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1 Preface

In 2010, the Maryland State Legislature passed two (2) bills, House Bill 0903 and Senate Bill 0775, which required the establishment of a Statewide Salt Management Plan. The legislature tasked the Maryland Department of Transportation State Highway Administration (MDOT SHA), in conjunction with the Maryland Department of the Environment (MDE), to develop a road salt management best practices guidance document by October 1, 2011, for use by the state or use and/or reference by local jurisdictions. The purpose of this document is to provide guidance and direction for the optimized use of road salt (primarily sodium chloride) during winter operations, to lessen the adverse impacts of salt in the state. These Best Practices for Salt Management discuss how to minimize road salt use from its delivery, storage and handling at salt storage locations, to its placement on highways during winter storms, to post-storm cleanup operations. The following Best Practices should be a starting point in an agency’s plan to minimize the negative impacts of salt on highway assets and the natural environment of Maryland.

The primary objective and goal of this Statewide Salt Management Plan is to provide a framework for highway agencies to deliver safe, efficient roadway systems during winter storms in a cost effective, environmentally sound, and sustainable manner. The secondary objective and goal of this plan is to consolidate MDOT SHA’s current practices and documents into a single comprehensive guidance document.
2 Introduction

To be effective, a Salt Management Plan should contain principles that define the basic goals of a jurisdiction in order to deliver service to the public while meeting the agency’s mission. The common goals for all jurisdictions include:

2.1 Public Safety

Effective winter storm maintenance has a direct impact on the safety of roadway users and on the personnel performing the maintenance. In the development of this plan, safety will be the primary goal.

2.2 Environmental Protection

Since the use of salt in high concentrations can have a negative impact on highway structures as well as the roadside environment and receiving waters, the development of the Best Management Practices (BMP) contained in this plan will consider practices that promote careful handling and application of winter materials such as rock salt and brine solutions, minimize the total usage of those materials, and thereby minimize and reduce the negative impacts of winter operations.

2.3 Efficient Transportation System

Efficient transportation systems are essential in maintaining the mobility necessary for economic stability and in providing the quality of life expected by a jurisdiction’s constituency. Salt Management Plan development should factor in these requirements.

2.4 Fiscal Responsibility

State, county and local jurisdictions are bound by budgets determined by their governing bodies. The Salt Management Plan for these jurisdictions must be within their financial capabilities.

2.5 Continual Improvement

To progress in the reduction of salt usage and negative impacts, jurisdictions need to consistently seek to improve current practices. Each jurisdiction should assess goals, technologies, practices, materials and equipment on a recurring basis to determine if any changes can affect salt usage or reduce negative impacts. Since these changes may have a fiscal impact, there must be recognition that many changes may be incremental.

2.6 Local Development of Salt Management Plans

Because of the variances in state, county and local transportation agency resources and mission objectives, Salt Management Plans for said jurisdictions should be locally developed. The plans should define the key elements of an environmental management program. Commitment to the plan should include accountability, goals, measurement of progress, communication, reporting, and periodic review. These aspects will ensure that local Salt Management Plans are living documents that allow for continual improvement.
3 Safety and Mobility

Agencies, such as MDOT SHA, are keenly aware of their goal to provide safety and mobility during winter storms in a cost-effective manner while minimizing environmental impacts to the maximum extent practicable.

In the reality of winter storms, the ideal outcomes for this goal are difficult to achieve and at times, in conflict with one another. The principal driving force that often decides the hierarchy in this potential conflict is the defined level of service (LOS) an agency is obligated to provide its citizens.

However, LOS may not be the most appropriate and practical level of measurement during winter operations. During a winter storm, agencies should consider defining safety and mobility in terms of a “passable roadway”, considering the limitations imposed by weather conditions, resource availability and environmental concerns.

MDOT SHA defines “passable roadway” as a roadway surface that is free from snow drifts, snow ridges, and as much ice and snow as is practical that can be traveled safely at a “reasonable speed for the conditions”. A passable roadway should not be confused with "bare pavement," which is essentially free of all ice, snow, and any moisture. It should be assumed that a bare pavement condition may not exist until the weather conditions improve and plowing can remove the full amount of snow and slush from the pavement.

"Reasonable speed" should be defined as a speed at which a vehicle can travel without losing traction. During and immediately after a winter storm event, a reasonable speed is assumed to be lower than the posted speed limit. Motorists should expect some inconvenience and modify their driving practices to suit road conditions.

3.1 Passable roadway expectations

It is considered inappropriate to attempt to melt snow as fast as it hits the ground or to keep the highway wet to eliminate any accumulation. Ideally, the proper combination of plowing with the appropriate amount of salt or brine should be used to prevent the bond from forming If snow pack should occur, agencies should strive for “passable roadway” conditions and eventually “bare pavement” as soon as practical after the winter storm event has ended.

3.2 Class 1: Interstate highways and major US routes that connect to adjacent states

For a winter event that is forecast to start as snow or sleet, highways in this category should be pre-treated with salt brine between two hours and two days prior to the anticipated start of the event. This will provide a thin layer of salt to adhere to the pavement and prevent the frozen precipitation from bonding to the surface. During the active winter storm event, these highways should be maintained in “passable roadway” condition on all lanes and ramps. Plowing is the primary tool for snow removal, with road salt and/or salt brine as a re-application, to continue preventing the bond of ice or snow to the pavement.

3.3 Class 2: High volume highways (high average daily traffic (ADT))

For a winter event that is forecast to start as snow or sleet, highways in this category should be pre-treated with salt brine prior to the anticipated start of the event. This will prevent the frozen precipitation from bonding to the surface. Highways in this category typically have high traffic volumes that make it necessary to focus on more than just the driving lanes during the winter storm event. On these highways “passable roadway” conditions should be maintained on the driving lanes, turn lanes and acceleration/ deceleration lanes during the winter storm event. Plowing is the priority for snow removal.
Agencies should strive to keep the snow from packing on the driving lanes, turn lanes and acceleration/deceleration lanes during the winter storm event. Only enough road salt or salt brine should be re-applied to keep the precipitation from bonding to the roadway surface.

3.4 Class 3: Highways with moderate ADT

On these highways, agencies should strive for “passable roadway” conditions on the driving lanes, turn lanes and acceleration/deceleration lanes during the winter storm event. Plowing is the first priority for snow removal. Agencies should apply only enough road salt and/or salt brine to prevent bonding during the event.

3.5 Class 4: Highways with low ADT

On these highways, agencies should strive for “passable roadway” conditions on the driving lanes during the winter storm event. Plowing is the priority for snow removal. The agency should strive to keep the snow from packing on the driving lanes during the event, only applying enough road salt and/or salt brine to keep the precipitation from bonding to the roadway surface.

The classes generally correspond to the roadway functional classifications as defined by the Federal Highway Administration (FHWA).

3.6 Exceptions

Exceptions to this guideline will occur when a winter storm event is followed by subsequent storms that happen at a frequency where it is not possible to obtain passable roadway conditions and bare pavement between events. The severity of an event, roadway temperatures, and availability of resources will dictate how soon passable roadway conditions and bare pavement can be obtained.

Passable roadways during winter storm events, as identified above allows emergency responders to provide adequate response times and transport to emergency facilities.
4 Establishing Goals to Reduce the Negative Impacts of Salt

The tool that most winter maintenance agencies use to provide safe, passable roadways is the tried and true combination of plowing and salting. While the best practices of this plan are readily understood as tools for managing the impacts of winter materials on budgets, highway managers should also be aware of the costs and negative consequences of salt on highway infrastructure and environments beyond the right of way.

Salt and all winter materials have positive benefits as well as potentially negative impacts. In addition to the costs of the deicing materials and their application, the use of these materials can be economically damaging to MDOT SHA because they deteriorate concrete and corrode aluminum and steel. No less importantly, these materials may also cause costly damage to trees, grass and other plants, and can also damage water quality and harm aquatic organisms.

Perhaps worst of all from the perspective of the highway manager, the heavy and repeated use of salt and other winter materials can permanently damage the structure of landscape soils, reduce the ability of soils to physically support traffic loads and resist rutting, and can destroy the ability of soil to sustain plant growth. All of these consequences can lead to large areas of bare and eroding soil, washouts, and various types of structural failures.

As the use of salt and other winter materials increase in any area, the severity, economic costs and environmental impacts of salt also tend to increase. The purpose of the Statewide Salt Management Plan is ultimately to reduce the likelihood, severity and costs of winter materials and their consequences. To that end, some understanding of the specific problems that may be caused by winter materials are useful to understand.

Rock salt is predominantly sodium chloride. In addition to damaging structures, sodium causes physical deterioration of soils, makes soil more alkaline and removes nutrients, and after years of sufficiently heavy use can cause such extensive damage that complete removal and restoration is the only practical solution. In addition to damage from sodium, the chloride content of rock salt is cumulatively damaging to soils, plants and water quality.

Although soils can absorb and safely ‘excrete’ relatively large amounts of sodium and chloride over time due to the cleansing action of rainfall, the heavy and repeated application of salt is eventually unsustainable and leads to irreversible damage. Likewise, heavy and repeated use of brine solutions which may contain sodium chloride as well as magnesium chloride pose similar problems and are eventually damaging to both plants and soils when applied to excess.

As noted above, the purpose of this plan is to reduce the direct and indirect costs of winter operations, and to explain the ways that salt and other winter materials can be used with the greatest safety to highway infrastructure and green assets. In the end, this plan is intended to serve the interests of citizens and the business community by reducing the cost applying winter materials as well as the cumulative costs and environmental impacts of heavy salt use.

There is an adage “that which gets measured, gets done” and best practices for salt management are no exception. Highway managers must track salt usage along with other related snow and ice control efforts, and they should also measure the severity of winter weather to determine how severity correlates to salt use and salt damage to highway structures and landscaping.

Setting annual quantity goals for salt reduction is not always practical due to the dynamic nature of winter storms that vary in number, intensity, and other factors. Thus, measurements should be used to recognize and respond to trends and usage patterns, rather than to simply develop annual reduction goals. However, by analyzing trends and understanding the negative impacts of winter materials, it is possible to develop and implement a responsible plan with long-term goals that reduce the likelihood of damage while maintaining an acceptable level of safety and mobility for highway
users.
5 Equipment and Materials

Winter operations require specific equipment and materials to maintain safe, passable roads. The equipment must be properly serviced, calibrated and/or repaired prior to the beginning of the season. Materials require proper storage, handling and distribution across the roadway system.

5.1 Types of Winter Materials

Salt is the primary snow and ice control material used by MDOT SHA and by many agencies throughout the country. It is used because it is effective for winter storms in Maryland, inexpensive, easily stored, and readily available. Granular road salt is used primarily during storms when precipitation has already begun to fall. Over the past few decades, research into other materials has been conducted, but none have been able to replace salt in benefit/cost effectiveness and reliability. While it will continue to be the primary material for fighting winter storms, agencies should continue to look for ways to minimize its use. That is the focus of this Salt Management Plan.

The second most commonly used material by MDOT SHA and other agencies across the country is salt brine (liquid sodium chloride). Salt brine is used by MDOT SHA and other agencies primarily in anti-icing operations prior to storms. It is sprayed on highways by applying a critically measured solution two hours to two days prior to the onset of frozen precipitation to prevent snow and ice from bonding to pavement. It is also used to pre-wet granular salt as salt is spread on highways in deicing operations to reduce bounce and scatter. Salt brine is used when snow or ice has already accumulated on the surface of the highway. Deicing involves plowing and spreading salt to remove the frozen precipitation from surfaces. Anti-icing and deicing will be explained in greater detail later in this document.

Salt brine has several attributes that explain its rising usage. First, it is easily manufactured using a brine maker. Dry salt is dissolved in fresh water and brought to a concentration of 23.3% sodium chloride, this brine is then pumped to storage tanks where it is available for application on roads. Whereas salt begins to lose its effectiveness at 20 degrees, brine has a freeze point of -6 degrees, and will work when road salt is ineffective. MDOT SHA, for example, has 15 brine makers strategically placed across the state. Soon, MDOT SHA anticipates the installation of additional makers to re-distribute production in a more efficient manner.

