Utah Salt Storage Facilities Guidelines and Best Management Practices

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UTAH SALT STORAGE FACILITIES GUIDELINES AND BEST MANAGEMENT PRACTICES

by

Weston C. Bellon

A report submitted in partial fulfillment of the requirements of the degree of

MASTER OF SCIENCE

in

Civil and Environmental Engineering

Approved:

__________________________  __________________________
Blake Tullis, PhD             Wade Goodridge, PhD
Major Professor              Committee Member

__________________________
Joseph Caliendo, PhD
Committee Member

UTAH STATE UNIVERSITY
Logan, Utah
2018
ABSTRACT

Utah Salt Storage Facilities Guidelines and
Best Management Practices

by

Weston C. Bellon, Master of Science
Utah State University, 2018

Major Professor: Blake Tullis
Department: Civil and Environmental Engineering

An environmental analysis was conducted at the Utah Water Research Laboratory of
samples gathered from Utah Department of Transportation (UDOT) salt storage facilities
retention ponds across the state. The analysis indicated high levels of TSS largely made up of
minerals directly associated with the deicing solution currently used by UDOT in roadway
applications. As a companion to that analysis, best management practices have been identified
and compiled to provide a resource for the proper management of salt storage facilities in the
state of Utah. Topics included as best management practices include locating new storage
facilities, proper salt storage, proper salt handling, and retention and evaporation pond design
and maintenance. The application of these guidelines will increase the economic efficiency of
deicing procedures as well as protect the environment from potential contamination.
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INTRODUCTION

The purpose of this report is to provide a reference for the future construction and current management of salt storage facilities for the Utah Department of Transportation (UDOT). This report will serve as a companion to the water quality analysis report generated for the detention ponds associated with the salt storage facilities and will assist in the prevention of environmental contamination. Throughout this report the term “salt” will be used to describe the base material used to create a brine solution for road application.

The water quality analysis mentioned in the previous paragraph will not be outlined in detail in this report. However, a general summary is worthy of mention for the purposes of this report. As a result of the analysis, it was determined that the major obstacle to a water reclamation endeavor would be the extremely high levels of Total Dissolved Solids (TDS). This was deemed due to a high concentration of salt in the water which can be easily explained through an understanding of the solution mixing, loading, and cleanup processes (Goodridge, et. al., 2018).

The methods outlined in this report will encourage an efficient, safe, and clean procedure for the storing, mixing, loading, and clean-up of road salt and brine solution. A brief introduction including the background of road salt application will be discussed, followed by the method of choosing a site for salt storage facilities, best management practices in salt storage, solution handling and finally retention pond specifications.
BACKGROUND

UDOT is one of the many organizations that implements the use of salt in road deicing applications. With an annual budget for snow removal of nearly 24 million (UDOT Snow Removal, 2017), deicing becomes a significant factor in economizing snow and ice removal. Salt is used so universally due to its effectiveness at decreasing the freezing point of water. UDOT asserts the use of salt is primarily to create a layer of brine solution under the snow and ice, allowing for easy removal by the plow. This method essentially prevents any bond from forming between the pavement/asphalt and the overlying snow and ice. Such a prevention in bonding facilitates easier removal of the snow or ice. The quick and effective removal of snow and ice from road surfaces throughout the winter is not only crucial for the safety of those traveling, but for the transportation of goods and services that contribute to society.

Given that the transportation system is so vital to industry and commerce, delays can adversely affect local economies. The national Highway Traffic Safety Administration published a report estimating economic impact of motor vehicle crashes in 2000 (Blincoe, et al., 2002). They report an annual cost for reported crashes at $22 billion and an estimate for unreported and reported crashes at $51 billion. The latter estimate factors in a statistic of 57 percent of all crashes not being reported to the police. Additionally, twenty-four percent of vehicular crashes are weather related (Pisano, Goodwin, Rossetti, 2008). Pisano, Goodwin, and Rossetti (2008) also indicate that 7,400 people are killed and over 673,000 people are injured in these crashes.

In order to prepare for storm events that can create potentially dangerous travel conditions, UDOT and other agencies across the state store salt at facilities frequent enough to provide quick application of brine solution. The application of a brine solution on the road surface prior to or
during a storm is generally not considered an environmental threat due to the relatively small amount of solution applied and the large amount of dilution due to added moisture from the snow and ice.

