - ✓ Results
  - ✓ Other info – BMPs in practice for consideration, etc.

- **Analysis of Alternative De-icing Materials**, **Site Design Considerations and Watershed Offsets** – Describe alternative de-icing materials (calcium magnesium acetate, e.g.) that could be used for winter maintenance activities, and discuss what was considered, incorporated, and/or eliminated and why. Discuss what site design features or amenities were incorporated or considered, such as parking garages, heated sidewalks, vegetation, etc., to minimize salt use. Include a discussion on other options for offsets within the watershed such as educating others and applying good salt application strategies to other facilities.

Not all items above need to be included within the plan, generally the more complex the project, the more detailed the plan. In addition, some of these items may already be thoroughly covered in the broader Winter Maintenance Plan.

ATTACHMENT B – SMART SALTING PRACTICES

A checklist for snow and ice management contractors.

Recommended practice	Check which response applies to current practices and anticipated site maintenance activities for the job site.				
	Already do	Will do	Might do	Will not do	If "will not do"….why not?
Use of a salt application rate chart.					
Calibrate equipment each year.					
Learn about the de-icer ingredients and use the appropriate one for the condition.					
Look for reasons if and why materials are leaking or spilling from vehicles and repair them (e.g. gaps, overfilling, etc).					
Develop a comprehensive winter maintenance policy. Follow your policy.					
Measure and use pavement temperatures.					
Use anti-icing appropriately prior to the storm.					
Plow before applying de-icers.					
Use wet materials (pre-wet or pre-treated).					
Don't apply sodium chloride (road salt) for pavement temperatures below 15ºF.					
Don't apply de-icers for pavement temps under -10º F. It's too cold.					
Separate salt and sand. Use salt for melting. Use sand for traction.					
Apply de-icers in the center of the road or on the high side of the curve.					
Store the salt in a building or under secure cover.					
Store salt away from water flow and direct the water away from storage area.					
Store snow away from lakes, ponds and wetlands.					
Sweep up sand, dispose of properly.					
For each event, document what you did and how well it worked. Use this information to make improvements.					

Checklist is adapted from worksheet created by Fortin Consulting as a part of the Minnesota Pollution Control Agency Smart Salting Voluntary Certification Program.