MDOT SHA and other highway agencies also use limited amounts of liquid magnesium chloride (mag). Mag has a freeze point of -23 degrees and can work in winter storms with very cold pavement temperatures. Mag is used only to pre-wet salt prior to application. MDOT SHA, for example, does not spray mag directly on highways prior to storms. Although mag works well once precipitation begins to fall, SHA and other highway agencies across the country have found that mag can make highway surfaces slippery, under certain atmospheric conditions, during the hours leading up to the start of the storm.

Agencies, including MDOT SHA, use abrasives (sand or crushed stone) in their winter operations although these materials have no snow melting characteristics. Abrasives are not normally used when a very high level of service is required. In addition, abrasives can clog drainage structures and contribute to air pollution. Agencies may consider using a mix of salt and abrasives to increase traction for motorists during storms with freezing rain or with very cold pavement temperatures when salt becomes less effective. MDOT SHA uses these mixes primarily in Western Maryland. Abrasives should be used sparingly as they are maintenance intensive, requiring mechanical removal via street sweeping and may also require storm drain or ditch cleaning after the winter season.

Agencies should continue to explore and research innovative materials which can produce results equal to or better than sodium chloride.
5.2 Material Storage and Handling

Agencies should store salt in salt barns, salt domes, or other permanent structures whenever possible. MDOT SHA for example, stores all its material in domes or barns. The structures should be well maintained. Potential problems should be identified during routine operations or through a periodic inspection program. Maintenance should be performed on structures during the off-season. Aging structures that have repeated high repair costs should be replaced when funding is available. Preventive measures, including only loading a salt structure to design capacity, are the most effective method in maintaining these structures. Over loading the structure will lead to foundation and structural failure.

Properly maintained structures, along with good housekeeping practices, allow agencies to keep salt in proper structures, minimizing negative impacts. MDOT SHA uses a variety of methods to prevent salt from spilling out of structures. Maintenance shops place straw bales, aggregates, or wooden gates at the structures’ entrance. Agencies should gather salt spilled near salt structures during loading and unloading operations. Unused material should also be returned to the salt structure.

When fixed structures prove to be cost-prohibitive or not feasible, salt should be stored on impervious surfaces, such as asphalt pads, to prevent groundwater contamination. If material is not stored in fixed structures, it should be covered with a secured tarp.

Agency procedures should be in place for capturing salt spilled on pavemen during the loading or unloading of the material. MDOT SHA for example, maintains regulatory required Stormwater Pollution Prevention Plans (SWPPP) for all primary facilities, and has developed SWPPPs for satellite salt storage facilities as a BMP. The SWPPPs outline pollution prevention measures for salt storage and handling. Large salt spills should be addressed using equipment such as a front-end loader, while small amounts can be addressed with a shovel and broom. In either case, the material should be returned to the salt structure as soon as possible. To ensure salt is properly contained and not exposed to stormwater, routine inspections are conducted by facility personnel and environmental professionals.

Liquid deicing materials, such as salt brine or magnesium chloride, should be stored in well maintained and labeled storage tanks. Because of the corrosive nature of these substances, routine maintenance must be performed on the storage tank fittings, valves and pumps to keep them in good working order.

Additionally, the liquid storage structure itself should be checked for bulging, expansion, leaking or dripping and any findings should be corrected as soon as possible. MDOT SHA also ensures that new brine tanks installed during a major facility renovation are constructed with secondary containment to hold, at minimum, the volume of the largest tank.

5.3 Snow and Ice Control Equipment

MDOT SHA purchases a variety of equipment and assigns it across the state to meet the needs of each maintenance facility.

5.3.1 MDOT SHA Equipment

Agencies should procure and employ the most effective snow removal equipment possible. Dump trucks should be equipped with well-maintained front plows that can mechanically remove as much snow as possible from highways. When appropriate, agencies should use side or “wing” plows to increase the amount of snow, in area, that can be mechanically removed from highways. Recently, MDOT SHA procured new hybrid rubber/ceramic plow blades that are designed for high performance and efficiency. MDOT SHA has found that these blades have higher surface area contact with the road,
enhances the clearing ability while limiting the wear on line striping and pavement markings.

MDOT SHA has expanded the use of these blades throughout the state, and other agencies should look to do the same. Effective mechanical removal of snow is the most environmentally sensitive method of snow removal and results in less salt needed to maintain a road in a safe, passable condition.

Dump trucks should also be equipped with well-maintained salt spreaders and spinners that can apply the required amount of salt on roads in an effective pattern that minimizes material waste. Agencies should consider and employ, whenever possible, electronically-controlled salt spreading equipment. This equipment can be used to lock-in specific application rates that will prevent operators from using more salt than necessary.

Agencies should calibrate all salt spreading equipment, regardless of its type, prior to the start of a winter season and check it for accuracy periodically during the season. This is a critical aspect of effective salt management. Additionally, technological advances now allow for this equipment to capture location, as well as salt application rates and usage, which is specifically useful for environmentally sensitive areas.

Agencies should use other specialty equipment for removal of snow from highways, when appropriate. Snow blowers are effective in removing a heavy buildup of snow, particularly from highway shoulders. Front end loaders are effective in removing a heavy buildup of snow from sections of roads where plows are not effective, such as narrow residential streets with parking on both sides. In this case the snow needs to be placed into dump trucks and hauled away. Motor graders may be needed to mechanically remove snow or ice that has “packed” on highways. Effective use of these specialized pieces of equipment lessens the need for salt in order to return a highway to a passable condition.

MDOT SHA maintains a fleet of dump trucks, the majority of which are single axle units capable of carrying 5 to 6 tons of salt. The remainder of its dump truck fleet consists of tandem and tri-axle trucks capable of carrying 10 to 15 tons of salt. The dump trucks are equipped with well-maintained plows, and electronically controlled spreaders that are capable of applying the required amount of salt on roads in an effective pattern that limits material waste. The equipment is calibrated for accuracy prior to the winter season. MDOT SHA also has a limited fleet of specialty equipment including snow blowers, front end loaders, and motor graders.

As with winter materials, agencies should continue to explore and research innovative equipment for the mechanical removal of snow and ice from the roadways. For example, MDOT SHA has researched, piloted and procured “tow plows” for assignment to various shops. These tow plows, in conjunction with a front plow, can perform snow and ice removal comparable to multiple trucks with only front plow and can cover an additional lane beyond a truck with front and wing plow. MDOT SHA has also retrofitted some of its truck fleet with wing plows on both sides of the vehicle, allowing coverage of additional lanes.

MDOT SHA also has procured 45 “loader scales”. These scales, installed on front end loaders, can accurately weigh salt being loaded into a truck to track salt usage by the truck when running its routes. This is helpful when it is necessary to address roadways in environmentally sensitive areas, such as watersheds, residential wells, and public reservoirs.

5.3.2  Hired Equipment Contract for Snow Removal Services

Agencies should consider hiring supplemental contract equipment to support their own forces if needed, to maintain prescribed levels of service. Hired equipment must be equipped with well-maintained plows and spreaders to assure effective and efficient snow removal and salting operations. Poorly equipped and maintained contract equipment can lead to excessive salt use.
Agencies should train hired contract equipment operators in all facets of plowing and salting operations. Poorly trained contracted operators can use excessive amounts of salt. MDOT SHA trains its contract operators using a PowerPoint presentation prior to the winter season.

Agencies need to train frontline supervisors to ensure effective management of contractors and their equipment. This ensures that contract operators are following an agency’s policies and procedures, particularly in salt usage.

For example: spreader systems on contracted dump trucks should be calibrated prior to winter. Tests should be performed on the units to ensure that the amount of salt physically spread on a highway correlates to a setting on the control knobs in the truck’s cab. It is critical that contract trucks are calibrated, and its operators are closely monitored by agency personnel to avoid improper salting. MDOT SHA ensures that contractors’ trucks are calibrated for quality control prior to signing a contract.
6 Training Initiatives

Training is a critical component of salt management and a best practice in winter operations. Agencies should provide training in salt management to maintenance managers and frontline forces on a regular basis. Many agencies, including MDOT SHA, have a “Snow College” or “Snow Academy” to accomplish this initiative. The focus of the training should be on best practices that stress the importance of using the least amount of material as possible to provide safe, passable roadways for motorists. MDOT SHA, for example, provides “Snow College” (Appendix B) every year for all new employees and 20% of maintenance forces. In this manner, MDOT SHA ensures that all maintenance personnel receive updated training every five years.

Training initiatives should target specific audiences. Shop or garage managers and frontline supervisors should receive additional training in the science of snow removal operations, effective winter storm management, winter materials inventory management, the properties of salt and other winter materials, and data collection and analysis.

MDOT SHA representatives travel to each of the 28 MDOT SHA maintenance facilities in the fall to make presentations (Appendix C) about salt usage, storage, and operations. Internal outreach with our staff has had a huge impact on our salt reduction successes. Discussions encompass all aspects of MDOT SHA’s salt usage and our obligation, not only to the environment but the individual customer as well. The information communicated among all parties has been extremely beneficial, leading to the creation of best practices in our salt reduction strategies that will be useful for years to come.

Training should also be provided to hired equipment operators and temporary employees. The training (Appendix A) concentrates on the need to adhere to an agency’s snow and ice control policies and procedures. A major focus of this training should be on the proper use of salt and other winter materials. MDOT SHA, for example, provides training prior to utilizing hiring contractors.

Each of MDOT SHA’s current training presentations are contained as an appendix to this document. These programs are revised annually to reflect changes in operations that are developed through post storm and season operations reviews, new materials, new equipment and/or new technologies.
7 Winter Storm Management

Winter storm management involves effective planning, execution, and review.

7.1 Weather and Pavement Condition Forecast

A key component of effective winter storm management is good weather and pavement condition forecasting. This is true 24 to 72 hours prior to a storm when planning is taking shape, during a storm, as forces react to changing conditions, and during post-storm operations when effective cleanup actions prevent potential safety issues.

Agencies across the country rely on the National Weather Service (NWS), or contracted weather services; pavement condition forecasters; as well as their own network of Road Weather Information System (RWIS) sites and Mobile Advanced Road Weather Information Sensors (MARWIS) as tools for winter storm management. The NWS provides a strategic forecast, alerting agencies of the potential for storms well in advance of their arrival. As a storm nears, the NWS will provide forecasts for approximate starting times and snowfall amounts over generalized areas of a state. The NWS does not, however, provide localized site-specific forecasts, nor does it provide information on pavement temperature or conditions, which are key components needed by winter storm highway managers.

Contracted weather and pavement condition forecasters provide the generalized forecasting provided by NWS and enhance it with localized, site specific, information. The contracted services not only forecast when snow will begin to fall and how much is anticipated to fall, but also forecast the anticipated pavement temperatures which play a large part in how much snow will actually accumulate on highways.

The RWIS network is a series of strategically located local weather stations placed along an agency’s highway system. Each weather station consists of a tower that provides localized data such as type and intensity of precipitation, air temperature, wind direction and speed, dew point, and relative humidity. Each station also has sensors in the pavement that detect pavement surface and sub-surface temperature, surface freeze point, and salinity concentration. RWIS networks can also include non-invasive pole or structure mounted pavement temperature sensors at critical locations that give pavement only data at specific sites, which eliminates the need to embed sensors in the pavement. The MARWIS devices have been localized to the areas where the greatest risk of snow/ice and colder temperatures exist in the state.

MDOT SHA, relies on these four sources of information at each stage of its winter storm management. MDOT SHA maintains a close working relationship with the NWS and the contracted weather and pavement condition forecaster and maintains 50 RWIS stations across Maryland. MDOT SHA has also installed 100 non-invasive pavement sensors to fill in the gaps between existing RWIS locations. Beyond receiving regular reports from the weather forecasters throughout the winter, MDOT SHA engages in conference calls with them prior to and during significant winter events.