Salt storage facilities, however, can pose a significant environmental hazard due to the large concentration of salt stored in a relatively small area, as well as other contaminants potentially introduced from the salt distribution equipment and processes. UDOT is currently working with Utah State University to determine potential hazards located at the storage facilities, including the detention ponds and equipment cleaning procedures.

The 2016 UDOT Stormwater Management Program (SWMP) Plan includes several guidelines for the management of salt storage facilities. The regular assessment of such facilities is outlined as well as required minimum pollution prevention procedures. Action items for the pollution prevention of existing and future salt storage facilities is also included as well as BMP’s for Snow Removal and Deicing Practices and Salt Piles and Salt Storage (Utah Department of Transportation, 2016).

This report will serve as a companion to the water quality analysis provided by Utah State University and support UDOT’s SWMP Plan to further assist UDOT in their quest to reduce their environmental impact by creating a stand-alone reference for best management practices for existing and future salt storage facilities.

The report will walk through the appropriate steps in locating and constructing new salt storage facilities as well as proper storage practices, solution handling, and retention pond specifications.
SITE LOCATION

When locating a salt storage facility, factors similar to those of emergency services facilities should be considered. Proximity to major transportation routes will allow for quick access to priority motorways during a storm event, as well as allow for easy delivery of salt, fuel, and other maintenance supplies. The centralization of the service area should also be considered to provide the quickest access to the entire area. When considering these factors and others, care should also be given to locate and avoid environmentally sensitive areas.

The following list includes some of these environmentally sensitive areas.

- **Culinary Water Sources** – Public and private drinking water sources, including wells and springs, should be avoided due to the potential impact on water quality. Source Water Protection Areas should be identified with the help of local municipalities, and the distance from private wells should be considered based on local geology.

- **Non-Culinary Wells** – Any well, whether irrigation, industrial water supply, or even dry, should be avoided. These wells provide access for runoff to aquifers below ground. The proximity to these wells should also be considered based on local geology, but no closer than 300 feet (State of Ohio, 2013).

- **Storm Water Conveyance Features** – Ditches, storm drains, and other methods of storm water conveyance could allow for the quick movement of salty runoff from salt storage facilities. These features should be avoided or mitigated.

- **Surface Water Bodies** – Surface water bodies such as streams, rivers, lakes and wetlands should be avoided. A salt storage facility should not be located within the 100-year flood plain of a stream or river, and far enough from lakes, wetlands, or
other surface waters to eliminate any chance of direct discharge from the facility to the water body.

- **Hydrogeologically Sensitive Areas** – Areas with unconsolidated aquifers and areas with shallow, fractured bedrock should be avoided. These areas pose a high risk to ground water contamination due to easy infiltration to aquifers.

If possible, these areas of high sensitivity should be avoided for salt storage facility locations. If it is deemed impractical to do so, extra care should be applied during the construction and operation of such a facility to reduce the risk of environmental contamination. Facility operators should be aware of local hazards and operations should be monitored to ensure sensitive areas are not contaminated.
SALT STORAGE

Proper salt storage includes more than just adequate space for the season’s salt supply. Other factors include the application of an impermeable pad, adequate cover, and enough space to maneuver the necessary equipment during loading, mixing and delivery. This section will provide guidelines for the methods involved in salt storage.

The amount of salt stored on site should be the first consideration in the development of a salt storage plan. An insufficient salt supply may decrease the effectiveness of storm response and introduce a source of pollution in the case of emergency deliveries. It may be difficult to determine the required salt storage capacity for a specific site, but the following guidelines provided by the Salt Institute may be helpful.

• “Never reduce last winter’s figure simply because you hope next winter will be milder. Make realistic estimates based on average needs over the previous five or ten-year period.

• Understand the supply impact from the previous winter weather. Harsh, long winters deplete storage and affect salt demand for the following winter.

• Be sure to consider new mileage added to your road or street system. Don’t overlook new subdivision streets, interstate or express highways and routes acquired from other political subdivisions.

• Improve winter maintenance operations. Going to straight salt, including applying liquid brine or pre-wet solids, or adding more salt routes can substantially influence salt requirements while providing a higher level of service.” (Salt Institute, 2015).
Salt should be stored and handled on an impervious pad. This pad should be constructed of the appropriate thickness and reinforcement to reduce the risk of cracking due to the load of the salt pile and equipment necessary to handle the salt. Cracks compromise the impervious nature of the pad by allowing seepage to the soil beneath. In the case of construction in sensitive areas or with a pad that is at risk of cracking, an impervious liner should be installed beneath the pad to further reduce the risk of seepage due to imperfections in the pad.

