SALT RUNOFF CONTROL AT TRUCK STATIONS AND BULK STORAGE SITES

2015 Salt Handling Report

An Update To:

"Salt Runoff Control at Stockpile Sites"

Published in 1972, updated 1989 and 2012

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Note: Changed the year and date of publication to reflect the update.

Prepared by:
Salt Handling Task Force Committee

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MESSAGE FROM STATE MAINTENANCE ENGINEER

MnDOT relies on salt as an important part of our Snow and Ice Program to clear the roads. Once salt dissolves in stormwater or snowmelt, it will not settle out, it continues to move with the water. Recent research suggests that up to 75% of this salt may stick around in our watersheds, and not be flushed out. For these reasons, it is important that we act responsibly with salt at every stage of the process.

We are already leaders because of our training programs, our smart use of technology, and our research programs. When it comes to salt storage and handling, the best solution for eliminating salt contamination into the environment is good housekeeping practices. Truck stations and bulk storage sites have the potential to release extremely high concentrations of salt, and therefore preventative maintenance needs to be a high priority. To ensure our ability to use salt into the future, we need to continue to handle and store it responsibly today.

Steve Lund

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INTRODUCTION

Salt runoff at bulk salt and winter sand stockpile sites has always been a concern to the Minnesota Department of Transportation (MnDOT). During 1972, Rodney Pletan of the Maintenance Standards Section prepared .a report on "Salt runoff Control at Stockpile Sites" which outlined the environmental problems that salt storage could cause and possible courses of action to prevent these problems from occurring. In 1989 the report was updated and a comprehensive environmental evaluation was performed on all the MNDOT salt handling and storage sites in an effort to identify problems and prioritize building construction. Since 1989 MnDOT has made great progress in constructing buildings to protect salt and salt/sand stockpiles from exposure to the elements. Discharge of salt laden wastewater to wastewater drain fields has largely been eliminated by connecting buildings to City sewers or installation of wastewater holding tanks where sewer was not available. Other operational changes as suggested by the 1989 report have been made thus further reducing salt runoff. A committee was formed to:

1. Review the 1989 report
2. Compile a questionnaire to be completed by the Area Maintenance Superintendents
3. Evaluate adherence to recommended solutions in the 1989 Report
4. Update the 1989 report to reflect current practices and regulations
5. Provide more specific guidelines for the design of salt storage buildings
6. Modify and provide Best Management Practices for current salt handling operations
7. Provide an update to current regulations

This report must be made available to all managers and personnel involved in the design, operation and maintenance of truck stations and bulk storage sites. As facilities are constructed to prevent salt runoff, the proper operation of these facilities and handling of salt becomes paramount. A great responsibility is thus placed on the truck station staff to protect the local environment. Any lack of concern in either design or operation can lead to environmental contamination and associated costly remedial actions and/or litigations. As a responsible state agency, MnDOT must set an example by taking the lead in protecting the environment and its neighbors.

A summary of the questionnaire completed by the Area Maintenance Superintendents is attached to this report. The questionnaire was assembled to help understand how well MnDOT was following recommendations developed in the 1989 Salt Handling Report and help evaluate where changes should be made. Included in the appendix is a document entitled Major Findings of the ***2012 Salt Handling Group***, which summarizes current issues and recommendations.

This report was written by the Salt Task Force Committee consisting of the following members: Floyd Baird, Tara Carson, Mike Kelley, Mark Fischbach, Barbara Loida, David Morisette, Kathleen Schaefer, Wesley Smith, Joe Huneke, and Mark Vogel. Many other individuals also contributed to the report. The 1989 report served as the background and format for this report. Most of the information prepared in the 1989 report is still valid. This report has been updated to better reflect current issues and best management practices.

EXECUTIVE SUMMARY

OBJECTIVE

The objective of this report was to:

1. Evaluate adherence to recommended solutions in the 1989 Report and update these solutions as necessary to provide guidance for current salt runoff issues.
2. Provide a current report on salt runoff prevention and appropriate salt handling practices and make recommendations to address current problems.
3. Update current regulations as they pertain to salt handling practices and salt runoff.