7.2 Pre-Storm Planning

Pre-storm planning is an effective tool for managing salt usage in a storm and a best practice in winter operations. Effective planning prior to storms will equate to better performance during a storm including more efficient usage of salt. MDOT SHA’s statewide pre-storm planning for example, can begin as early as 72 hours prior to major winter storms. MDOT SHA’s planning for typical winter storms begins 18 to 24 hours prior to events.

Agencies should begin resource planning well in advance of the forecasted start of a winter storm. Anti-icing should be performed if appropriate for the storm. Agency personnel and hired contractors, if applicable, need to report to their shops or garages with enough lead time to thoroughly inspect plow
trucks and make any minor repairs. All units reporting to winter event operations should do so in effective, working condition. Any major repair should have been addressed prior to the season’s start or immediately after the end of the previous storm. It is imperative that equipment is working properly and prepared for operations. Agency and hired truck operators should load salt and other deicing materials on their equipment in an environmentally prudent manner.

Agencies should consider holding pre-storm meetings with shop or garage personnel. These meetings would provide managers with an opportunity to alert personnel about the latest weather and road forecasts, emphasize the need for effective plowing, reiterate the need for sensible salting, identify appropriate salt application rates, and recommend the use for additives such as salt brine or magnesium chloride. It also allows for information exchange and a sharing of opportunities for improvement. Many MDOT SHA shops routinely hold pre-storm meetings for all events.

Once the equipment is ready, it should be pre-positioned on its snow route prior to the start of the event. Pre-positioned snow equipment speeds up the response time of an agency. This is particularly important if the forecasted start time of the storm could affect morning or evening rush hour traffic. If snow fighting equipment becomes trapped by traffic congestion, it might not be able to get to its snow route in an acceptable time. A forecast that estimates a storm’s start during rush hour also highlights the need for pre-treating roadways with salt brine, discussed below.

7.3 Anti-icing Operations

Anti-icing, a proven, proactive, nationwide winter strategy, should be practiced by agencies in Maryland whenever appropriate for a storm. MDOT SHA, for example, has been conducting anti-icing operations since the late 1990’s. It has intensified the activity over the past several winters, addressing most highways in Maryland. Anti-icing involves placing a material, usually a liquid such as salt brine, on highways prior to the onset of precipitation. Anti-icing can also be accomplished with a pre-wetted salt placed on highways immediately before the start of a winter storm. Finally, it can be accomplished with an application of salt as snow is first starting to accumulate on a pavement.

The primary goal of anti-icing is to prevent snow and ice from bonding to a highway or bridge surface, allowing for more effective and efficient plowing and salting operations during the event. This will often lead to lower overall salt usage during storms and perhaps more importantly, an increase in the safety of motorists at the start of a storm. If snow or ice is allowed to bond to a pavement, heavy plowing and salting is needed to break the bond.

MDOT SHA’s experience has shown that timely application of brine prior to the start of storms keeps highways in the best condition once frozen precipitation begins to fall. This is particularly important if a storm begins well in advance of its forecasted arrival time, and maintenance forces are not fully mobilized. The anti-icing application of brine becomes, in essence, the first application of salt that can “hold” the road until salt trucks can address the situation.

Highway agencies across the country, including MDOT SHA, do not perform anti-icing operations for every forecasted winter event. If a winter storm is forecasted to begin as rain, anti-icing will usually not be performed. In this case, rain would wash the salt brine off of the highway surface, wasting materials, time, and money. Additionally, if pavement temperatures are forecasted to be 15° or colder at the onset of the storm, anti-icing is not usually performed. Finally, if a winter storm had recently occurred and salt residue is present on highway surfaces, anti-icing might not be necessary.

7.4 Winter Storm Operations

Once a storm begins and precipitation starts to accumulate on highway surfaces, agencies begin deicing operations. If a typical winter storm begins with light snowfall, a light coat of pre-wetted granular salt or salt brine should be applied. If a winter storm begins with moderate to heavy snowfall,
applications should be adjusted accordingly. Pre-wetted salt and salt brine tends to adhere to the pavement surface, ensuring the material remains on the roadway surface during the winter storm event, consequently reducing the amount of salt that bounces off the highway onto roadsides or into drainage ditches. Pre-wetted granular salt also goes into solution more quickly, which increases its effectiveness.

The key is to get material onto the roadway as early as possible to prevent snow or ice from bonding to the highway surface. This will allow for effective plowing and lighter salt applications throughout the remainder of a storm.

As the storm continues, forces need to react to changing conditions. As the initial application of salt begins to lose effectiveness and snow continues to build on highways, forces should begin plowing operations. If the initial application was successful, the buildup will be “mealy” and easy to remove with proper plowing techniques. The plow operator should re-apply just enough salt or brine to keep subsequent snowfall from bonding to the pavement. This process may have to be repeated multiple times during a winter storm. If a winter storm is associated with very cold pavement temperatures, granular salt should always be pre-wetted with a liquid deicer to increase its effectiveness. By increasing the effectiveness of salt, less will be needed.

MDOT SHA has several shops that use brine not only for the initial pre-storm application, but also for re-application during the event. These shops have identified Direct Liquid Application (DLA) routes and only treat the roadway with brine. MDOT SHA continues to promote the practical expansion of liquid only routes throughout the state.

On multi-lane highways, plow trains (individual snow fighting equipment; such as plow trucks spanning diagonally across the travel portion of the pavement), should be considered to remove as much snow as possible in a coordinated sweep. MDOT SHA makes extensive use of plow trains. If a plow train is effective and the surface is passable, minimal salt is needed to keep the highway in an acceptable condition until the train comes through again. Every effort must be made by the train to direct the application of salt onto areas where plowing has already occurred. Otherwise, trailing trucks could plow off salt just placed on the road by the lead trucks. Agencies should train their forces in effective plow train operations, a key element in salt management.

Agencies should consider varying the LOS provided to motorists during storms based on resource availability, type/intensity of storm, location, and time of day. For example, if a storm occurs during the overnight hours, some snow can build up on highways if it is not allowed to become snow packed, the highway remains passable, and is in a reasonably safe condition. In this case, an agency can use less salt than it would otherwise. Conversely, if the same amount of snow falls on the same highway prior to, or during periods of heavy traffic, such as rush hour, more salting will be necessary to keep the road at a higher, or same level of service.

7.5 Severe Winter Storms

Severe winter storms create unique challenges for a salt management plan. Agencies must be prepared to step up their response throughout the event, from pre-planning operations to final storm cleanup. They will be called upon to provide passable roadways, especially for emergency response, while fighting heavy accumulations of snow, freezing rain, or blizzard conditions. MDOT SHA, has fought severe winter storms over the past several winters and has learned much in the process.

When fighting storms with heavy accumulations of snow, agencies should concentrate on plowing operations and limit salt applications. Plow trucks should still spread a small amount of salt and/or brine to prevent snow from packing on the road. However, the emphasis should remain on continuous plowing. As the storm begins to wind down and most of the snow has been removed, an appropriate amount of salt will help remove the remaining
frozen precipitation from the surface. As in all other events, salt applications should be as efficient as possible. MDOT SHA adheres to this approach.

Freezing rain storms also present special challenges to agencies. Freezing rain, if left untreated, will coat highways with ice, creating severe safety and mobility issues for motorists. MDOT SHA has found that the best treatment for freezing rain is pre-treating and reapplying salt brine, which prevents the ice from forming. A focal point during a freezing rain event is ensuring salt brine is placed and remains on the roadway at all times to prevent ice formation.

Some agencies use abrasives, such as crushed stone or sand, to provide traction for motorists. Agencies should consider a mix of salt and abrasives to lessen salt usage and still provide a level of safety for motorists. If a salt/abrasive mix is used during a storm, there may be a need for a cleanup of the abrasives from highways once the storm ends and the surfaces dry.

When preparing for freezing rain storms, agencies should use a “shotgun approach”, where trucks are prepositioned at key locations along highway systems to ensure a quick response to likely trouble spots. While trucks are normally bunched together for snow storms where plowing is necessary, they should be scattered using the “shotgun” approach in freezing rain events. MDOT SHA, for example, uses this approach which allows it to treat much of the highway system simultaneously.

Winter storms that occur at the start of or during rush hour traffic pose significant challenges to effective salt management. A winter storm that drops one or two inches of snow during rush hour can be more troublesome than a winter storm that drops five or six inches during off-peak travel times. MDOT SHA and other agencies have learned that they must place pre-wetted salt or brine on highways prior to heavy traffic. Once traffic builds up on highways, plow and salt trucks cannot address snow buildup. In addition, snow can be “packed” on the highway surface, requiring very heavy plowing and salting to remedy it. Appropriate applications prior to rush hour is one of an agency’s best tools in limiting total salt usage during this type of event.

Severe winter events such as blizzards or back-to-back storms create unique challenges to agencies and effective salt management. While normal plowing and salting can keep a highway in a passable condition during a typical winter storm, heavy snowfall requires more intensive plowing operations. Cycle times of plow trains to cover their assigned route are severely challenged with heavy snowfall storms. In these events, agencies should still apply salt, at a reduced rate, during each plow train cycle.

This is critical if snowpack or icepack is to be avoided. Salting should keep subsequent snowfall in a plowable state, so it can be addressed in the next plowing cycle.

Agencies do not usually have sufficient equipment and personnel to run plow trains for hours on end. Equipment breakdowns can eventually affect the operation. In addition, it is critical that agencies provide adequate rest for their employees during severe storms. This keeps operators fresh, so they can make good choices while plowing and salting, and repair technicians fresh so they can keep equipment operable. An appropriately rested workforce should translate into effective salt management.

Some winter storms are so severe that the Governor may declare a State of Emergency in order to utilize additional resources, such as the National Guard. Additionally, authorities have the option to limit the amount and type of vehicle travel. When this occurs, highway agencies are allowed to clear roads of snow and ice in a more effective manner. During a State of Emergency, MDOT SHA re-prioritizes its roadways to focus primarily on interstates, US routes, and roadways with high ADT. This focus ensures passable primary roadways for emergency equipment and intrastate commerce.
7.6 Stockpiling and Disposal of Removed Snow

During blizzards or back to back storms, snow can build up to a point where it cannot be plowed. Some municipalities have difficulty plowing snow in heavily populated or congested areas. In these cases, snow needs to be hauled away in dump trucks. Agencies need to coordinate with the (MDE) and the Maryland Department of Natural Resources (DNR) to identify storage locations for the snow in less environmentally sensitive areas. These pre-approved locations can be used to store snow, which may contain salt or other materials, until it melts over time. Another option is to use snow melting systems to speed up the operation. This is important if the holding area needs to be cleared in order to physically hold more snow.

7.7 Operations in Sensitive Areas

Maryland Public Works Departments and local highway agencies should coordinate with MDE to determine criteria for determining areas sensitive to exposure to salt and salt runoff. While MDE and MDOT SHA recognize the importance of all waters in Maryland, areas of high susceptibility were determined to be:

- Wetlands of Special State Concern as defined in COMAR 26.23.06
- Tier II waters as defined in MDE’s Total Maximum Daily Load (TMDL) Integrated 303D Report
- Use III, non-tidal cold-water streams or Use III-P, non-tidal cold-water streams – public water use
- Wellhead Protection Program as defined by MDE’s program.

In addition to the areas of high susceptibility, MDOT SHA and MDE also agreed that roadside and/or receiving waters exhibiting indicators of salt contamination should be monitored and salt management practices in those areas should be assessed to determine if changes in practices and salt usage can effectively be implemented.

Site specific plans for environmentally sensitive areas should be considered. A plan for a sensitive area may include reduced salt usage or no salt usage at all. It may also include the use of another snow and ice control material. These sensitive areas are taken into consideration when identifying potential DLA routes. These routes should be known to all who perform salting operations, as well as to the general public using Maryland roadways.