The site should be graded as such to prevent run-on from encountering the salt storage and handling area. A slope of 1 to 2 percent should suffice to let water drain away from the salt storage pad. If it is impossible to appropriately grade the area sufficiently to avoid run-on from entering the salt storage area, a curb should be installed to direct the flow around the pad. No floor drains should exist in the salt storage area.

Stored salt should always be covered. The practice of covering salt during storage serves many benefits. These benefits include, but are not limited to; minimizing run-off that can lead to environmental contamination, preventing lumpy salt that can be difficult to use, and minimizing salt loss, saving the agency money in materials. Salt can be covered using a permanent or temporary structure, as well as with a tarp.

Current UDOT practices require the construction of a storage structure at each new facility. This is the ideal situation. If located and oriented correctly, a permanent storage structure can allow a safe, efficient, and clean location for the storage and handling of salt.

The Salt Institute’s Salt Storage Handbook provides a reference for structure design based on the size of required piles (Salt Institute, 2015). As well as providing enough room for salt piles, ideally a storage structure would allow enough room for the loading, mixing, and other handling activities to be performed under cover.
When designing a salt storage structure, it is important to consider the pervious nature of the walls. In general, the structure should be placed on an impervious pad, with walls impervious to a height of at least one foot above where the pile meets the wall.

Storage structures that do not meet this requirement should not have salt piles in contact with the walls. In this case the structure could experience seepage, potentially leading to environmental contamination and damage to the structure.

For existing salt storage structures, it is important to recognize the weaknesses of certain types of structures to take measures to prevent contamination, salt loss, or structural failure. Below are several types of structures that may be encountered at existing salt storage facilities, some potential drawbacks, and methods of preventing adverse situations.

- **Wood Framed Structures** – Many wood framed structures originally constructed for other reasons have been repurposed for salt storage structures. The pervious walls of wood structures are at risk of leaking contaminants, and experiencing damage due to wind, snow, equipment, or rot. Maintenance should be performed more frequently on these structures to prevent deterioration. Salt piles should also be placed in a way that does not contact the wall, as the wood frame is generally not designed to support such a lateral load.

- **Three-Sided Structures** – Open end, three-sided structures are common for salt storage. They allow easy access to salt piles and are generally constructed of impervious walls designed to support a lateral load from a salt pile. Care should be taken when dealing with these structures to orient them in a way that does not allow prevailing winds, carrying rain and snow, to enter the open side of the structure. Site
grading should also be observed to reduce the risk of run-on from entering the structure.

![Three-sided storage structure at UDOT facility.](image)

**Figure 1. Three-sided storage structure at UDOT facility.**

- **Enclosed Structures** – Enclosed structures can be four sided or dome shaped and are generally more expensive than the two options above. However, they do offer the most comprehensive environmental protection. Consideration should be given to budget and other necessary improvements as the cost of an enclosed structure may provide better protection if divided up between multiple three-sided structures at sites that need improved storage.

If problems are detected during regular inspections of salt storage structures, the following guidelines should be followed as provided by the Ohio Water Resources Council’s

*Recommendations for Salt Storage:*
• Any roof leaks, tears, or damage should be temporarily repaired during winter to reduce the entrance of precipitation, with permanent repairs being completed prior to the next winter season. At no time should leaks be allowed to persist when materials are being stored inside. Leaks in walls need to be similarly repaired.

• For the pad/loading pads, practice preventative maintenance such as periodic resealing to maintain the low permeability. Seal expansion joints when necessary.

• Repair and reseal cracks in the floor (State of Ohio, 2013).

Some of the older salt storage facilities across the state do not have storage structures. In this case, the proper use of a tarp is essential to reduce contaminated runoff and salt loss. The tarp should be durable and water proof, and be large enough to cover the entire pile. Multiple tarps may also be used if sewed together, although a single tarp is preferred.

The Salt Institute’s *Salt Storage Handbook* provides a reference for the size of tarp necessary based on the size of the pile as well as guidelines for sewing tarps together and providing a taped seam to improve waterproofing. The bottom line when using a tarp is the more water gets through, the more contaminants are released and the more salt is lost.

When using a tarp, the shape and orientation of the pile should be considered. The pile should be accessed on the downwind side of the pile, while maintaining coverage on the rest of the pile. Anchors should secure the tarp in place while only a section necessary for loading be exposed temporarily.