SCOPE

The study addressed itself to all of the 265 salt and winter sand stockpile sites used by the Minnesota Department of Transportation. A questionnaire was completed to establish adherence to the 1989 Report recommendations and to help identify current problems. State and federal rules were reviewed to establish required present day standards of performance. Recommendations for elimination of salt runoff and proper handling of salt were reviewed and modified to better address current problems.

SUMMARY OF SOLUTIONS

Each maintenance area should analyze each site and apply those measures which are most effective considering expediency, cost of implementation and benefit received. Some of the major actions suggested are as follows:

1. Operational measures to prevent or minimize the formation of salt runoff:
    a. Eliminate, relocate or rearrange the site
    b. Manage the site inventory to eliminate salt and sand runoff
    c. Store all salt or salt/sand under building cover
    d. Premix winter sand within winter season or as late as possible
    e. Minimize the salt/sand ratio in winter sand piles
    f. Provide proper erosion control devices on outside of sand piles to prevent runoff
    g. Implement good housekeeping practices
    h. Inspect and repair bituminous pads annually
    i. Remove salt on trucks as much as possible without the use of water and place salt back in salt storage building
    j. Wash all equipment indoors
    k. Conserve water when washing trucks
2. Operational measures to minimize the effects of salt:
    a. Continue to explore and research recycling and beneficial uses for salt laden water
3. Construction measures to prevent or minimize the formation of salt runoff:
    a. Construct adequate storage buildings to provide year-round cover for all salt and winter sand stockpiles
    b. Develop specific building and floor design details to limit and contain salt exposed to precipitation within the loading and salt handling areas while also allowing for effective salt handling operations
    c. Construct impervious pads under all stockpiles
    d. Review site drainage prior to building construction

SUMMARY OF FINDINGS AND CONCLUSIONS

Salt and winter sand stockpiles and truck wash operations can generate chemical pollution. The best approach to avoidance of chemical pollution is to prevent the formation of salt runoff; in other words, avoid or minimize the opportunity for the chemicals and water to come in contact with each other. If salt brine is allowed to form, the only way to completely control it is to confine and collect the contaminated solution and dispose of it properly by adding it back to a winter sand pile, or hauling it away to an approved disposal site. Collecting salt runoff in an impermeable onsite earthen pond does not remove or treat the salt. A wastewater treatment facility generally will not remove the salt from the water. Due to the chemical characteristics of salt in solution, salt will not settle or be filtered out of wastewater. Some current control facilities may be effective in settling other contaminants present in runoff, such as sand, but have no effect on salt.

SUMMARY OF GOALS AND RECOMMENDATIONS

The Minnesota Department of Transportation shall continue a program of Best Management Practices to abate or minimize environmental effects of salt and winter sand stockpiles. In addition, the formation and disposal of salt dissolved water from the washing of snow and ice trucks must be minimized. This can be accomplished by the following goals:

1) Avoid contact with salt and water
2) Reuse or recycle salt dissolved water on-site
3) Dispose of salt dissolved water that is not reused in an acceptable manner

Specific recommendations to achieve these goals are as follows:

1) Provide and improve building storage at all sites with insufficient salt and salt/sand storage.
2) Develop and implement a plan of good housekeeping practices to minimize environmental problems at all sites. Simple practices of good "housekeeping" and "tidiness" and "best management practices" will go a long way in abating salt contamination and, as a result, reduce to a minimum the number of sites requiring special pollution control treatment.

I. GENERAL INFORMATION

PROBLEM STATEMENT

The improper handling of salt at MnDOT truck stations and bulk storage sites could result in the contamination of groundwater, surface water, and soils. The potential for groundwater, surface water, or soil contamination exists at any MnDOT site where salt is stored. MnDOT's goals and the thrust of this report is to:

1) Eliminate or reduce the potential of environmental contamination
2) Review and improve on the established methods of handling of salt at each MnDOT site

DEFINITIONS

For the purpose of this report, the following definitions shall apply:

Aquifer. An aquifer is a water-saturated geologic layer that will yield water at a sufficient rate so that wells and springs can serve as practical sources of water.

Collection Facility. Any containment system used for the collection of salt runoff, i.e. earthen basin, underground storage tank, curbed pad, etc.

