Winter Maintenance Assessment Tool: An Innovative Way to Manage Salt Use

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Overview

- Introduction
- Chloride & Water Quality
- MPCA’s Chloride Management Plan
- Winter Maintenance Assessment Tool (WMAt)
Introduction

Twin Cities Metro Area Stats

• Population: 3,459,146
• Typical Winter Stats:
  • Average Snowfall: 50”
  • Average Temp:
    • 20°F (Dec.) & 15°F (Jan.)
• Size: Approx. 3,000 mi²
• Land Use: 1/3 Urbanized

• Surface Waters: Roughly 3,000 lakes, wetlands and stream reaches in TCMA
• 75% of people rely on groundwater for drinking water in MN
Chloride & Water Quality

What’s the dilemma?

- Safe roads, parking lots & sidewalks are essential – high expectations from the public
- Chloride is a permanent pollutant
  - Cannot be treated or filtered with traditional BMPs
- 78% of the chloride applied in the TCMA is retained here (Stefan et al. 2008)
- Chloride concentrations in streams in the Northern US have approximately doubled from 1990-2011 (Corsi et al. 2015)

1 tsp. of de-icing salt pollutes 5 gallons of water
What’s the problem with salt?

- Chloride is toxic to aquatic life (EPA)
  - 230 mg/L - long-term
  - 860 mg/L - short-term
- Contaminates groundwater
- Chloride can disrupt the natural mixing process in lakes
- Impacts vegetation and wildlife
- Corrodes road surfaces/bridges
- Potential human consumption concerns

Sources of Chloride

- Winter Maintenance Activities
  - Roads
  - Parking Lots
  - Driveways
  - Sidewalks
  - Salt Storage
- Other
  - Dust suppressants
  - Fertilizers
  - Land application
- Municipal and Industrial Wastewater Sources
  - Municipal wastewater
  - Municipal water treatment
  - Industrial wastewater
- Residential Water Softeners
  - Publicly Owned Treatment Works
  - Septic Systems
  - Direct Discharge
  - Surface Runoff
  - Lakes & Streams
  - Groundwater
Chloride in MN Groundwater

- Shallow groundwater in the TCMA is impacted by high chloride concentrations
- 30% of shallow monitoring wells in the TCMA above standard
- About one-third of wells across the state showed increased concentrations over time
- Impact on baseflow concentrations in surface waters
Chloride Management Plan
Purpose - Scope - Audience

Purpose
- Highlight the impacts of chloride on TCMA water quality
- Develop an appreciation of the competing demands of level of service and reduced salt usage
- Set performance-based goals for restoration and protection
- Inform and guide implementation of improved winter maintenance practices and policy needs
- Demonstrate the success and economic benefits of improved practices

Scope
- Status and trends of chloride levels in lakes, wetlands, streams, and groundwater
- Sources of chloride
- Restoration and protection goals
- Implementation strategies to reduce chloride impacts
- Educational and training resources
- Continued monitoring, tracking and adaptive management

Audience
- Local working groups (local governments, watershed management groups, etc.)
- Winter maintenance groups (MnDOT, local governments, private applicators, commercial property owners, residents, etc.)
- Elected officials and policy-makers
- State agencies (MPCA, MnDOT, DNR, BWSR, etc.)
Outline of CMP

1. Background and Description
2. TCMA Chloride Conditions
   Water quality conditions, sources, trends and TMDL summary, protection
3. Prioritizing and Implementing Restoration & Protection
   Prioritization and Critical Areas
   Implementation strategies, Education resources, Citizens attitudes
   Success stories, Cost, and Funding Opportunities
4. Monitoring and Tracking
   Recommendations for monitoring, Tracking implementation efforts
5. Research Needs
6. Stakeholder Process
Chloride Trends