The Salt Institute categorizes salt piles into four different shapes, a windrow shaped pile, radial or kidney shaped pile, sugarloaf shaped pile, or conical shaped pile. Methods are also described for the loading of such piles except for the conical shaped pile, which is not
recommended. The shape of the pile should be determined by the available space for storage, loading and mixing, and prevailing wind direction (Salt Institute, 2015).
DEICING SOLUTION HANDLING

Proper salt handling procedures can greatly reduce potential contamination and loss of salt. All staff employed at salt storage facilities should be trained on proper handling technique. Salt handling should be monitored at all stages from delivery to mixing and loading. The following practices will assist in training staff and ensuring an efficient and clean method of salt handling.

When salt is delivered, it should be placed immediately under cover. In an ideal situation, salt would be unloaded inside the structure, not placed outside and then moved. Care should be taken to pile salt inside the structure to allow future deliveries to occur under cover. One way of doing this is to push the delivered salt to the back of the storage area, considering how much of the pile can contact the structure wall. This is especially true for three-sided storage structures. Salt stored in these structures should be kept as far from the opening as possible to reduce the effects of wind, rain and snow on the stored salt.

Figure 2 provides a great example of proper salt storage. The structure provides impermeable walls to the necessary height and provides adequate room for salt handling under cover. The piles are also pushed back far enough into the structure to eliminate salt contact with rain and snow.
If it is impossible to handle salt under cover, only quantities necessary should be taken outside. All salt handling should occur on an impermeable pad. Spilled salt should be collected and returned to storage as soon as possible. If mixing must be performed outside, it should be performed prior to the storm, in dry weather, and loaded into the spreaders or stored for future use.

Following the storm event, any area where salt handling took place should be cleaned along with the equipment. Any salt collected from the cleaning process should be returned to storage. Figure 3 demonstrates the importance of site cleanup following a storm event. The piles of salt left uncovered will eventually all drain to the retention pond with rain and snow, leading to a loss of salt and an increase in pond contamination.
If salt is stored under a tarp, great care should be taken to reduce the time of exposure of the salt to the elements. This goal is the reason for the specific shapes of salt piles suggested by the Salt Institute. Also recommended by the Salt Institute in its *Safe and Sustainable Salt Storage Handbook* are the following procedures for removing salt from large, outdoor tarped piles.

- “Remove covering at the working face just high enough to load out the day’s shipment. This will minimize moisture absorption and secure the cover if wind direction shifts toward the working face.
- Maintain the working face perpendicular to the long axis of the pile by loading alternately left/right and right/left.
• Avoid creating a horseshoe-shaped working face that results from removing the center of the pile and leaving extended edges or aprons.

• Chunks of salt that form as the crust of the pile breaks up must be crushed and blended into the pile and not allowed to accumulate.

• Maintain adequate cover at the lower edge or toe of the working face to permit maximum possible resealing of the edge of the cover when operations are completed for the day. Take care to avoid cover damage caused by cascading salt from the upper section of the working face.

• Establish and maintain the working face at the downwind end of the stockpile whenever operationally feasible.” (Salt Institute, 2015).

The primary deicing mechanism used by UDOT is the application of a brine solution. If this solution is stored, it should be done in well maintained and properly labeled vessel. A proper maintenance schedule should consist of regular inspection of valves, fittings and pumps and timely repairs of leaking or dripping components. Secondary containment should be considered wherever possible and generally provides 110-125% of the capacity of the largest tank (State of Ohio, 2013).

The equipment used to handle salt should be washed in an area that drains entirely to an appropriate location such as a retention/evaporation pond to store the water for future treatment or reuse. The design and maintenance of these ponds will be described in a future section.
RETENTION POND SPECIFICATIONS

The collection and storage of contaminated water on site is an essential part of the environmental protection plan associated with a salt storage facility. A written plan should be created for each storage facility prior to construction to provide specific guidance on site specific storm and wash water management practices. This section will provide guidelines to create these written plans.

As described in previous sections, site grading provides the base for storm water management across the site. Grading should prevent any run-on from contacting stockpiles whether covered by a structure or tarp. Storm water that does not come in contact with salt should be directed away from the site and onto adjacent property or the storm system. Water that does collect salt should be directed to proper containment locations such as a retention or evaporation pond. This is the reason for the importance of attempts to contain as much of the salt storage and handling areas as possible.

Contaminated storm water and wash water should be directed to the pond by means of a collection system. The collection system can consist of ditches, berms, pipes, or curbs to isolate the regions contaminated during salt handling procedures. The system should be sized to accommodate a 100-year storm event.