Drainfield. A wastewater treatment method which uses subsurface soil treatment and disposal

Earthen Basin. A basin, typically made of earthen dikes, used for the collection 'and storage of salt runoff. Earthen basins may be lined or unlined. A lined earthen basin is sealed with an impermeable membrane liner such as vinyl. An unlined basin refers to a structure that lacks an impervious liner and is formed only with soil.

Groundwater. Underground water existing below the groundwater table that can be removed by wells. Runoff. The term runoff is used to mean any water contaminated with salt flowing on or from a site whether via surface flow or subsurface flow.

Salt. The term salt as used in this report refers to Sodium Chloride, Calcium Chloride, Magnesium Chloride, and Potassium Chloride.

Sanitary Sewer. A sewer connected to a municipal or sanitary district wastewater treatment facility.

Storm Sewer. A sewer constructed for the purpose of transporting storm water to a discharge point, typically a ditch or stream.

Treated Sand. Same as a salt/sand mixture.

Winter Salt/Sand. The term winter sand refers to an abrasive used for snow and ice control consisting of plain sand mixed with 4% to 10% salt to keep it from freezing.

BACKGROUND

From 1959 through 1988, MnDOT has used an average of 109,000 tons of salt per year on Minnesota's highways for snow and ice control. Average salt usage for the last ten years of this period was 125,000 tons per year and has increased over the last 5 years of this period to 146,436 tons per year. As a result, tons of salt used per lane mile has increased.

From 1989 until 2011 sodium chloride usage has increased to a season average of 211,968 tons per year. Some of this increase in salt usage can be attributed to higher standards of service (salt solutions program), wider roadways and increased number of intersections, ramps, bus shoulders and turning lanes.

The chemical primarily used by MnDOT for highway de-icing is sodium chloride (NaCl) commonly known as rock salt. Calcium chloride (CaCl2) is also used, but makes up only 1 to 2 percent of the total salt usage. Sodium chloride is purchased in bulk form; calcium chloride is generally purchased in bags. Sodium chloride and calcium chloride are stored in either straight bulk or bag form or in the form of winter sand.

MnDOT has and is still actively pursuing alternatives or modifications to our use of salt. Research has been or is being conducted on the use of the following for roadway snow and ice control: straight salt, reduced salt demonstration, pre-wetting with liquid sodium chloride, magnesium chloride, and non-chloride products such as potassium acetate. Ongoing studies also include the use of different materials, better equipment, and weather related processes. To date, alternatives to sodium chloride have been found but are significantly more expensive.

CHEMICAL POLLUTION

At a MNDOT truck station or storage site salt can be the source of contamination to the groundwater, surface water, and soil due to improper salt storage and or improper salt handling management.

When salt or winter salt/sand stockpiles come into contact with water, through precipitation events, salt is dissolved into the water forming a brine. If enough water is added to a stockpile, runoff results. This runoff is basically a saturated solution at the point of discharge at the edge of a pile, and as such, exceeds the tolerance limits of most aquatic organisms.

Note that the period from March to November is when most salt brine formation and leaching would occur.

One of the major concerns regarding salt runoff is groundwater or aquifer contamination. Salt brine is technically composed of water and various concentrations of sodium, calcium, and chloride ions. It is the chloride ion that makes a water taste "salty". Typically, a chloride concentration of 250 mg/I or greater will impart a salty taste to water. All groundwater contains some natural concentrations of sodium, calcium and chloride ions and some in concentrations high enough to be tasted.

Salt brine infiltrates into the ground, reaches the water table, and eventually is spread laterally over a large area by ground water flow. Chloride ions, being very soluble, are not filtered out, absorbed or otherwise removed by the soil and thus move readily and extensively with groundwater flow. Therefore, once in the groundwater system, "salty" water can readily contaminate individual wells and whole aquifers.

Once groundwater becomes contaminated with high chloride concentrations, it is difficult to recover or remove the contamination. The only reasonable method of pollution control is to prevent the salt brine from entering the aquifer in the first place. Water containing high salt concentrations that ultimately discharge to the groundwater should be eliminated.

Salt exposed to soil over extended periods of time will eventually prevent the soil from growing desirable vegetation. The sodium ion from the salt compound is chemically attracted to soil particles and will render the soil ineffective in holding water.