- Lakes = chloride is highest in Jan. – May
- Streams = chloride is highest Dec. – April
- Streams influenced by wastewater treatment plant discharges = chloride is highest during low flow conditions
- Relationship between road density and chloride concentrations
**Chloride Reduction Strategies: Winter Maintenance Practices**

- **Shift from granular to liquids**
- **Improved physical snow removal**
- **Snow and ice pavement bond prevention**
- **Training for maintenance professionals**
- **Education for the public and elected officials**
- **Winter Maintenance Assessment tool**
Chloride Reduction Strategies: Non-Traditional Winter Maintenance Practices

- Adopt a lower level of service
- Alternative pavement types/Infrastructure changes
- Driver Behavior Changes
- Non-chloride deicers

**Success Stories**

<table>
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<tr>
<th>Entity</th>
<th>Time Period</th>
<th>Main Actions Implemented</th>
<th>Salt Reduction</th>
<th>Cost Savings</th>
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<tbody>
<tr>
<td>University of Minnesota, Twin Cities</td>
<td>Start 2006</td>
<td>Began making salt brine and anti-icing and adopted several other salt reduction BMPs</td>
<td>48%</td>
<td>New equipment cost $10,000</td>
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<tr>
<td>City of Waconia</td>
<td>Start 2010</td>
<td>Switch from 1:1 sand to straight salt &amp; liquid anti-icing, calibration &amp; equipment changes</td>
<td>70%</td>
<td>$6,000/yearly cost savings</td>
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<tr>
<td>City of Prior Lake</td>
<td>2003-2010</td>
<td>Upgrade to precision controllers &amp; sanders; anti-icing &amp; pre-wetting; use of ground temps</td>
<td>42%</td>
<td>$2,000 per event estimated cost savings; 20 – 40 mg/L decrease in receiving water chloride (liquid app-only watershed)</td>
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<tr>
<td>City of Richfield</td>
<td>Start 2010</td>
<td>All-staff training; yearly winter calibration; use of low-pavement temperature exciters</td>
<td>&gt; 50%</td>
<td>$30,000: 2010-2011</td>
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<td>Rice Creek Watershed Districts</td>
<td>2012-2013</td>
<td>Staff training; purchased shared anti-icing equipment</td>
<td>32%</td>
<td>$26,400 in one winter</td>
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<tr>
<td>City of Cottage Grove</td>
<td>2011-2012</td>
<td>Staff training</td>
<td>Not available</td>
<td>$40,000 in one winter</td>
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<td>City of Shoreview</td>
<td>Start 2006</td>
<td>Stopped using a salt/sand mixture and moved on with straight salt; set up all of its large plow trucks with state of the art salt spreading controls, pre-wetting tanks and controls and pavement sensors; use of calcium chloride in the pre-wetting tanks reduced the amount of rock salt as well; all applicators and supervisors annually attend training; crews attend an annual snowplow meeting to review procedures and talk about salt use and conservation methods; trucks set up for anti-icing main roads with calcium chloride</td>
<td>44% since 2006</td>
<td>$44,468 in 2014</td>
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<td>City of Eagan</td>
<td>Start 2005</td>
<td>Moved from a 50/50 salt/sand mix to straight salt; eliminated purchase of safety grids; EPOKE winter chemical application technology; use AVL pre-wet at spinner</td>
<td>Unknown</td>
<td>$70,000 annual savings</td>
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<tr>
<td>Joe’s Lawn &amp; Snow</td>
<td>Start 2013-14</td>
<td>Owner &amp; staff training; purchase of new spreader, temperature sensors, equipment calibration; use of temperature data; ongoing experimentation</td>
<td>50%</td>
<td>$70 estimated annual savings</td>
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</table>

Notes: Traditional deicers: sand, calcium chloride, rock deicer. Non-traditional deicers: deicers that do not use chloride (sand, rock, etc.)
Winter Maintenance Assessment tool (WMAt)