Collection ponds should be constructed with an impermeable synthetic liner to prevent discharge into the ground water. Ideally, collection ponds should be sized to allow enough storage for the pond to act as an evaporation pond. Clean out of the pond should be performed on a regular basis and the spoils disposed of in accordance with Utah Department of Environmental Quality (DEQ) standards. Disposal options will be discussed in more detail below.
Proper pond cleanout should be performed on a regular basis. A maximum amount of time should be determined for each site depending on use and sludge buildup. Examples of sludge buildup in the ponds can be seen in the figures below. These images were taken at a UDOT salt storage facility and are good examples of why it is important to clean out the ponds on a regular basis to allow for inspection and repairs. The continued sediment buildup at the bottom of the pond complicates pumping actions should it be necessary to reuse or dispose of the pond water.

Figure 4. Salt deposits at the bottom of evaporated retention pond.
Disposal of pond water and sludge may be unique to each site and will be aided by a regular testing program. The water and sludge should be analyzed through a process much like the one utilized in the recent study conducted by Utah State University on a regular basis (Goodridge, 2018). The frequency and methods of testing each site should be included in the site management plan. Up to date contaminant information will be essential in determining appropriate disposal/reuse options.

Included in the report created for the study conducted by Utah State University is an outline for spreadsheet calculations to determine appropriate dilution ratios for pond water reuse as well as pros and cons of other treatment methods (2018). Significant findings in the report show that existing contaminants in the pond water are at levels where the water may be re-used in developing new brine mixtures for road treatment.

When testing is performed on a regular basis, current water quality can be plugged into the created spreadsheet to determine the amount of dilution necessary to produce an adequate brine
solution from the pond water. This method needs to be approved by Utah DEQ, and should not be performed without first notifying Utah DEQ. This reuse method could save tax payer money by reducing the cost associated with salt acquisition and water treatment.

To assist in the development of a reuse program, it is recommended that tests be performed on the salt that is sourced for the creation of the brine solution. The results of such a test will be important in determining the source of certain contaminants and potential means of mitigation.

In order to pump the pond water for reuse, care must be given to extract only the undisturbed water, and avoid contamination from trash and stirred sludge. One way this can be ensured is through the use of an inlet structure. The end of the pump hose should be fitted with a floating inlet structure or other means of allowing only the water into the system.

The *Dolphin Strainer* produced by Megator provides a great example of potential inlet control as it is designed to target water just below the surface. The perforations are on the sides only to minimize the amount of sludge sucked up as the inlet approaches the bottom of the pond. The brochure for this product can be found in the appendix (Megator, 2018). Whichever method of pond water disposal is used, a small amount water should be left in the pond and allowed to dry in order to avoid concentrated contaminants from the sediments being extracted with the last remnants of pond water.

The use of a filter may also be necessary to remove target contaminants such as high amounts of oils and grease if they are discovered during testing. The appropriate use of a granular activated carbon, or even a sand filter may be necessary prior to the development of a reuse slurry to remove certain contaminants that do not fit a certain criterion. Further research is necessary to determine an appropriate criterion for a base water quality standard prior to making
a slurry. Following the development of such a criterion, testing also needs to be performed at random sites across the state to gauge the necessity of filtration prior to slurry development.

Disposal of sludge will depend on contaminants and concentrations. Potentially hazardous materials, such as uranium, were discovered in the sludge at several sites during the investigation performed by Utah State University (2018). This material may not be suspended in the water, but further analyses should be performed to determine specific contaminants in the sludge.

Sludge disposal first requires the removal of water from the pond using a technique described above. This would allow for the sludge to be dried facilitating a disposal process that may be more efficient and safe than suspending the sludge in the water column as it is scooped out. Proper timing on sludge removal must be planned to avoid the introduction of hazardous dust into the air from dried pond sludge.
CONCLUSION

The conscious development and application of the best management practices contained in this report will improve road clearing efforts while increasing economic, and environmental efficiency. Several sources were used in the compilation of this report and should be considered where further information is desired. The Salt Institute, can be referenced for many items including the design of structures, size of piles, and other technical information.

The “Safe and Sustainable Snowfighting Award,” available through the Salt Institute, provides specific checklists for facility managers to assess their operations (Salt Institute, 2017). The application form for this award is included as Appendix A.

Observations and results from a recent study on UDOT maintenance detention and retention ponds indicate that further BMP’s could be developed regarding the mixture of brine solutions and which may lead to reduced costs in the purchasing of salts for road treatment.