The potential for reduced levels of service exists for motorists when normal plowing and salting operations are not conducted in sensitive areas. Signage alerting motorists about the reduced levels of service may be required to indicate the need to slow down and remain alert.

Agencies should develop new strategies and test new technologies in these areas that may lead to improved service without impacting the environment. MDOT SHA, for example, is piloting the Maintenance Decision Support System (MDSS) at several sites in Maryland. The program provides a high-resolution weather and pavement forecast for snow routes and recommends material application rates based upon data received during winter operations. The program attempts to find the lowest amount of salt or other winter material application rate while still maintaining an agency’s acceptable level of service.

7.8 Automatic Vehicle Location (AVL)

A critical component of effective winter storm management is knowing where snow fighting equipment is located at all times. Many agencies across the country have deployed AVL systems to help in this effort. The AVL system tracks the physical location of dump trucks and other snow fighting equipment during winter storms and displays results on monitors. The AVL system is a tool for managers to track progress during winter storms. It can be used by
managers to locate and deploy the nearest truck to a highway incident, speeding up emergency response.

An AVL system can also be used to determine the material application rate at which a truck is plowing and spreading salt. Data captured through the AVL system can be analyzed after winter storms to identify opportunities to increase the efficiency of winter operations. Finally, and perhaps most importantly, AVL is a tool to increase the safety of the drivers.

MDOT SHA deployed an AVL system during the summer of 2011. AVL units were placed in all MDOT SHA dump trucks, supervisor’s vehicles, and other specialty equipment. Portable AVL units were also placed in some contracted trucks that perform snow removal for MDOT SHA.
8 Post Storm Operations

Post Storm Operations include a variety of tasks including cleaning equipment, stockpile maintenance, and operation reviews.

8.1 Equipment Cleaning and Maintenance

Agencies should develop plans for equipment cleanup and maintenance after winter storms. Cleaning of snow plows and trucks should occur immediately after operations are complete, when possible.

These cleaning operations should occur inside the wash bays at a shop’s facility. Cleaning of salt spreaders and plow blades that have been removed from vehicles should occur in a manner whereby wastewater does not discharge into stormwater systems.

MDOT SHA maintenance facilities where vehicle maintenance occurs are required by MDE’s General Permit for Discharges from Stormwater Associated with Industrial Activities (Discharge Permit No. 12-SW) to develop and implement a site-specific Stormwater Pollution Prevention Plan (SWPPP). While the MDOT SHA plans are site specific, they all contain consistent protocols, inspections, documentation and reporting requirements related to potential pollution sources such as equipment cleaning and maintenance operations. Should a plan not already exist, one should be developed.

8.2 Material Cleanup at Storage Facilities

Immediately after winter storm operations have ceased, all unused salt should be returned to a storage facility. All exposed abrasives should either be moved to a covered facility or covered securely with a tarp. If salt/abrasive mixing has occurred in an uncovered area, any remaining stockpile should be returned to the salt storage facility. MDOT SHA’s SWPPPs, for example, include requirements for material storage at maintenance facilities.

8.3 Operations Review for Continual Improvement

An agency review of operations after winter events is an essential best practice in winter operations and salt management. Agencies in Maryland should consider having post storm reviews at their maintenance facilities for most winter storms and agency-wide reviews for major storms.

Post storm reviews should concentrate on three key elements: what worked well, what didn’t work well, and most importantly, opportunities for improvement. The opportunities for improvement lead to best practices. Post storm reviews can also be used to identify “champions” who get snow routes cleared with less salt. The “champions” should be encouraged to share ideas with others at the shop to encourage and promote efficiency in salt application.

8.4 Post Storm Data Analysis

Agencies should consider capturing salt usage data by truck, snow route, shop or garage, district, and agency-wide. Shops should consider measuring salt usage in relation to the number of lane miles served, and inches of snow fought. One formula for measurement is “pounds of salt used per lane mile per inch of snow.” In this process, agencies can measure the salt usage performance between trucks on a common route, routes within a single shop or garage, and from shop to shop or garage to garage.

Agencies should also consider electronic means of collecting salt usage data. Various electronic salt spreader controllers have this capability. At the close of a winter storm, data on salt usage can be downloaded from the spreader and analyzed by shop managers. Agencies should also consider using AVL...
technology for salt usage data collection. AVL technology has the capability of identifying salt usage and when and where each application was made. Additionally, MDOT SHA is piloting the use of loader scales to accurately measure the amount of salt being loaded into trucks in lieu of estimating weight by the number of scoops. In conjunction with this pilot study, MDOT SHA is researching the potential use of radio frequency identification (RFID). This concept would use active RFID installed in the loader to communicate with passive RFID installed on the truck. The loader would identify the truck unit and document the weight in salt being loaded into the truck and communicate that information back to the manager in the shop. Along with helping to better manage the use of salt during an event, this concept could potentially allow for more accurate re-order of salt for the barn or dome after the event, preventing the facility from being overloaded.
9 Spill Prevention and Control Plan for Winter Operations

First and foremost, agencies should make every effort to prevent the uncontrolled release of winter materials into the environment at storage facilities and on highways. MDOT SHA, for example, developed and implemented site specific SWPPPs for each of its maintenance facilities. The individual plans consider potential sources of stormwater pollution and describes practices to reduce these potential pollutants. While the plans are site specific, they all contain a common approach to spill management of winter materials.

9.1 Salt Spill Prevention

When loading salt at storage locations, trucks should never be overloaded. If they are, salt can spill from the sides or back of the truck when it’s leaving the facility or when it’s on route.

Overloading trucks with salt is avoidable and a clear violation of best practices for salt management. If spillage occurs, it should be addressed during a storm if time allows or at the close of the event.

Another best practice is the deployment of tailgate flaps that prevent salt from spilling out of the back of dump trucks. These small triangular pieces of metal can be made in house for a few dollars but can save tons of salt over the course of a winter season. MDOT SHA requires tailgate flaps on all state and contractor trucks.

There are times when salt can spill from a truck that was not overloaded. If the auger in a truck’s salt spreader box becomes jammed with a large chunk of salt or debris, the operator may have to manually clear the box. At times, the jam is cleared but salt falls to the pavement. At other times, a truck operator may have to raise the dump truck bed to move material to the rear of the truck. This occurs when the salt in the bed of the dump truck begins to get low. During this operation material can spill from the rear of the truck.

Whenever salt spills from a truck, either from being overfilled or not, it should be swept up and placed back in the bed of the dump truck. Operators must do this in a safe fashion so as not to endanger themselves or motorists. Effective salt management does not equate with unsafe practices.

9.2 Brine and Magnesium Chloride Mixing and Storage Tanks

To minimize the possibility of leakage and spills from liquid storage tanks, a weekly inspection program should be implemented, and secondary containment should be installed. Whenever drips/leaks are found, maintenance and/or repairs should occur immediately. Until the repair can be completed, the leak should be contained if it is located outside of the secondary containment.
10 Recordkeeping and Annual Reports

Agencies should keep up-to-date records of all winter operations, especially records of salting. Records should be kept for each winter event, and for each winter season. This will allow for seasonal analysis and the identification of trends. MDOT SHA maintains up-to-date records of salt usage and other key performance measures and produces quarterly and annual reports for its statewide business plan.

MDOT SHA has been keeping extensive electronic records of winter operations since 1999. MDOT SHA tracks personnel, equipment and material usage (to include salt and brine) at each of its maintenance shops. It also tracks weather and pavement conditions during winter events. The information is summarized in various reports for real time operations status and is post-processed for operations cost estimates. MDOT SHA continues to research opportunities to further use technology in support of data gathering.

Like MDOT SHA, agencies should perform an in-depth analysis of winter operations, with an emphasis on salt usage, at the close of each season and periodically during the season. This analysis should culminate in an annual report. The annual report should serve as means for learning lessons, identifying opportunities for improvement, identifying trends, and developing recommendations for operations for the following winter. The annual report can also be used by an agency’s senior management to determine the need for changes in policies, procedures, processes, and expenditures and to determine any budgetary implications of identified needs.
11 Annual Winter Wrap-Up Meeting

Agencies should hold an annual meeting to review winter operations, deepening their understanding of lessons that came out of the post storm reviews, and identifying areas of concern such as salt management, equipment improvements, etc. The annual meeting can be used to identify key opportunities for improvement and set up teams to tackle them over the summer. It is critical that the progress of the teams is tracked closely so that the efforts come to completion prior to the following winter. MDOT SHA followed this approach at the close of the 2014 – 2015 winter season and made considerable progress in its subsequent operations.
12 Public Education and Outreach

Agencies should make every effort to provide the public with information concerning their winter operations and winter storm activities. Agencies should consider an annual media briefing to update radio stations, television and print media in their area about their winter operations program. Agencies can use this opportunity to review their experiences during the past winter, discuss their plans for the upcoming winter, and highlight new initiatives. This information could then be shared, through the media outlets, with the public.

MDOT SHA’s Office of Communications, for example, holds an annual “Snow Show” each fall for its outreach to the public, inviting the media for coverage to ensure the public is aware of how MDOT SHA is prepared for the winter season. During the briefing, MDOT SHA stresses the need for motorists to be mindful of the potential dangers of driving during winter storms. They highlight their “Ice and Snow, take it Slow” campaign as well as their message to stay home during winter weather events. MDOT SHA also stresses the need for motorists to give snow fighting equipment space to do its job.

Agencies should consider having their emergency operations centers activated for winter storms and using them for outreach. MDOT SHA’s Office of Communications, for example, provides live interviews with media representatives in a proactive manner, as well posting events on social media. This allows MDOT SHA to keep the public, via the media representatives, updated on the status of its operations and the overall condition of the highway system.

Agencies should also consider providing customer service for their citizens during and after winter storm events via telephone and internet. An agency’s maintenance shop or garage personnel or its emergency operations center can respond directly to citizen needs in real-time on a localized basis. General questions about operations can be handled through the shop or garage managers or by the agency’s office personnel.

MDOT SHA deployed a public facing website where our customers can view every single piece of snow fighting equipment used during any given winter event. This was developed due the organization wanting to be transparent, as legally and safely possible, with our winter operations deployment. While no personal information is shared with the public they can see exactly where a piece of equipment has been within the last 30 minutes and use this information to make better decisions on whether to travel or not during the storm.
13 Testing and Evaluation of New Materials, Equipment, and Strategies for Continual Improvement

Agencies should always be striving to continually improve the efficiency of winter operations. One way to improve operations is by testing out well-researched new ideas that pose minimal risk to operations but have a substantial upside. The new ideas can be in the form of different types of winter materials, updates to existing standard operating procedures, deploying new spreader plows or other winter equipment, or implementing new strategies or tactics for fighting storms. Testing and evaluating new technologies can lead to lower salt usage and is a Best Practice for Salt Management.

MDOT SHA, for example, has tested and evaluated tow-behind plows, a trailer mounted plow that is towed by a dump truck. The tow-behind plow, in conjunction with the dump truck’s front plow, can clear a path 24 feet wide, while a standard front plow can only clear a section of roadway eight feet wide. MDOT SHA is also exploring the use of graphical displays using its GIS program to improve practices in salt management.