REGULATIONS AND STANDARDS

Both Federal and State water quality regulations have undergone considerable revision since 1972. While salt stockpiles have not, as yet, been singled out for specific action, the trend is to use existing regulations and apply them as needed to specific problems. MnDOT has in the past, and must continue to take an active lead in cleaning up salt handling operations and solving contamination problems or face the prospect of other agencies imposing solutions on MnDOT.

Federal Regulations

The Federal Water Pollution Control Act of 1972 and the Clean Water Act of 1977 gives the Environmental Protection Agency (EPA) the authority to set water quality standards for waters of the United States and to control sources of pollution. The EPA has delegated most of this authority, in Minnesota, to the Minnesota Pollution Control Agency (MPCA). This authority is now intertwined in MPCA rules and will be discussed under state regulations.

State Regulations:

Surface Water. Minnesota Rules 7001.1000 requires that no person may discharge pollutant from a point source into waters of the state without first obtaining a National Pollutant Discharge Elimination System (NPDES) permit from the MPCA. A point source is defined as a "Discernible, confined and discrete conveyance" such as a ditch, pipe or channel. To date no MnDOT salt storage facilities or to our knowledge no other salt storage facilities, have been defined as a point source. However, the fairly broad definition of a point source does not preclude salt storage facilities from any such future designations. At present salt storage facilities have been treated as non-point sources of pollution.

Non-point source water pollution is relatively unregulated at the present time. In 1986 an Interagency Issues Team forwarded a report to the Governor on Non-point Source Pollution. This report covers highway deicing chemicals, among other topics. The report recommended that legislation be adopted along the lines of MnDOT's storage policy as follows:

> ***When locating new salt or sand/salt mixture storage sites, the proximity of the site to existing water wells, lakes, rivers, streams, ground water recharge areas and flood-prone areas must be considered; the use of such areas for stockpiles must be avoided whenever possible.***
>
> ***All salt and sand/salt stockpiles must be placed on impervious pads constructed to hold all stored material and contained within a building.***
>
> ***Impervious pads should be constructed for enclosed stockpiles to prevent surface water from running through the base of the pile.***

To date, no such legislation has been acted upon.

Groundwater.

The 1989 Legislature passed the Minnesota Groundwater Protection Act (Chapter 103H). This law has as its goal "that groundwater be maintained in its natural condition, free from any degradation caused by human activities". It is recognized that for some human activities, this degradation prevention goal cannot be practicably achieved. However, where prevention is practicable, it is intended that it be achieved. Further, this act directs that each state agency which has a program that caused or may contribute to groundwater contamination, such as highway deicing, shall develop best management practices to be consistent with the non-degradation goal.

The MPCA is also directed to develop best management practices for the prevention of groundwater degradation for specific activity categories. Given MPCA's interest in highway deicing chemicals as a non-point water pollution source, it is likely that the recommendations for salt storage facilities discussed earlier will be adopted in some form as groundwater protection ***best management practices.***

CHEMICAL AND BIOLOGICAL BEHAVIOR OF SALT AND WATER

Listed below are a number of facts which relate to the behavior of salt and water.

a. Both sodium chloride and calcium chloride dissolve very readily in water.
a. A saturated solution of sodium chloride will contain 3 pounds of salt per gallon of water.

b. A saturated solution of calcium chloride will contain 4.9 pounds of salt per gallon of water.
   b. Salt will not filter out of a solution except via sophisticated means. Soil may slow down the flow of fluids such as salt brine but the salt will not significantly filter out of solution.

a. Sodium exchanges with minerals such as calcium and magnesium in the soil and this may keep sodium levels high near the source of contamination.
b. Chloride does not bind to the soils and remains mobile, thus being more likely to enter the groundwater than sodium.
   c. Typical chloride concentrations of various waters:

Chloride Content

Type of Water	(ppm or mg/L}
Rain Water	2
Spring Water	25
Deep well water	50
Urine	5,000
Sea Water	35,000
Saturated Salt Brine (Sodium Chloride)	359,000
Saturated Salt Brine (Calcium Chloride)	745,000

   d. U. S. Public Health Service recommends and MPCA Rules set a drinking water standard of 250 mg/I for chloride as the taste threshold.
   e. 5. MPCA has established standards for allowable chloride concentrations in receiving waters such as lakes and streams. Chloride standards for surface water are:

a. High quality recreational waters (2A) is 50 mg/I chloride
b. High quality industrial waters (3A) is 50 mg/I chloride
c. Good quality industrial waters (3B) is 100 mg/I chloride