Partnership

- **Technical Expert Team – 2011**
  - State: MnDOT
  - County: Scott, Dakota, Hennepin
  - City: Minneapolis, St. Paul, Waconia
  - Other Gov’t: Three Rivers Park District
  - Private: EnviroTech, Prescription Landscape, Force America, Fortin Consulting

- **Team Goal**: Develop an easy-to-use, flexible and comprehensive tool to help agencies and companies reduce salt usage in the 7-county metro
WMAAt Goals

1. Document current practices  
2. Chart a path towards salt reduction  
3. Allow a flexible approach for implementing BMPs  
4. Develop a strategy unique to operation  
5. Evaluate small areas of winter maintenance  
6. Shows user recommended practices (learning tool)
### WMA Assessment: SS and BMP Example (2014-15)

#### Table of Contents

- General Links:
  - New Home Page

- Questionnaire Sections:
  - General Information:
    - WMA Information (100% complete)
    - Site Use/Storage Data (99.9% complete)
  - Assumptions:
    - Anticline (100% complete)
    - Aquifer (100% complete)
    - Groundwater Recharge (100% complete)
    - Aquifer Storage/Discharge (100% complete)

- Before the Storm:
  - Anticline (100% complete)
  - Depth to Water (100% complete)

- Reduce Waste:
  - Storage (100% complete)
    - Pile (100% complete)
    - Leaching (100% complete)
    - Unloading (100% complete)
    - Spread Pattern (100% complete)
    - Fines Up (100% complete)
    - Chipping (100% complete)
    - Disposal (100% complete)
    - Assessment (100% complete)

### Reduce Waste: Storage

#### Q4.1.a. What is the most common way you store your bulk salt in the winter?

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<tr>
<td>Salt pile located indoors or in container</td>
<td>Salt pile located indoors or in container</td>
<td>No bulk salt stored</td>
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<tr>
<td>Pile tarped and strictly maintained</td>
<td>Pile tarped and strictly maintained</td>
<td>No bulk salt stored</td>
<td></td>
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<tr>
<td>Pile tarped but not strictly maintained</td>
<td>Pile tarped but not strictly maintained</td>
<td>No bulk salt stored</td>
<td></td>
</tr>
<tr>
<td>No bulk salt scattered</td>
<td>No bulk salt scattered</td>
<td>No bulk salt stored</td>
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</table>

#### Q4.1.c. Do you prevent moisture from entering your salt shed(s)?

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</thead>
<tbody>
<tr>
<td>All good quality buildings with doors</td>
<td>All good quality buildings with doors</td>
<td>No bulk salt stored</td>
<td></td>
</tr>
<tr>
<td>All good quality buildings with no doors and salt protected from the opening</td>
<td>All good quality buildings with no doors and salt protected from the opening</td>
<td>No bulk salt stored</td>
<td></td>
</tr>
<tr>
<td>Old quality buildings or a mix of good and bad buildings</td>
<td>Old quality buildings or a mix of good and bad buildings</td>
<td>No bulk salt stored</td>
<td></td>
</tr>
</tbody>
</table>
### WMA Assessment: SS and BMP Example (2014-15)

#### Table of Contents

**Q4.1.a. What is the main storage area?**

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</tbody>
</table>

**Comments for WMA Question 4.1.a**

- All of the salt in the salt sand pile that was not used during the winter and stored over the summer would be gone by fall. Had to start over with the new, (2 scoop block sand, 1 scoop pea gravel, 1 scoop salt) Over the winter months the loss would be renewed, approximately 9.7%.
  - Source: Law Vandervell, City of St. Paul Park, 2/18/13
  - Thought minimal loss during winter 5-7%.
  - Source: Scott Woodfin, Retired MnDOT Minnetonka, 2/18/13

- 5% loss from tarping to indoors.
  - Source: Barry Ashenden, City of Eagan Grove Heights
  - Says tarp is ok if done right.