There are many organizations across the country that are performing research on new winter strategies, testing new materials in laboratories, and evaluating the effectiveness of new products on highways and bridges. Agencies in Maryland should consider and take advantage of these resources, most of which are free of charge to others in the winter maintenance community. The following links provide information about these research organizations:

http://www.clearroads.org/

The Clear Roads pooled fund project provides real-world testing in the field of winter highway operations. This ongoing research program has already attracted 20-member states and is funding practical winter maintenance research.

http://www.aurora-program.org/

Aurora is an international partnership of public agencies that work together to perform joint research activities in the area of Road Weather Information Systems (RWIS). This website is designed to introduce the program, the partners, and its collaborative research projects.

http://www.ops.fhwa.dot.gov/weather/index.asp

The Road Weather Management Program, within the FHWA Office of Operations, seeks to better understand the impacts of weather on roadways, and promote strategies and tools to mitigate those impacts.

http://www.meridian-enviro.com/mdss/pfs/

The Maintenance Decision Support System Pooled Fund Study leads the nationwide effort to provide research, development, and application of computer-based winter maintenance decision support, including route specific weather and pavement condition forecasting, and suggested responses to a winter storm event, based on an agency’s rules of practice.

http://sicop.transportation.org/Pages/About-SICOP.aspx

The American Association of State Highway and Transportation Officials (AASHTO) advocates transportation-related policies and provides technical services to support states in their efforts to efficiently and safely move people and goods. Its Subcommittee on Maintenance (SCOM) provides technical services to support high level research into preserving and maintaining a world-class highway system. The Winter Maintenance Technical Services Program addresses AASHTO’s goals for the snow and ice control community.
http://pnsassociation.org/

The Pacific Northwest Snow-fighters (PNS) Association strives to serve the traveling public by evaluating and establishing specifications for products used in winter maintenance that emphasize safety, environmental preservation, infrastructure protection, cost-effectiveness and performance.
14 Summary

Agencies should view these Best Practices for Salt Management as a starting point in their winter operations. Agencies should always strive for effective salt management and road safety.

Agencies should also seek opportunities to work with various regional, county and local organizations to provide seamless operations during winter storms. However, agencies need to be cognizant of the fact that other agencies will have different needs based upon public safety, geography, traffic and weather patterns, environmentally sensitive areas, available resources, budgets and constituency expectations.

Maryland’s highway agencies should seek opportunities to consult with each other after major winter storms and after the completion of winter seasons to share lessons learned in Best Practices for Salt Management.

Best Practices for Salt Management is a living document updated on a regular basis. In that regard, MDOT SHA will attach a series of appendices to this document. They will address issues such as training, pre-storm checklists, post storm reviews, and material handling. In addition, MDOT SHA will continue to attach appendices to this document as new information becomes available. Best Practices for Salt Management should be a key tool to provide the citizens of Maryland with safety and mobility during winter storms in a cost-effective, environmentally sustainable manner.Appendix A: Hired Equipment Presentation
15 Appendix A: Hired Equipment Presentation
Presentation Agenda

• Contract Item Numbers/Invoicing Sample
• Right to Audit Clause
• Conflict of Interest Clause
• Contractor Requirements
• Salt Usage/Environmental Impacts
• Plowing Best Practices
• Equipment/Facility/Structure Damage
Item Number/Invoicing Changes

- Item numbers have been established for equipment type/configuration in the Contract

- These will be required on the Contractor Equipment Questionnaire and all invoices moving forward

- If item numbers and equipment types/configurations are not included on the invoices this will delay payment
the above items, the hourly rate for dump trucks, pickup trucks and all anti-icing equipment also include a Contractor-provided and Administration approved cellular phone, CB radio, and 12-volt DC Power Port or similar power source, truck-mounted high speed two-way pump, hose and all incidentals necessary to perform loading and unloading of materials (Liquid Applicator Truck and Tank Truck), and application of liquid materials (Liquid Applicator Truck). Hourly rates for dump trucks and pickup trucks with Contractor supplied plow, salt spreader or both include Contractor provided and Administration approved equipment. The rates are as follows:

### Item Single Axle Dump Trucks

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### Item Tandem Axle Dump Trucks

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# Questionnaire Example

Maryland Department of Transportation State Highway Administration  
Montgomery and Prince George’s Counties

## CONTRACTOR EQUIPMENT QUESTIONNAIRE

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Please indicate Y for Yes and N for No within these columns.

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**Animation Factory**: www.animationfactory.com
# Invoice Example

Maryland Department of Transportation State Highway Administration
Montgomery and Prince George’s Counties

## WINTER HIRED EQUIPMENT CONTRACTOR INVOICE

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Total Amount of Invoice 1430.00

Company Representative Name (printed)

Company Representative Signature Date

MDOT SHA Sample Invoice Template (07-29-2019)
Right to Audit Clause

- This requires the Contractor to maintain all records pertaining to the Contract for three (3) years, after the Contract end date, and make them accessible at MDOT SHA’s request.

- This could be documents that are paper, electronic, .pdf, carbon copy, etc.

- Any monies found owed to the Administration will be deducted from future payments or captured by other means if necessary.
Conflict of Interest Clause

- This requires the Contractor to disclose any relationships within company framework that might cause a conflict of interest

- The Contractor is required to disclose any potential conflict of interest to MDOT SHA once they become aware

- The Contract may be terminatedbut MDOT SHA will need to conduct a thorough investigation
Winter Operations

• Safety is the Maryland Department of Transportation State Highway Administration’s (MDOT SHA) number one priority during all snow storm activities

• Snow removal equally shares first priority regarding highway maintenance operations

• MDOT SHA and Contract forces are jointly responsible for minimizing impacts to our environment and minimizing winter operations costs
Winter Operations

- MDOT SHA’s policy states that winter operations will continue until all state roads are free of snow and ice.

- If needed, relief drivers shall be employed by the Contractor.
Contractor Equipment Requirements

- All equipment used for snow removal operations **SHALL** have met the Contract requirements

- All equipment used for snow removal operations **SHALL** be listed on or added to the Contract before use

- If any equipment used by the vendor is found to be non-compliant the Contract may be terminated
Snow Removal Requirements

• Operator’s are required to have all equipment calibrated and operational prior to check in

• All contract personnel and equipment must be logged in and out of service, and operators must provide their cell phone number

• **NO REPAIR DELAYS!** All equipment should be ready for work upon arrival

• MDOT SHA will not pay for down time on trucks and equipment that extends beyond one hour
Snow Removal Requirements

- All CB radios must be in good working condition
- Check with your Snow Supervisor for the appropriate channel
- MDOT SHA equipment being utilized by contract forces shall **NOT** be used for any other work
Automatic Vehicle Location (AVL)

- AVL technology will be used to track the current and past locations of MDOT SHA trucks and select contract equipment.

- AVL technology will increase the efficiency, effectiveness, and safety of MDOT SHA and contracted equipment operators.
Automatic Vehicle Location (AVL)

- The Contractor’s truck shall provide a 12 volt DC Power Port or other similar power source for the plug-in AVL unit
- The power source shall be in the truck’s cab in order to protect the AVL device from damage
- The Contractor’s personnel may be assigned an AVL unit when they report for a storm
- The Contractor’s personnel must sign a form accepting the AVL for the event
Automatic Vehicle Location (AVL)

- The AVL unit must be kept operational throughout the storm and returned, in working order, at the close of the storm when the operator is logged out.

- Failure to keep the AVL operational will result in a 50% deduction from the season ending retainer.

- A second occurrence will result in no season ending retainer and the contract may be terminated.

- The Contractor will be billed $250 for failure to return the unit in working order.
Call-Out Phases

- Each storm is evaluated based on the forecasted accumulation and severity

- Report times can be accelerated based on intensity of the storm, timing of the event, and other factors beyond our control
Call-Out Phases

- **Phase 1** - (0-1 inch forecast or <0.1 inches of freezing precipitation) Includes only MDOT SHA Trucks

- **Phase 2** - (1-2 inch forecast or 0.1 to 0.2 inches of freezing precipitation) Includes Phase 1 trucks and hired spreader trucks to supplement MDOT SHA work forces on designated routes where there are no assigned MDOT SHA trucks
Call-Out Phases

• **Phase 3** - (2-4 inch forecast or >0.2 inches of freezing precipitation) Includes Phase 2 trucks and hired spreader trucks to supplement the MDOT SHA work forces during heavier snowfalls

• **Phase 4** - (>4 inch forecast or major freezing precipitation) Includes all Phase 3 trucks and hired push trucks to supplement MDOT SHA work forces on designated routes as roadway conditions warrant
Statewide Salt Usage Trend

<table>
<thead>
<tr>
<th>Year</th>
<th>Usage Rate</th>
<th>Inches of Adj. Accum.</th>
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<td>2018/2019</td>
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</table>
Salt Impacts on the Environment

So what’s the big deal?? Salt is a naturally occurring substance!

While salt is a naturally occurring substance, high concentrations of salt negatively affect or destroy land based and aquatic habitats and species.
Salt Impacts on the Environment

- Once granular salt mixes with snow or ice it becomes a brine solution. This solution then runs off the roadway and is forever stored in soil or water and can reach levels that are considered unhealthy to the environment.

- Salt will contaminate drinking water supplies in wells and in reservoirs, slows the establishment of vegetation or crops, and destroys waterways for fish and other marine life.
Salt Impacts on the Environment

Dumping salt in this area killed the vegetation and the area was at risk for erosion. This area had to be restored by removing contaminated soil, backfilling and seeding and mulching.
TMDL

- **Total Maximum Daily Load**

- Definition: a regulatory term in the U.S. Clean Water Act, describing a value of the maximum amount of a pollutant that a body of water can ingest on a daily basis while still meeting water quality standards

- TMDL’s already exist for phosphorus, nitrogen, and sediment for many watersheds and waterways in Maryland
TMDL

• TMDL’s for Chlorides (salt) are currently being discussed for some of Maryland’s watersheds and waterways.

• Should they be implemented MDOT SHA will be required by law to not exceed a set salt usage rate during winter operations.

• Once a TMDL is placed on a watershed or waterway it carries heavy fines if not adhered to.
TMDL

Ask yourself these three simple questions when it comes to TMDL’s and salt usage...

Do I enjoy spending time outdoors and enjoying some of Maryland’s finest seafood?

Do I value the drinking water, health and well being of my spouse, child, or elderly parent?

Is there something I may be able to do different to make a difference?
THE BOTTOM LINE

Over salting is ruining our environment and the very water we need to survive so realize it and let's collectively do something about it...
YOU play a more prominent role in protecting our environment during winter operations than you may have originally thought.
Practical Salt Usage

• A well trained operator knows when to apply salt, and when not to

• Use the correct amount of salt necessary to get the job done

• Using more salt than necessary actually works against you and damages the environment
Practical Salt Usage

- **Never** overload trucks to avoid spillage of salt at MDOT SHA facilities and on the road.

- **Always** travel at a safe speed for optimum performance, safety, and to help keep salt on the road and out of the roadside ditches.
Practical Salt Usage

- **Always** keep your load covered to avoid unnecessary loss of material when traveling

- **Don’t** salt roads that have already been salted

- **Only** apply salt to your designated snow route when directed by MDOT SHA personnel

- **Always** use appropriate shop application rates or rates as directed by MDOT SHA management
Practical Salt Usage

• **Don’t** apply salt to a undesignated snow route unless directed to by MDOT SHA personnel

• **All** unused salt must be returned to the dome or barn that it was loaded from

• **Never** spread salt just to get rid of it
Best Practices for Plowing Safety

- Be aware of the weight of heavy snow and the damage it can cause when thrown by a plow

- Never plow snow over bridge parapets or jersey barrier walls - that could endanger traffic and/or pedestrians below
Best Practices for Plowing Safety

Watch out for manholes, railroad tracks, expansion joints, bridge abutments, utility cuts, mailboxes, etc.
Best Practices for Plowing Safety

Watch for curbs and steel plates...
Best Practices for Plowing Safety

Be aware your truck’s bed height - watch for overhead signs, traffic signals, utility wires, tree limbs and bridges
Roadway Configurations

Intersections

• Empty your plow before crossing intersections

• Reduce the size of the windrow

• Avoid building snow banks that interfere with sight distance

• Keep traffic signs unobstructed from view
Roadway Configurations

Ramps and Curves

- Plow ramps and curves from the high side to the low side
- Spread salt on the high side of ramps and curves
- Keep your speed down on all ramps and curves
Roadway Configurations

Bridges and Overpasses

• Bridge surface may be higher than the road surface due to the bridge freezing and expanding

• Care must be taken not to throw snow over the bridge to the road below

• Keep the sidewalks on bridges open for pedestrians
Shoulders, Medians & Jersey Barriers

- Plow away from medians with minimum width shoulder and barrier wall

- Avoid plowing snow against a jersey barrier as this creates a ramp for vehicles to possibly become airborne
Mountains and Hills

- Traction is limited on hills
- Stopping can be difficult on hills
- Watch for melted snow refreezing in the road valley
Railroad Crossings

- Avoid piling snow against signals, switch boxes, signs, etc.