Plans and procedures developed as a result of this report should be approved through the Utah DEQ. The collaboration between UDOT and Utah DEQ will provide the most economically and environmentally efficient model in salt storage and distribution.
REFERENCES


APPENDIX A – Salt Institute Award Application

The Salt Institute began encouraging safe and sustainable snowfighting in 1972, when it began its Sensible Salting Program. Decades later, SI is still leading the way in promoting best practices in snowfighting to ensure uncompromised winter safety, mobility, and protection of the environment.

Partnering with leaders in winter maintenance, SI has expanded its long-standing “Excellence in Storage Award” to include safe and sustainable operations. In 2012, we presented the Salt Institute’s “Safe and Sustainable Snowfighting Award,” a program that recognizes agencies that demonstrate best practices in salt storage and snowfighting.

Clear winter roads protect lives and commerce. Road salting and effective plowing can reduce injury crashes by up to 88%. And a one-day major snowstorm that shuts down roads can cost a state between $300 and $700 million in direct and indirect costs. Snowfighting is often an undervalued profession, but at the Salt Institute we see the snowfighters as heroes, whose dedicated work protects lives and enables our winter economy.

To apply for the “Safe and Sustainable Snowfighting Award” the facility manager should complete the attached application form and checklist, have it signed by his/her immediate supervisor and return it and all supporting documentation to the Salt Institute by June 1. Please answer all questions. Applications will be judged by our evaluation committee and in some cases a Salt Institute representative will make an on-site facility visit.

Award recipients will receive a “Safe and Sustainable Snowfighting Award” certificate and will be recognized in a Salt Institute press release.

If you have questions please contact Laura Elliott by phone (239.231.3305) or email (laura@saltinstitute.org).

www.saltinstitute.org ■ www.safewinterroads.org
# Winter Maintenance Safety and Sustainability Checklist

## Winter Maintenance Section

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<th>Yes</th>
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<td>Are all roads within an agency’s area of responsibility assigned a level of safety and service?</td>
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<td>Are the different levels of safety and service clearly identified?</td>
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<td>Can agency personnel easily determine whether and when a given stretch of road has achieved its desired level of safety and service?</td>
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<td>Has the community served by the agency been involved in the process of determining levels of safety and service for roads serviced by the agency?</td>
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<td>Does a plan exist to evaluate levels of safety and service on agency roads on a regular basis?</td>
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<td>Is the level of safety and service of a given road segment determined by including factors such as AADT, peak hour traffic, access for emergency services, school hours and bus routes, and other similar factors?</td>
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<td>Have road segments that are in particularly environmentally sensitive areas been clearly identified, and assigned a level of safety and service accordingly?</td>
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<td>In the last two years, has your agency been free from lawsuits resulting from personal injury or property damage as it relates to improper winter maintenance?</td>
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<td>Maximum Total Points for Level of Safety and Service</td>
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<td>Does the agency have a method to specify application rates as a function of pavement temperature, route cycle time, and storm type?</td>
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<td>Does the agency have the capability to pre-wet all solid applications? On the truck (2 points) or in the facility (1 point)?</td>
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<td>Does the agency have the capability to apply liquids before and during a storm?</td>
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<td>Does the agency limit the use of abrasives or abrasive-salt mixtures to those conditions in which straight salt usage is not appropriate?</td>
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<td>Does your agency utilize the deicing tool (NCHRP577) in selecting the most economical and effective deicing products.</td>
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## Equipment Selection and Operations

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<td>Are all material delivery systems calibrated regularly? Annually (1 point) or monthly (2 points)?</td>
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<td>Do all agency vehicles have surface temperature measuring equipment attached?</td>
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<td>Is all winter maintenance equipment specified and purchased on the basis of life-cycle costs?</td>
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<td>Does delivery equipment have the capability to record where material was placed on the road, and at what rate it was placed?</td>
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<tr>
<td>Is the equipment fleet managed using a pro-active maintenance system?</td>
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<tr>
<td>Is it standard practice in equipment operations to use the most fuel efficient vehicle capable of efficiently conducting a specified task?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do fuel efficiency, vibration reduction, minimizing of pavement damage, and wear resistance all get incorporated into cutting edge selection for snow plow blades?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are various pieces of equipment (e.g. snow plows, material delivery systems) easily exchanged between vehicles (i.e. in less than 10 minutes)?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum Total Points for Equipment Selection and Operations</td>
<td></td>
<td></td>
<td>9</td>
</tr>
</tbody>
</table>