#### Q4.1.c. Do you prevent moisture from entering your salt shed(s)?

- ✔

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### Winter Maintenance Assessment Tool (WMA): Summary Reports

**Main Summary Pages for each Assessment Period:**

- Summary of BMP Question Responses for Past (2010-11)
- Summary of BMP Question Responses for Current (2015-16)
- Summary of BMP Question Responses for Future (2020-21)

**Comparison of BMP Responses:**

- Comparison of BMP Responses Between Current (2015-16) and Future (2020-21)

**Salt Savings:**

- This assessment does not include a Salt Savings Calculations component.
### Improved Best Practices

[Comparing Current (2015-16) assessment period with Future (2020-21) assessment period]

#### Question 12: What materials do you calibrate for?

**Current:** For most commonly used product(s)

**Predicted:** For every product used

#### Question 13: What guidance do you give to your crew for hand spreading?

**Current:** Have a line on spreader indicating fill line for each site

**Predicted:** Amount of devicer is calculated each time based on square footage and pavement temperature

#### Question 22: How are (granular and/or liquid) application rate guidelines determined?

**Current:** We make our own application rate chart. The rates are higher than MN filed handbook for snowplow operators or the MN parking lot and sidewalk manual but much less than we used to use

**Predicted:** We make our own application rate chart. The rates are comparable to the MN field handbook for snowplow operators or the MN parking lot and sidewalk manual

#### Question 27: Do most of your operators follow application rate recommendations?

**Current:** Half of the time

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### Poor Practices

650 For roads, what is your primary method of deicing?

741 Do you leave your spreader on when backing up during parking lot plowing operations?

742 For low-speed roads, how do you plow and apply salt?

#### Current (2015-16)

<table>
<thead>
<tr>
<th>Question #</th>
<th>Question</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Do you calibrate your push granular spreaders?</td>
<td>No</td>
</tr>
<tr>
<td>10</td>
<td>For manual granular controls, do your operators know how to read the calibration charts?</td>
<td>No</td>
</tr>
<tr>
<td>16</td>
<td>For parking lots / sidewalks, what is your most common anti-icing rate for straight salt tires?</td>
<td>No</td>
</tr>
<tr>
<td>18</td>
<td>Do you have more than one type of liquid to choose from (for anti-icing or deicing)?</td>
<td>No</td>
</tr>
<tr>
<td>30</td>
<td>Have you made changes to reduce loss of anti-icing liquids from airborne?</td>
<td>No</td>
</tr>
<tr>
<td>41</td>
<td>For roads, what do you do with a light snow (&lt; 2” total for event)?</td>
<td>More than 1 gallon per 1000 sq. ft.</td>
</tr>
<tr>
<td>43</td>
<td>For parking lots, what do you do with a light snow (&lt; 1” total for event)?</td>
<td>Without plowing, salt or sand it if needed</td>
</tr>
<tr>
<td>64</td>
<td>Prevent is mixing salt and liquid at the truck, when you increase the amount of liquid, do you change your granular application rate?</td>
<td>Without plowing, salt or sand it if needed</td>
</tr>
<tr>
<td>66</td>
<td>Are you using liquids for de-icing (plowing or after the storm)?</td>
<td>No, use same application rate</td>
</tr>
<tr>
<td>71</td>
<td>For extremely cold, below zero pavement temperatures:</td>
<td>We use the best we have, but it's not very effective below 0 degrees</td>
</tr>
<tr>
<td>86</td>
<td>Are your trucks tarred during application?</td>
<td>No</td>
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<tr>
<td>88</td>
<td>Where is the salt packing area for the trucks?</td>
<td>Outdoors</td>
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<tr>
<td>113</td>
<td>Does salt commonly leave the truck through cracks, gaps, or when forget to turn off augers/convertor (not from salt lost over the top)?</td>
<td>Yes</td>
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</table>
Comparison of Responses Between Assessment Periods

Assessment Name: St. Paul (2015-16)
Location: St. Paul
Winter Periods: 2015-16
Surface Type(s): High Speed Roads, Low Speed Roads, Parking Lots, Sidewalks