PRESENT EARTHEN BASIN FACILITIES

A number of earthen basins have been constructed to handle salt runoff since 1972. Earthen basins are generally ineffective in curbing or eliminating contamination by salt runoff unless they are sealed and do not have a discharge. Salt does not settle out unless it is in a super-saturated solution, so any discharge negates the effect of an earthen basin. If the basin is not lined with an impervious liner, salt brine can enter the groundwater through infiltration. Throughout most of the state rainfall exceeds evaporation, therefore evaporation cannot be utilized as a sole control of salt brine. Use of earthen basins is discouraged as a method of brine control.

II. APPROACH TO PREVENTING SALT RUNOFF

Based on the preceding information, the approach to preventing salt runoff should be to:

Step A. Identify and perform Operational measures that will prevent or minimize the formation of salt runoff.

Step B. Identify and perform Construction measures that will prevent or minimize the formation of salt runoff

Some sites will benefit significantly just by making some operational adjustments. Some sites may require the construction of additional facilities to address the problems. Any efforts to solve problems with existing facilities will help reduce the need for additional facilities or at least, minimize the size requirements.

The primary ***emphasis should be in finding ways of eliminating, and controlling unwanted contact with salt and water*** with secondary emphasis on recycling salt runoff.

OPERATIONAL MEASURES

This is to prevent or minimize the formation of salt runoff at existing stockpile sites.

Salt brine is formed whenever moisture and salt are allowed to come in contact with each other. Salt coming in contact with water is the cause of the problem. Measures which avoid or minimize contact of salt and water prevent salt runoff from forming. Examples are as follows:

1. Eliminate or relocate site. Each site should be re-evaluated as to its need. Moving a site, combining it with another site or simply eliminating the storage of salt or winter sand from a site can be considered in an effort to minimize the number of problems which require attention.
2. Rearrange the site. ***Outside stockpiles should only be used as a temporary measure until buildings can be constructed.*** Moving stockpiles can be used to control the direction of runoff flow. Stockpiles should be placed on high ground so that surface water flows away from the pile. Otherwise, impermeable but temporary berms (cold mix, for example) should be placed on the high side of piles to force surface water to flow around piles rather than into and through them. The object is to limit the amount of water entering a pile and, as a result, avoid water unnecessarily coming into contact with the salt.
3. Manage site inventory. Limit the stockpiling of salt and winter sand to only the amount that can be stored on the site to building design capacity. Periodic ordering of salt and sand during the winter reduces the amount susceptible to runoff. ***Careful ordering in the latter part of winter will provide for minimum leftovers during the rainy season.***
4. ***Maximize the use of covered buildings always. Absolutely no salt or winter sand should be allowed to be left outside during the rainy season and it must be the near future goal that all salt and winter sand be located inside covered buildings all year long.***
5. ***Premix initial winter sand as late as possible.*** This will help avoid contact with late fall rains which cause leaching out of brine as well as upsetting the uniform distribution of salt within the pile.
6. ***Minimize the salt/sand ratio in winter sand piles.*** Only mix that amount of salt into sand piles necessary to avoid freezing. The less salt there is in an exposed winter sand pile, the less there is to leach out in the form of brine.
7. Avoid spillage during loading and delivery operations. Good housekeeping practices should be employed at all times. Spillage should be cleaned up after every storm event.
    a. ***Repair bituminous pads.*** Inspect and patch the bituminous pad under the stockpiles annually and repair cracks on a regular basis.

Operational Measures

This measure is to prevent or minimize the formation of salt runoff at existing truck wash operations.

1. Clean trucks without using water. Clean the snow, sand and salt from trucks as much as possible without the use of water. Knock off snow, salt and sand near the treated sand pile so it can be added to the pile. Clean the box corners,sander, wheel wells, etc. using brooms, scrapers, compressed air or other tools that will remove the sand and salt accumulation in a safe manner without the use of water.
2. Wash trucks and equipment indoors only.
3. Conserve water. Conserve water when rinsing and washing trucks. Install a self-closing nozzle on the hose and don't let the water run continuously when the hose isn't being used to rinse or wash a vehicle. Use a pressure washer whenever possible. Pressure washers have been found to reduce water usage by 50% to 70%.