Your Agency’s Score for Equipment Selection and Operations
### Performance Measurement and Continuous Improvement

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do you have a post-storm review process that is used after each storm?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do you have a formal system to measure whether and when the required level of safety and service has been achieved on each road segment?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is your storm severity measurement quantitative?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do you have a system that actively seeks out ways to improve your winter safety and service activities?</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Maximum Total Points for Performance Measurement and Continuous Improvement**

- Your Agency's Score for Performance Measurement and Continuous Improvement

### Strategic (annual) Operations

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do you provide annual refresher training in winter maintenance for all winter maintenance personnel?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do you conduct a post-winter review of all activities in the spring/early summer of each year, to identify areas of success and areas in need of improvement?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do you review snow plow routes annually for efficiency?</td>
<td></td>
<td></td>
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<tr>
<td>Do you have a pre-active frost prevention strategy?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do you have a snow drift prevention program in operation?</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Do you provide some sort of media interaction meeting in the fall, to prepare the local media for the upcoming winter season and your activities in it?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do you have a well-defined system for the media to contact your organization during winter storm events?</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Do you have a system to provide the media with special access that allows them to communicate winter maintenance activities effectively to the community (e.g. reporter ride-alongs)?</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Do you have some form of annual open day or open events to allow the public to learn about what you do?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do you conduct forums or surveys to obtain feedback from the public on the winter safety and maintenance services that you provide to your community?</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Do you track the total loading of materials placed on the road network each winter?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do you have a system in place to designate certain road segments as being environmentally sensitive (at least annual review)?</td>
<td></td>
<td></td>
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<tr>
<td>Do you have systems in place to provide real-time road surface condition information to the traveling public?</td>
<td></td>
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<tr>
<td>Do you hold annual (at least) co-ordination meetings with appropriate emergency services agencies?</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

**Maximum Total Points for Strategic (annual) Operations**

- Your Agency's Score for Strategic (annual) Operations

### Tactical (per storm) Operations

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do you use some sort of Value Added Meteorological Service to provide forecasts for your winter storms?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are these forecasts site specific (i.e. they provide different forecasts for different road segments)?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do these forecasts provide pavement temperature forecasts?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do you adapt your storm strategies depending on the time of day at which the storm starts or ends, to take account of variations in traffic levels?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do you have methods in place to deal with disruptions that can occur during winter storms (e.g. equipment failure, traffic congestion, crashes etc.)?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do you have systems in place that allow for easy communication with emergency services in your area?</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Maximum Total Points for Tactical (per storm) Operations**

- Your Agency's Score for Tactical (per storm) Operations

### Maximum Total Score for Winter Maintenance Section:

- 47

### Total Score for Winter Maintenance Section:
# Salt Storage Section

## Storage & Safety

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Does this facility store at least 75% of its annual requirement of salt?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Has this facility been operational for at least one full winter season?</td>
<td></td>
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<tr>
<td>Do you have a written policy for snow and ice control operations?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Does this facility have a written safety program?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is this facility fenced or otherwise secured to prevent unauthorized access?</td>
<td></td>
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</tr>
<tr>
<td>Has this facility been free of any safety violation citations by government regulatory agencies in the past two years?</td>
<td></td>
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<tr>
<td>Does this facility have outside lighting for night operation?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Does this facility have inside lighting for night operation?</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Does this facility conduct safety meetings at regular intervals (monthly, quarterly, annually)?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Maximum Total Points for Safety</strong></td>
<td>9</td>
<td></td>
<td></td>
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</tbody>
</table>

**Your Agency’s Score for Safety**

## Housekeeping

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is this salt storage facility kept free of debris/trash or equipment not related to snow and ice control?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Does this facility have a fenced, walled or secured area where all recyclable materials are stored?</td>
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<tr>
<td>Is solid waste generated at this facility, whether near the storage area or otherwise, contained for proper removal/disposal?</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Does this facility have a written procedure requiring that all salt and/or salting/miner mixtures spilled during loading or unloading operations are cleaned up and placed under cover before the end of each working day or at conclusion of a storm event?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Does this facility have a written policy requiring cleanup of loading and spreading equipment after each snow/ice event?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Maximum Total Points for Housekeeping</strong></td>
<td>5</td>
<td></td>
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</tr>
</tbody>
</table>