- Raise plows slightly when crossing railroad tracks
Two Way Road Single Truck
First Pass

Plow lane in one direction and drop salt behind truck
Two Way Road Single Truck
Second Pass

After plowing in one direction, turn at end of route, plow lane in opposite direction and salt both lanes
Two Way Road Two Trucks
Multi-Vehicle Plowing

• The deeper the snow, the more overlap needed to avoid leaving a windrow
• First truck clears 8 feet of the left traffic lane, leaving 4 feet for second truck
• Second truck overlaps 1 foot clearing 4 feet of first lane and 3 feet of second lane, leaving 9 feet for third truck
Multi-Vehicle Plowing

- Third truck overlaps 1 foot clearing 7 feet of second lane, leaving 2 feet for fourth truck
- Fourth truck overlaps 1 foot clearing 2 feet of second lane and 5 feet of shoulder
- One more truck would be required if a third lane was present
Multi-Vehicle Plowing

- Four or more lanes would require more plow trucks

- The larger trucks should be at the end of the train

- The last truck plows ramps
Plowing Points to Remember

• Always give bridges and ramps special attention

• Salt the high sides of curves

• Do not over-use salt. Use just enough to get the job done

• Designate specific trucks in a plow train for salting to ensure no overlap of resources
Plowing Points to Remember

- Salt loses most of its effectiveness at temperatures below 20°F
- Salt stops working altogether at -6°F
- Adding more salt to an already salted roadway can actually cause the brine solution to freeze
Operator Guidelines

- **Always** contact your MDOT SHA supervisor prior to leaving your designated snow route or if you get separated from your assigned SHA truck.

- Show up or commute time, from the designated MDOT SHA facility to assigned route, must **not** be excessive.
Operator Guidelines

- Always communicate the need for fuel or meals with your snow supervisor prior to leaving your assigned route.

- Coordinate all refueling to minimize disruptions to the snow removal operations.
Operator Guidelines

• Check the cutting edge of your plow before each event to avoid damage to the plow structure

• When working for MDOT SHA, DON’T plow and salt parking lots, driveways or roads that do not belong to MDOT SHA
Operator Guidelines

- Relief operators shall be changed out on their snow routes or at predetermined location approved by MDOT SHA
- All trucks loaded with salt while on standby or just plowing should be covered to avoid freezing
Accidents and Damage

- Always maintain a heightened state of awareness when working around salt structures or out on the roadways.

- Report all accidents involving MDOT SHA equipment or facilities promptly to the snow supervisor and obtain a police report.

- MDOT SHA will not be held responsible for damage incurred to the Contractor’s vehicle while carrying MDOT SHA’s snow removal equipment.
Accidents and Damage

- Upon returning to the shop, the driver will stay with their truck and assist with the repairs of MDOT SHA equipment.

- If a repair part is required at the shop, all repair parts must be acquired by a shop mechanic.

- All damaged or non-operating equipment must be reported to the snow supervisor, repaired ASAP and/or prior to the next storm.
## Overhead Structure Hits

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<th>Inspection Type</th>
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<th>Salt Truck?</th>
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</tbody>
</table>
Overhead Structure Hits

• Keep truck bodies lowered when traveling
• Use extreme caution when raising to fill the auger box
• Remain aware of your surroundings:
  • signals
  • utility wires
  • overhead signs
  • bridges
Overhead Structure Hits

- The “Notice of Unsatisfactory Performance” will now allow post-season retainers to be deducted and your contract terminated for multiple infractions

- SO PLEASE BE VIGILANT…
Thank You For Your Attendance!

There is no better time than the present to express our appreciation for your support.

The Maryland Department of Transportation State Highway Administration thanks you for making a difference towards our winter snow removal activities.
SNOW COLLEGE

ROADWAY WINTER OPERATIONS
SHA’s Goals

- The primary objective for all maintenance personnel during the winter operations is to make every effort to maintain all roadways under their jurisdiction in a safe and passable condition throughout a storm.

- To provide an exceptionally high level of service to our customers at the lowest possible cost in dollars and in damage to the environment and the highway system.
WINTER OPERATIONS STRATEGIES

- **Anti-icing** is a proactive winter strategy of preventing snow or ice from bonding to the pavement.

- **Deicing** is traditional reactive winter maintenance strategy of breaking the snow/ice and pavement bond once formed.

- Both strategies are critical and play roles in SHA’s snow and ice control operations.
ANTI-ICING OPERATIONS

- Anti-icing involves a **timely** application of pre-wetted salt or liquid chemicals on highways usually before start of a storm.
ANTI-ICING OPERATIONS

• Anti-icing helps SHA maintain highways in the best condition possible throughout a storm.
  
• Anti-icing lessens the occurrence of snow pack.
  
• Anti-icing increases traffic safety at a lower cost.
  
• Anti-icing limits damage to the environment.
DE-ICING OPERATIONS

• Deicing operations require large amounts of salt to work its way through snow pack and break its bond to the pavement.

• Deicing results in higher safety costs due to delays in achieving bare pavement.

• Deicing leads to more damage to the environment and highway system.
USING SOLID MATERIAL

- For proper operation, spreader systems need to be calibrated yearly.

- At the beginning of a storm, the initial salt application should be made as soon as snow or ice begins to accumulate on the pavement.

- The prevention or breaking of the snow bond to the road is the primary reason for applying salt in a snow storm.

- Salt produces a brine solution that keeps snow and ice from bonding to the pavement.
USING SOLID MATERIAL

- A well trained operator knows when to apply salt, and when **not** to.

- The main idea in a storm is to use no more salt than is necessary to correct the condition at hand.

- Using more salt than necessary to correct the condition will work against you and it damages the environment.
SAFETY

• Snowstorms are the number one hazard to traffic on our roadways.

• Snow removal equipment is the number two hazard to traffic.

• The number two cause of accidents was found to be the snow plow attached to the dump truck.
SAFETY

• Remove the plow after completing snow removal operations.

• Remove the plow frame or lower the lift arm to reduce the potential hazard to other vehicles.

• It is never a safe practice to back up a dump truck.
SAFETY

• Backing during a snow storm is just asking for trouble.

• Watch for overhead obstructions during salt spreading operations when raising the dump bed.

• The higher the dump bed is raised, the more likely the truck is to tip over.
SAFETY

• The higher the truck bed, the lower the truck’s speed should be.

• Plow trucks are not authorized emergency vehicles.

• Operators must obey the same rules as any other vehicle on the road.
TERMS AND DEFINITIONS

- You can refer to the Roadway Winter Operations Course Manual, Section 2, for multiple terms and definitions used throughout this presentation.
GENERAL KNOWLEDGE

ROADWAY PLOWING

• Operator’s knowledge must include the preventive maintenance (PM) of a dump truck and any related pieces of equipment.

• How to mount the various types of plows, salt box, and spinner.
ROADWAY PLOWING

- The operation of the plow, salt box, saddle tank, and spinner.

- Maneuver a truck around obstacles with a plow mounted.
TROUBLESHOOTING

- Keep an eye on your plow blade for wear and replace when needed.
- Store extra plow pins in truck.
- Keep all truck lights free of snow and ice.
- Keep radiator grill free of obstruction to prevent engine overheating.
TROUBLE SHOOTING

• Carry spare fuses and bulbs.

• Carry windshield cleaner and an ice scraper.

• Be familiar with the type and size of hoses for replacement.
TROUBLE SHOOTING

• Know which hydraulic coupling controls what function.

• Carry a quick link for repairing a broken chain.

• Carry jumper cables.
PRE-SEASON PREPARATION MEETING

• Have a meeting with all personnel involved in snow removal operations before the winter begins.

• Personnel involved are shop personnel, route supervisors, contractors, and EOC representative.
PRE-SEASON PREPARATION MEETING

Some topics that should be covered:

- Route assignments
- Roadway/Snow hazards
- Turn around points
- Changes in traffic patterns
ROADWAY HAZARDS

Always be alert to obstructions to your plowing.
ROADWAY HAZARDS

Manhole Covers

Steel Plates
ROADWAY HAZARDS

- Cold Spots and Black Ice
- Low Shoulders / No shoulders
- Overhead obstructions - bridges, trees, wires
- And, of course, the traveling public
ROADWAY MARKING DEVICES

• Delineating posts
• Stop bars
• Arrows
• Raised pavement markers
LOADING & UNLOADING SALT STORAGE STRUCTURES
SALT DOME LOADING

- Back through the dome entrance to fill both front sides.

- Go forward to fill both sides and the rear of dome.

- Fill in the center to equal height.
SALT DOME LOADING

- Build a ramp inside of dome.
- Level off top of pile.
- Repeat process over again.
- Fill in the ramp from the back wall to entrance after reaching desired height.
SALT DOME UNLOADING

- Remove salt from the entire face of salt pile.

- Never dig a straight narrow path into a salt pile.
SALT BARN LOADING

Very little loader articulation is needed to load a barn design.
SALT BARN LOADING

A longer ramp with less incline is needed to load barn.
SALT BARN LOADING

Salt must still be kept below the maximum salt height line.
PRE-STORM PREPARATION
EQUIPMENT CHECKS

- Match plow number to truck number.
- Mount plow frame and plow to truck.
- Load truck bed with salt, cinders, sand, or mixture.
- Cover the load.
SALT BOX INSTALLATION AND MAINTENANCE
SALT BOX INSTALLATION

Hinge installation

Strap installation
SALT BOX MAINTENANCE

Check oil level in Auger motor.
Lubricate the Auger End Bearing at the beginning of each shift.
SALT BOX MAINTENANCE

Clean spreader after each storm.
SALT SPREADER SYSTEMS
DICKEY - JOHN ICS2000
SALT SPREADER SYSTEMS
DICKY - JOHN CONTROL POINT
SALT SPREADER SYSTEMS
FORCE AMERICA SSC5100 SPREADER CONTROL
SALT SPREADER SYSTEMS
FORCE AMERICA SSC6100 SPREADER CONTROL
ROADWAYS AND SURFACES
TWO-LANE ROADWAYS

One 12 foot wide lane traveling in each direction.

The standard plow angled correctly will clear 8 to 9 feet per pass.
ROADWAYS AND SURFACES
TWO-LANE ROADWAYS

Four passes needed to clear the entire road.

Clear road shoulders.
MULTI-LANE HIGHWAYS

Multiple lanes traveling in both directions.

Road width determines the number of plow trucks needed.
Factors considered are the median width, shoulders and Jersey barriers.

When possible, begin plowing before rush hour traffic.
ASPHALT ROAD SURFACE

- An asphalt road surface has a crown in the center to aid in run-off.
- Super-elevated curves have a high side.
- Always keep in mind how these roadway features respond to salting operations.
CONCRETE ROAD SURFACE

- Reinforced concrete has a contraction joint every 40 feet.

- Reinforced concrete has an expansion joint every 600 feet.

- Bridges have expansion joints at both ends and may have an expansion dam near the middle of the bridge.
ROADWAY CONFIGURATIONS

INTERSECTIONS

• Empty your plow before crossing intersections.
• Reduce the size of the windrow.
• Avoid building snow banks that interfere with sight distance.
• Keep traffic signs unobstructed from view.
RAMPS AND CURVES

• Plow ramps and curves from the high side to the low side.

• Spread salt on the high side of ramps and curves.