Construction Measures To Prevent Or Minimize The Formation Of Salt Runoff At Stockpile Sites

The obvious solution to eliminating the formation of salt runoff is to build covered buildings with paved floors. Salt stockpiles are the first priority to receive covered buildings. It is MNDOT's goal to also provide covered storage for all winter sand piles.

1. ***Buildings. Include design standards to include floor slope and building sizes.***
    a. Pads. In order to avoid percolation of salt downward from under a stockpile, impervious pads must be constructed at all sites. These pads should be large enough to provide for room for the loading operation. In addition to avoiding salt percolation, a pad will add to the efficiency of the loading operation and avoid the chance of stones getting into the load and hampering spreading operations.

III. FINDINGS AND CONCLUSIONS

1. Improperly stored salt and improper truck washing can cause environmental problems if not handled properly. This deserves the attention of MNDOT personnel if they are to protect the environment, maintain a desirable image, prevent public criticism, and protect their right to use de-icing materials for snow and ice control.
    a. It was a goal of the 1989 report to construct covered storage and loading of all salt and winter sand material. For the most part this has been accomplished. This goal of totally covered storage and loading must be completed as soon as feasibly possible.
    b. There is no one solution to problems in all situations; rather there is a family of solutions, each of which may or may not apply to a given situation.
    c. Salt will not precipitate or settle out of a normal unsaturated brine solution nor may it be removed in a typical wastewater treatment facility. Therefore, salt settling basins are ineffective as a pollution control measure. Because of size requirements, frozen conditions in the winter, costs of operation and maintenance and potential for seepage, earthen basin type facilities should be considered only as a last resort for capture and transport of salt runoff. It should be noted that earthen basins may serve other runoff control purposes other than for salt runoff.

IV. GOALS AND RECOMMENDATIONS

1. The Minnesota Department of Transportation shall continue a program of Best Management Practices to abate or minimize environmental effects of salt. In addition, the disposal of salt runoff from the washing of snow and ice trucks must also be addressed. This can be accomplished by the following goals:
    a. Avoid unwanted contact between salt and water
    b. Continue researching the effectiveness of reuse or recycle of salt brine on-site
    c. Dispose of salt runoff in an acceptable manner
2. Specific recommendations to achieve these goals are as follows:
    a. Provide adequate salt and/or salt/sand storage at all sites.
    b. As an interim measure, provide controlled salt brine disposal systems until covered storage is provided.
    c. Provide environmentally conscious annual training to all employees involved with handling and application of salt in an attempt to minimize salt runoff.
    d. Wash trucks and equipment indoors only.
    e. All sites should develop and implement a plan of good housekeeping practices to minimize environmental problems. Simple practices of good "housekeeping" and "tidiness" and "best management practices" will go a long way in abating adverse visual impact and salt contamination and, as a result, reduce to a minimum the number of sites requiring special pollution control treatment

APPENDIX

MAJOR FINDINGS OF THE 2012 SALT STORAGE AND HANDLING GROUP

The 1989 Salt Handling Report recommended a number of solutions to minimizing the formation of salt dissolved water and resultant salt runoff. These solutions as recommended in 1989 for the most part still apply today.

Tremendous progress has been made since 1989 in implementation of many of these solutions. Numerous buildings have been constructed such that almost all sites now store salt and salt/sand mixtures under cover. Many sites now load under cover. Discharges of salt dissolved wash water to in-ground treatment systems have been eliminated.

While great progress has been made, a questionnaire of the area maintenance superintendents appears to indicate additional improvement is necessary in the following areas:

1. Management of Site Inventory - The 1989 report recommends limiting the amount of salt and winter sand to the amount that can be stored in a covered building. The report also recommends careful ordering to minimize leftovers during the rainy season. It appears that in many cases there is no attempt to limit summertime storage of salt. Many of the sites are filled with salt to overflowing in the summer months. Storage of large amounts of salt during the high precipitation months greatly increases the potential for salt runoff as most of the precipitation occurs during the rainy season. Buildings are typically open to the south and east where wind-driven summer rains can blow large amounts of water into the salt storage buildings.
2. Water Storage Issues within Buildings - The 1989 report recommended some method for catching and handling site water that is exposed to salt. Buildings have typically been built with an impermeable liner and sloped to allow storage, capture, and re-use of water exposed to salt. Based on the questionnaire, there are many issues with either too much water storage within the buildings, not enough storage resulting in difficult operating conditions and/or salt runoff, or a lack of communication from the designers on how to properly utilize the building.