**Your Agency’s Score for Housekeeping**

## Environmental

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Does this facility comply with all zoning ordinances?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Does this facility comply with all applicable building and sanitation codes?</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Is the primary storage pile covered by a rigid, coated structure or a waterproof cover?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Does this primary storage facility contain all salt and salting/miner mixtures?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is loading of spreader trucks done on asphalt, concrete, or another type of impervious pad?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Does this storage facility have a written inspection program to periodically assure the integrity of the pad, lighting, structure or other items?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is runoff of salt brine from this storage facility controlled on property owned by the agency or collected for disposal in accordance with applicable permits?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is this facility free of any environmental violation within the past year?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Does this facility have a written policy for disposal of wash water from trucks and spreaders?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Maximum Total Points for Environmental</strong></td>
<td>9</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Your Agency’s Score for Environmental**

## Maximum Total Score for Salt Storage Section:

**24**

## Combined Total Score for Maintenance and Storage Sections:

Eligible for Award?
Safe and Sustainable Snowfighting Award

Safe and sustainable snowfighting has always been emphasized by the Salt Institute. The Salt Institute gives annual Safe and Sustainable Snowfighting Awards to agencies showing dedication to best practices. To enter, fill out the Safety and Sustainability Checklist and fill out the information below and mail to the address below (applications also available at saltinstitute.org). There is no entry fee. Applications need to be received by June 1. Winners will be announced in the Fall and will receive certificates.

SNOWFIGHTING AGENCY (as you would like it to read on the certificate)

NAME OF AGENCY

STREET ADDRESS

MAILING ADDRESS

CITY, STATE/PROVINCE, ZIP/POSTAL CODE

AREA CODE / PHONE

DATE

E-MAIL

APPLICANT CERTIFICATION
I certify that this is a true and accurate response and would welcome an on-site inspection by Salt Institute personnel.

SIGNATURE

SUPERVISOR CERTIFICATION
I affirm that the information is complete and correct.

SIGNATURE

NAME (PRINT)

TITLE

NAME (PRINT)

TITLE

Email or fax the Award Application to:

Salt Institute
405 5th Avenue South, Suite 7C
Naples, Florida 34102
Telephone: 239.231.3305 • Fax: 239.330.1492

Email questions to: laura@saltinstitute.org
APPENDIX B – *Dolphin Strainer* Brochure from Megator

**Floating Suction Strainers**

Megator Dolphin Floating Suction Strainers draw from just below the surface, avoiding sand, mud and floating matter. They do not get buried when grounded in shallow water. Made entirely of tough, corrosion-resistant plastics and stainless steel.

- Reduce wear of pumps
- Prevent pump damage
- Prevent stoppages
- Lessen cavitation risk
- Save their cost many times over
- Always float upright
- Will not lose buoyancy
- Tough, shock-proof
- Corrosion proof

Used for dewatering mines, quarries, excavations and sumps. For water supplies from rivers, lakes, ponds and fire appliances. They are also used for oil storage and other installations required to draw from near the surface.
The strainer holes are $\frac{3}{16}$" diameter, the total area of the holes being between 3 and 4 times the cross-sectional area of the hose. The 6" size has a perforated body which along with the tube is constructed entirely of 18/8 stainless steel. Other sizes have replaceable strainer screens made from Darvic black P.V.C. Standard strainers are suitable for operating temperatures up to 194°F (90°C), but for temperatures above 150°F (65°C) stainless steel strainer plates are available as an optional extra.

<table>
<thead>
<tr>
<th>Size</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>Max capacity gpm</th>
</tr>
</thead>
<tbody>
<tr>
<td>1½&quot;</td>
<td>1½&quot;</td>
<td>6½&quot;</td>
<td>9/8&quot;</td>
<td>5½&quot;</td>
<td>37</td>
</tr>
<tr>
<td>2&quot;</td>
<td>2&quot;</td>
<td>6½&quot;</td>
<td>12&quot;</td>
<td>7½&quot;</td>
<td>74</td>
</tr>
<tr>
<td>3&quot;</td>
<td>3&quot;</td>
<td>8½&quot;</td>
<td>15</td>
<td>10&quot;</td>
<td>148</td>
</tr>
<tr>
<td>4&quot;</td>
<td>4&quot;</td>
<td>10½</td>
<td>17</td>
<td>12&quot;</td>
<td>304</td>
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<tr>
<td>6&quot;</td>
<td>6&quot;</td>
<td>19&quot;</td>
<td>22</td>
<td>15½</td>
<td>792</td>
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</table>