• Keep your speed down on all ramps and curves.
BRIDGES AND OVERPASSES

- Bridge surface may be higher than the road surface due to the bridge freezing and expanding.
- Care must be taken not to throw snow over the bridge to the road below.
- Keep the sidewalks on bridges open for pedestrians.
SHOULDERS, MEDIANs & JERSEY BARRIERS

- Plow away from medians with minimum width shoulder and barrier wall.
- Avoid plowing snow against a Jersey barrier.
- This creates a ramp for vehicles to launch to the other side.
MOUNTAINS AND HILLS

- Traction is limited on hills.
- Stopping can be difficult on hills.
- Watch for melted snow refreezing in the road valley.
RAILROAD CROSSINGS

- Avoid piling snow against signals, switch boxes, signs, etc.

- Raise plows slightly when crossing railroad tracks.
TYPES OF PLOWS

- THE ONE WAY PLOW -

- One way reversible plow (manual adjust).
- One way reversible plow (hydraulic adjust).
- One way non-reversible plow.
- Wing plow.
V-Plows are mounted to a Grader or Oshkosh.
V - PLOW

Plows in both directions at the same time.

Also known as the “Drift Buster”.
PLOWING TIPS AND TECHNIQUES

- PLOWING SPEED -

• Keep your speed fast enough to move the snow away from the roadway...

• ...but slow enough so as not to damage whatever it hits.

• The faster your speed the more unstable the truck.
PLOWING SPEED

• Plowing too fast can create a blizzard-like condition that can obscure your vision.

• Reduce plowing speed at bridges.

• Reduce your left shoulder plowing speed when Jersey barriers located in the median.
PLOWING SPEED

When part of a plow train, continually adjust your speed to maintain a good, even spacing between trucks.
POINTS TO REMEMBER

- Always give bridges and ramps special attention.
- Salt the high sides of curves.
- Do not over-use salt.
- Use just enough to get the job done.
POINTS TO REMEMBER

- Salt loses most of its effectiveness at temperatures below 20°F.
- Salt stops working altogether at -6°F.
- Adding more salt to an already salted roadway can actually cause the brine solution to freeze.
POINTS TO REMEMBER

• Salt mixed with calcium chloride melts snow and ice down to minus 67°F.

• Maintain 300 to 500 pounds salt distribution per lane mile.

• Do not use “Manual”, “Stationary Unload”, or “Blast” unless absolutely necessary.
POINTS TO REMEMBER

- Use the left spinner setting when spreading salt on two lane flat roadways.
POINTS TO REMEMBER

• Spread salt on high side of banked curves.

• Adjust spinner setting to correct for wind velocity and direction.
PLOWING TIPS

• Never drive faster than speed limit.

• Use a lower gear than normal driving.

• Use extra care plowing curves.

• Plow with direction of traffic.
PLOWING TIPS

• Do not block radiator with plow when traveling.

• Plow from centerline out to shoulder.

• Plow towards low side of ramps or curves.

• Plow away from wind when possible.
PLOWING TIPS

- Raise blade before making sharp turns.
- Don’t leave windrow across an intersection.
- Know your turn around points.
- Refuel with meal breaks or reloading.
Plow lane in one direction and drop salt behind truck.
SINGLE VEHICLE PLOWING

Plow lane in one direction, turn at end of route, plow lane in opposite direction and salt both lanes.
MULTI-VEHICLE PLOWING

• The width of the road determines how many plows are needed to clear the snow.

• Minimum overlap of any “plow train” should be about 1 foot.

• Distance between plow trucks should be around 150 feet.
MULTI-VEHICLE PLOWING

• The deeper the snow, the more overlap needed to avoid leaving a windrow.

• First truck clears 8 feet of the left traffic lane, leaving 4 feet for second truck.

• Second truck overlaps 1 foot clearing 4 feet of first lane and 3 feet of second lane, leaving 9 feet for third truck.
MULTI-VEHICLE PLOWING

- Third truck overlaps 1 foot clearing 7 feet of second lane, leaving 2 feet for fourth truck.

- Fourth truck overlaps 1 foot clearing 2 feet of second lane and 5 feet of shoulder.

- One more truck would be required if a third lane was present.
MULTI-VEHICLE PLOWING

- Four or more lanes would require more plow trucks.
- The larger trucks should be at the end of the train.
- The last truck plows ramps.
TYPES OF SNOW AND PLOW ANGLE

- Wet snow requires more plow angle to discharge snow from plow moldboard.

- Plow must still clear a path for the truck tires.
SADDLE TANK OPERATIONS

- Keep saddle tank filled with salt brine or mag during winter months.

- Spray mag or salt brine on your salt load at the rate of 10 gallons per ton of salt.

- Use saddle tank when applying salt to dry snow.
SADDLE TANK OPERATIONS

- Use saddle tank when pavement temperatures are 25°F or below.

- Use saddle tank to combat freezing rain, sleet, or black ice.

- Do not use saddle tank on slush or wet snow unless pavement temperatures are below 25°F.
LIQUID APPLICATOR TANK GUIDELINES

- Apply salt brine 2 to 10 hours before storm.
- Spray bridges and cold spots prior to cold weekends to prevent emergencies.
LIQUID APPLICATOR TANK GUIDELINES

- Standard application rate of salt brine is 45 to 80 gallons per lane mile.
- See section 15 charts for correct application.
Now let’s move on to Part II of the presentation.

Winter Operations
Environmental Considerations
SHA Snow College
Winter Operations
Environmental Considerations
Winter Materials Storage, Handling and Spreading
Before we get into this second part of the presentation, we need to ask you a few personal questions. OK?
How Many of You Like To Fish?
How Many of You Like To Hunt?
How Many of You Like Being Around The Water?
How Many of You **Really, Really** Like Being Around The Water?
How Many of You Like to Camp, to Hike, Bird Watch or Bike?
How Many Just Like Nature?
How Many of You Like To Eat Steamed Crabs or Oysters From Our Chesapeake Bay?
So, what does this have to do with Snow College you ask?
As SHA Employees you have an important role in protecting our environment during winter operations by Salting Sensibly.
What’s the big deal – salt is a naturally occurring substance!

While salt is a naturally occurring substance, high concentrations of salt negatively affect or destroy land based and aquatic habitats and species.
Once salt goes into solution (melts into the water) it cannot be recovered. It is stored in soil or water and can reach levels that are considered contamination.

Salt can contaminate drinking water supplies in wells and in reservoirs, inhibit the establishment of vegetation or crops, and eliminate habitat for fish and other aquatic species.
By implementing a few Best Management Practices (BMP’s) in handling salt and other de-icing materials, water resources can be protected.

BMP’s are also requirements in SHA’s National Pollutant Discharge Elimination System (NPDES) Industrial and Municipal Permits. Failure to implement the BMP’s can result in fines and/or criminal charges. These permits are issued by the Maryland Department of Environment.
Salt Storage

During the off-season, a barrier should be placed across the structure’s opening to prevent salt from contaminating the environment.
Salt Storage

Make sure when salt is delivered, that all inlets and drainage structures are protected and all the salt is under covered storage by day’s end. Here an inlet was protected by covering it with sheet signing, but overnight rain washed dissolved salt into the drainage system discharging it off site.
Abrasives stored under cover. Here the material is far enough away from opening that it does not need a barrier across the opening.
Brine and/or MgCl₂ Storage

Inspect tanks monthly paying particular attention to valves and fittings. Place drip pan under leaks and repair immediately.
Salt Handling

- During winter storm events, mixing salt and abrasives on impervious surfaces is allowable.

- Uncovered salt/abrasive stockpiles are allowed during a storm event; however, they must be placed under cover immediately after plowing operations have stopped and the mixing area must then be free of any residual salt and/or abrasives.
Salt Handling

Impact of a salt/abrasive mix not being placed under cover. Non-compliant with NPDES permit conditions.
Salt Handling

Mixing salt/abrasives on unpaved areas can result in destroying vegetation and causing an erosion problem.
To minimize spillage do not overfill trucks with salt or salt/abrasive mix. Upon completion of plowing event, all material on macadam (pavement) lot must be swept and returned to covered storage.
Upon completion of plowing, return all unused salt to covered salt storage area.

Dumping residual salt in this area killed the vegetation and the area was at risk for erosion. This area had to be restored by removing contaminated soil, backfilling and seeding and mulching.
Materials Spreading

To provide bare pavement in a cost-effective and environmentally responsible manner:

- Use appropriate shop application rates to match specific storm conditions.
- Unless otherwise directed, only apply salt to your designated route.
- Return unused salt to designated dome or barn. Never spread salt just to get rid of it.
Materials Spreading

By following appropriate Salt Spreading Guidelines you will be performing your job duties in an environmentally sensitive manner, reducing the amount of materials discharging from the roadway environment into the natural environment.

Remember - Excess salt run-off not only impacts aquatic habitat but also impacts drinking water in wells and reservoirs.
Materials Spreading

Keep your load covered. Use the tarp to reduce wind erosion of material.
Prior to winter maintenance season, calibrate equipment to ensure maximum efficiency and proper application rates.
Equipment Preparation and Cleaning

Check all fluid systems for leaks to reduce the risk of discharge of petroleum based products on roadways and macadam (paved) lots.
Clean equipment in wash bay so that wash water is treated by the grit separator and oil/water separator to minimize the discharge of sediment, salt and heavy metals into the environment.
Do your part in helping to protect the environment.

Be an Environmental Steward.

Salt Sensibly.
Total Daily Maximum Load (TMDL)

- Governs the amount of specific pollutants discharged into streams, watersheds, rivers, ponds, lakes and other bodies of water that are “impaired waterways” under the authority of the US environmental Protection Agency and Maryland Department of the Environment.
- Impaired waterways are those that have been adversely impacted by pollutants to the point that biological functions have been negatively impacted and/or diminished whereby habitat is marginal or non-existent and/or drinking water has been contaminated.
- MDE is currently developing TMDL’s for Chloride (salt) and anticipates issuing requirements for Chloride reduction within the next two years.
Chloride Impairments, Category 5 Waters from MDE’s 2014 Integrated Report

<table>
<thead>
<tr>
<th>Watershed</th>
<th>County</th>
<th>Ships</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bush River</td>
<td>BA</td>
<td>Churchville</td>
</tr>
<tr>
<td>Lower Gunpowder Falls</td>
<td>BA</td>
<td>Golden Ring, Hereford</td>
</tr>
<tr>
<td>Loch Raven Reservoir</td>
<td>BA, CI, HA</td>
<td>Churchville, Golden Ring, Hereford, Owings Mills, Westernport</td>
</tr>
<tr>
<td>Back River</td>
<td>BA</td>
<td>Golden Ring, Hereford</td>
</tr>
<tr>
<td>Baltimore Harbor</td>
<td>BA, BA</td>
<td>Glen Burnie, Golden Ring</td>
</tr>
<tr>
<td>Jones Falls</td>
<td>BA</td>
<td>Hereford, Golden Ring, Owings Mills</td>
</tr>
<tr>
<td>Gunpowder Falls</td>
<td>BA</td>
<td>Hereford, Owings Mills</td>
</tr>
<tr>
<td>Patuxent River/Lower North Branch</td>
<td>BA, BA, CI, MO</td>
<td>Dayton, Glen Burnie, Owings Mills, Washington</td>
</tr>
<tr>
<td>Liberty Reservoir</td>
<td>BA, CI</td>
<td>Hereford, Owings Mills, Washington</td>
</tr>
<tr>
<td>Magnolia River</td>
<td>AA</td>
<td>Annapolis, Glen Burnie</td>
</tr>
<tr>
<td>South River</td>
<td>AA</td>
<td>Annapolis</td>
</tr>
<tr>
<td>Pleasant River Upper</td>
<td>AA, HO, MO, PG</td>
<td>Annapolis, Dayton, Fairland, Laurel, Marlboro</td>
</tr>
<tr>
<td>Little Yaphank River</td>
<td>AA, HO</td>
<td>Annapolis, Dayton, Glen Burnie</td>
</tr>
<tr>
<td>Metomac Creek</td>
<td>DC, PG</td>
<td>Laurel, Marlboro</td>
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<td>Potomac River - Montgomery County</td>
<td>MD</td>
<td>Fairland, Frederick, Gaithersburg</td>
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<td>Anacostia River</td>
<td>MD, PG</td>
<td>Fairland, Gaithersburg, Laurel, Marlboro</td>
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<td>Calvert Creek</td>
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<td>Fairland, Gaithersburg</td>
</tr>
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<td>Severn Creek</td>
<td>MD</td>
<td>Gaithersburg</td>
</tr>
<tr>
<td>Patuxent River - Washington County</td>
<td>WA</td>
<td>Hagerstown</td>
</tr>
<tr>
<td>Conococheague Creek</td>
<td>WA</td>
<td>Hagerstown</td>
</tr>
<tr>
<td>Little Toehomy Creek</td>
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<td>Hagerstown</td>
</tr>
<tr>
<td>Buffett Creek</td>
<td>AL</td>
<td>Laurel</td>
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<td>Willis Creek</td>
<td>AL, GA</td>
<td>Keyser’s Ridge, Laurel</td>
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<td>Georges Creek</td>
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<tr>
<td>Casperian River</td>
<td>GA</td>
<td>Keyser’s Ridge</td>
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Chloride Impairments with SHA Responsibility
- SHA Shp
- Chloride Impairments
- Shop Territory
Chloride TMDLs Scheduled for the Next 2 Years with SHA Responsibility