Salt Savings Mode

Salt Savings Summary
Assessment Name: St. Paul - Salt Savings (2015-16)
Location: St. Paul - Salt Savings
Winter Period: 3/15-16
Surface Type(s): Low Speed Roads

<table>
<thead>
<tr>
<th>Winter Operations:</th>
<th>Prediction:</th>
<th>Predicted Cost Savings:</th>
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<tbody>
<tr>
<td>3,200 tons of salt applied</td>
<td>14,537 tons of salt needed (cubic granular + liquid)</td>
<td>Salt Savings: $33,803.00</td>
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<td>1,200 tons of salt stored</td>
<td>20,169,744 gallons of liquid used</td>
<td>Salt Savings: $33,803.00</td>
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<td>2,000 gallons of liquid used per acre per year</td>
<td>2,000 gallons for pre-wetting</td>
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<td>2,000 gallons used for pre-wetting</td>
<td>5,128 gallons for pre-wetting</td>
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<td>2,000 gallons for pre-wetting</td>
<td>25,000 gallons for pre-wetting</td>
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“Over the last 5 years we have made significant progress toward using Advanced and Best Management Practices over Poor practices.”

- Press release to the news paper or TV
- Tweet it or other social media
- Post it on your website
Operator Training

• Teach and reinforce all aspects of the operations
• Verify if supervisors are being consistent
• Identify where more emphasis on practices that are not uniformly implemented

Supervisor Training
Each year run the tool to compare with the year or years before

5 year plan

- Year 1 and 2 we will do change of practices that do not involve purchases
- Year 3 $20,000 towards purchases of tarps for trucks
- Year 4 $250,000 for a new storage shed
- Year 5 $200,000 toward anti-icing equipment
## Utilizing WMAt Reports

### Planning Tool
- Evaluate current practices
- Identify areas for improvement
- Develop interim and long term BMP goals
- Educational opportunity for operators

### Tracking Tool
- Track implementation (BMP) progress over time
- Track progress in achieving reductions
- Assist with MS4 permit TMDL reporting requirements
- Increase knowledge of reductions achieved through S2

## How Can I Access the WMAt

- The MPCA is currently funding & hosting the tool
- Available **NOW** for use (Google search – WMAt stormwater)
- Visit the MPCA’s Minnesota Stormwater Manual new Smart Salting section:  
  [http://stormwater.pca.state.mn.us/index.php/Road_salt,_smart_salting_and_winter_maintenance](http://stormwater.pca.state.mn.us/index.php/Road_salt,_smart_salting_and_winter_maintenance)
- Link can also be found at MPCA’s Road Salt & Water Quality website
MPCA Smart Salting Trainings

MPCA Smart Salting Level I Training

- MPCA, Fortin Consulting, Minnesota Local Technical Assistance Program (U of M) MnDOT, many local watershed partners
- Voluntary training program established in 2005
- Certification given to participants – must pass test
- Teach Best Practices to reduce chloride impacts
- Targeted to private applicators & local government
MPCA Smart Salting Level 1 Training

- Explore the tool with guided instruction
- Demonstrate how the tool can assist with planning and prioritizing BMPs
- Demonstrate how the tool can help show progress
- Discuss how the tool can be used to gain support to implement BMPs
- First pilot Nov. 2015 hosted by Minnesota Street Superintendents Association

MPCA Smart Salting Level 2 Training

Audience: Winter Maintenance Supervisors and Leadership
CLEAN WATER & SAFE ROADS

- Implement Action Plans
- WMAT & Smart Salting (S2) Trainings
- Developed & Documented Strategies (CMP)
- Set Goals (TMDL & Protection)
- Understand WQ & public needs

Partnerships, Collaboration & Shared Responsibility

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Visit the Road Salt & Water Quality website:
http://www.pca.state.mn.us/programs/roadsalt.html