   There is currently no standard for design of the salt storage pad. Design and construction of the salt storage pads have largely been left up to the Districts, resulting in many different designs.

3. Good Housekeeping Practices - The questionnaire indicates that housekeeping may need to be improved. Many sites do not have adequate equipment, personnel, or time to clean up spilled salt in a timely manner so as to limit salt runoff. In addition, it appears that many sites do not perform a proper pre-cleaning of trucks, by brushing salt out in the shed before washing trucks inside. This results in salt being dissolved and flushed down the drains and often times results in maintenance issues within the drains and sewers.
4. Keep Salt and Salt/Sand Mixtures Under Cover - It was a goal of the 1989 report to construct enough buildings such that all salt and winter sand is stored under cover. Immense progress has been made in this area. Some areas of the state still store salt mixtures outside for some portion of the year. Although sites now have covered storage, many sites either lack the equipment to utilize the vertical storage capacity, forcing salt to overflow out the front, or sites are buying more salt than there is room for in the storage area and it is being stored

   Washing of Equipment Outside - The 1989 report required all equipment to be washed inside to prevent salt runoff. Equipment, including trucks contaminated with salt, is still being washed outside.

RECOMMENDATIONS

It is recommended that the following additions be made to further reduce salt runoff while also improving operating conditions:

MAINTENANCE

1. Eliminate Water Contact with Salt - The 1989 report suggested minimizing the unnecessary contact of salt and water and treating the water that does come in contact with salt. The 2012 Salt Handling Group believes that we need to focus on eliminating unwanted contact with salt and water as there is no practical treatment of water exposed to salt.
2. An assessment should be performed to identify the most cost-efficient tools and methods for handling salt that will also meet our goals (e.g. conveyors, sweeper attachments).
3. Mandate and Prioritize Good Housekeeping Practices - Housekeeping Practices need to become a priority (add it to daily procedures) and sufficient equipment and personnel needs to be allotted such that good housekeeping is always possible. A method should be developed to consistently monitor and make adjustments to housekeeping practices.
4. Require Annual E-Training - All personnel involved with the handling of salt should receive training regarding the impacts of salt and how to properly store and handle salt.

DESIGN

1. Develop Specific Building Design Criteria - Involve Design Engineers in the development of more specific building design criteria to include recommended storage building pad designs, stormwater storage inside or outside of building, site layout recommendations (including snow storage), and standard design options.
2. Completely Enclose Buildings - Evaluate the possibility of designing completely covered buildings to limit the potential of wind driven precipitation entering the buildings. The questionnaire indicates problems with too much water entering the building when facing open building fronts to the south and east. Tall open buildings are very vulnerable to large amounts of wind driven precipitation entering the building resulting in salt runoff and/or poor operating conditions. Building pads cannot be designed for the range of potential weather conditions. Excessive stormwater accumulation and salt runoff out of the building are increasingly likely to occur with open front buildings.

BUDGETS AND PURCHASING

Revise Salt Purchasing Practices-Work with suppliers to determine delayed or Just-in-Time shipping options, in order to limit the length of time salt needs to be stored. Alternatively, accounting practices may need to be revisited. Currently, Districts are encouraged to use the remainder of their salt budget by the end of the fiscal year in June, which means they may be storing large amounts of salt through the spring and fall rainstorms in buildings that were positioned to avoid winter weather patterns.

FORMATS

We suggest that guidance as a result of this exercise needs to be presented in several formats for multiple MnDOT audiences.

1. Web-based, Living Document: This document would be a user-friendly reference guide for maintenance and operations staff, which would include stand-alone components useful for supervisors reminding their staff and for staff training.
2. Designer Guidance: This document should include criteria and examples for New Construction, Remodeling, and Retrofitting facilities.
3. Technical Memo: This document would be useful to create general awareness and support for these priorities among managers.