<table>
<thead>
<tr>
<th>Watershed</th>
<th>County</th>
<th>Shops</th>
</tr>
</thead>
<tbody>
<tr>
<td>Back River</td>
<td>BA</td>
<td>Golden Ring, Hereford</td>
</tr>
<tr>
<td>Gwynns Falls</td>
<td>BA</td>
<td>Hereford, Owings Mills</td>
</tr>
<tr>
<td>Little Patuxent River</td>
<td>AA, HO</td>
<td>Annapolis, Dayton, Glen Burnie</td>
</tr>
</tbody>
</table>
That’s the end of day one.

Thank you for your attention.

Created by:
The Office of Maintenance Training & Certification Team

Narration by Charlie Moss
Appendix C: OOM Winter Town Meeting
2019 OOM WINTER TOWN MEETING

Presenters:
Paul Richardson          Scott Simons
Today’s Agenda

› Winter Recap
  – Weather/Forecast
  – Opportunities for Improvement (OFI’s)
  – Goals Moving Forward
  – Overhead Structure Impacts

› Strategies for Reduction
  – Salt Brine
  – Tracking Resources
  – Reduction Techniques

› New Technology
  – Winter Operations Dashboard
  – Plow Tracker
  – MARWIS
  – Scan Tool
  – TSMO
Weather Forecast

Were the forecasts beneficial last season?
Right 100%? Maybe 75% Barely 25%? Not at all?
What were the possible issues?
Timing? Precipitation? Temperature? Duration?
Last Season’s Weather

› District 6
  – Averaged 24 winter events
    › 2 shops had 40 events
  – Average winter temperatures
  – Averaged 105” of adjusted accumulation
    › 4.5” more than last season

› All Others
  – Averaged 10 winter events
  – Temperatures averaged 30-35 degrees during winter months
  – Averaged 33” of adjusted accumulation
    › 5” less than last season
  – Multiple freezing rain events
District 1

District 1 Salt Usage Trends

<table>
<thead>
<tr>
<th></th>
<th>Cambridge</th>
<th>Princess Anne</th>
<th>Salisbury</th>
<th>Snow Hill</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014/15</td>
<td>501</td>
<td>353</td>
<td>540</td>
<td>504</td>
</tr>
<tr>
<td>2015/16</td>
<td>310</td>
<td>186</td>
<td>294</td>
<td>190</td>
</tr>
<tr>
<td>2016/17</td>
<td>507</td>
<td>393</td>
<td>404</td>
<td>328</td>
</tr>
<tr>
<td>2017/18</td>
<td>373</td>
<td>252</td>
<td>339</td>
<td>328</td>
</tr>
<tr>
<td>2018/19</td>
<td>362</td>
<td>268</td>
<td>297</td>
<td>196</td>
</tr>
</tbody>
</table>
Simple Question...

How much does 1 cubic foot of salt weigh?

Or is it a simple question?

Who thinks they know?
Simple Answer...

› 60 to 80 lbs.
  – dependent on certain factors

What are those factors?

Remember this answer!
Salt Used 2018-2019 Season

› 210,000 tons were spread last year
  ‒ 4,506 tons were used in brine

› That equates to about 70,000 scoops from a
typical 3 cubic yard loader bucket
  ‒ or 10,500 tri-axle loads
  ‒ or enough salt to make a wall around the entire
    Baltimore beltway 6’ high
  ‒ or enough to cover a football field from end zone to end
    zone 100’ high
Snow Removed 2018-2019

› 3.8 billion cubic feet across MDOT SHA roadways
› Enough to fill a line of dump trucks that would circle the world 2 times
› Or enough to fill 43,000 Olympic size swimming pools
## Winter Operations Planning

### District 1

<table>
<thead>
<tr>
<th>Phase 1 (0&quot;-1&quot; of snow)</th>
<th>SHA Fleet - 12</th>
<th>Hired Fleet - 0</th>
<th>82 Tons of salt = 547 lbs/lm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase 2 (1&quot;-2&quot; of snow)</td>
<td>SHA Fleet - 12</td>
<td>Hired Fleet - 8</td>
<td>160 tons of salt = 585 lbs/lm</td>
</tr>
<tr>
<td>Phase 3 (2&quot;-4+&quot; of snow)</td>
<td>SHA Fleet - 12</td>
<td>Hired Fleet - 9</td>
<td>160 Tons of salt = 585 lbs/lm</td>
</tr>
</tbody>
</table>
Why is this Important?

› MDOT SHA has partnered with MDE & DNR
  – Stream monitoring
  – Watershed monitoring

› These 2 partnerships have uncovered that MDOT SHA:
  – is not the largest contributor, per capita, of salt to surrounding waterways
  – is in compliance and has a documented Salt Management Plan
  – is willing to collaborate and share its best management practices

› MS4 Permit
  – MDE has recognized our efforts and has expanded the best management practices to the next generation permits
  – MDE has established a pilot in the Cabin John watershed and is discussing implementing a TMDL requirement in Montgomery County
Winter Storm Scenario...

› A winter event is scheduled to arrive at 1 AM on a weeknight with 1-3” of snow forecast. There will be a heavy band to move through between 3 and 4 AM. The storm should taper off around 5AM

› How would you handle?
Winter Storm Scenario...

› Have phase 2 hired contractors reporting at 12 AM with MDOT SHA staff to report at 11 PM

› Realizing the storm should be over around 5 AM minimal efforts and salt, 1 to 2 applications, should be needed prior to the heavy band

› Two applications of 150 lbs. with maybe an inch that has fallen has put your usage at 300 lbs/Im/in

› Now the heavy band starts moving in, its approaching rush hour and traffic is picking up
Winter Storm Scenario...

› This is when you will most likely see the coldest temperatures of the night

› You will need to get a shot of salt down prior to rush hour during the heaviest band. Plow down, spreader on at 250 lbs to keep the snow and ice from bonding, and buy you a little time

› Some of your areas have covered back up but the storm has tapered off, so another round of salt is required. Set spreader to 150 lbs and plow as needed

› Now the storm has ended and the roads appear clear. How did we do?
Winter Storm Scenario...

- It snowed all 3" that were forecast and your usage rate was 233 lbs/lm/in. This is exceptional, way to pay attention to the conditions and keep the application rate down

- It snowed a total of 2" and your usage rate was 350 lbs/lm/in. Great job as this falls in line with the FHWA recommended usage. This was a safe and sensible approach

- Only 1” of snow actually fell and your usage rate was 700 lbs/lm/in. That’s a little bit of miss although you kept your application rate down for each pass your overall usage was pretty high in the end
Other Influencing Factors

› Temperature (air/road)
› Type of precipitation (wet/dry)
› Accuracy of the forecast
› Residual salt on roadway
› Anti-icing
› External influences
  – police
  – CHART
  – elected officials
  – media
› Type of roadway
  – Interstate
  – Primary
  – secondary
› Other...

These are just some of the things that could influence decision making and could drastically change your usage rates.
Pre-wet salt works better than dry salt

Salt cannot melt snow & ice…must change phase into a liquid….

Brine can melt snow & ice
Direct Liquid Application (D.L.A.)

No rock salt
D.L.A. is not for everyone...

- DLA is tough
- It requires more attention
- Less time between passes
- Possibly more trucks on the same route to cover refill times
- Need to have extra brine on hand or replenish during storm
Here’s a tip

Have enough bar pressure to melt holes through snow/ice so the deicer can spread out under it. This breaks the bond.

If you gently spray on top of snow and ice, you will act like the Zamboni.
Pros and cons of liquid only applications

Pros:
- Less waste
- Costs less
- Less environmental harm
- Works fast
- Have no granular for problem areas on board

Cons:
- Tricky to use
- Less melting power
- Can ice up the road if you do not penetrate and melt from beneath
STORM

- STORM: State Wide Traffic Operations Resource Map
- Deployed last year
- Will utilize RWIS/MARWIS data to create a better understanding of roadway conditions
- Standardized metrics for reporting
MARWIS

- MARWIS Pilot narrowed to 3 districts (153 total by the middle of winter)
- For better coverage in localized areas
- Exposure to the data will aid in better decision making
- Should lead to possible expansion in the future

https://youtu.be/C4Zb0JsZZNI
Overhead Structure Hits
Overhead Structure Hits

› Keep truck bodies lowered when traveling
› Use extreme caution when raising to fill the auger box
› Remain aware of your surroundings:
  › signals
  › utility wires
  › overhead signs
  › bridges
Salt Structure Automated Measuring

- Cameras mounted in rafters
- Hard wired iPhones
- Real time measurements at the push of a button
- Eliminate some safety concerns
- Eliminate guess work
- Help with inventory tracking
- 30 million in inventory
- Track what we actually use
Simple Questions...

Who remembers how much 1 cubic foot of salt weighs?

What about how many total tons of salt we used last year?
Simple Answers…

60-80 lbs.

210,000 tons
Let’s dig into the salt pile...

› 210,000 tons = 420,000,000 pounds
› 210,000 tons = 70,000 scoops of salt
› 60-80 pounds = 1 cubic foot of salt
› Let’s say each cubic foot weighs 80 lbs.
› 80 lbs., multiplied by 70,000 scoops. That’s almost 2800 tons of salt
› Let’s put a $ figure to this 2800 x $80.00/ton = $224,000 that could be saved
› That is 0.7 % of the two scoops you put on a single axle truck
› Think even the little decisions make a big deal?
Final thoughts

› Even a small amount can make a huge difference.
› Cutting back your application rate by 5-10% for every pass could actually reduce your salt usage by upwards of 30% or more
› We know you all want to make a difference, but hearing things like “make a round”, “give it a light shot”, “burn the last little bit off”, “hit it heavy and go relax for a bit”. These types of things have a dramatic impact not only on money or usage rates but also the environment
› Not to mention our infrastructure, bridges, asphalt, concrete, vehicles, pipes, our homes, pipes in our houses, and drinking water
› We all know with almost any winter event you are going to make more than one round of salt, the next round you make try turning that knob down a notch or 2 see how it works
2019-2020 Winter Salt Usage Goal

400!!!
“The things you do for yourself are gone when you are gone, but the things you do for others remain as your legacy.”
— Kalu Ndukwe Kalu

“What you do makes a difference, and only you can decide what kind of difference you want to make.”
— Jane Goodal