CHAPTER 2

CLEAR ROADS

2-1.0 INTRODUCTION

The removal of snow and ice from the trunk highways in Minnesota is one of the most important jobs confronting maintenance personnel during the winter season. Putting a priority on snow and ice removal prevents a complete shutdown of highway transportation, especially during severe snow and ice storms. Minnesota motorists have invested large sums of money in Mn/DOT trunk highways; therefore, they expect to travel on well-maintained roadways throughout the year. Mn/DOT realizes that a large segment of our economy is based on highway transportation and we must utilize reasonable means to minimize hazards, slippery road surfaces, costly delays, and abnormal energy usage to the highway user.

Safety for the motorist and serviceability of trunk highways are the primary considerations of Mn/DOT. Snow and ice removal operations must be carried out so as to provide reasonable safety for the public as well as for employees.

Effective snow and ice control is achieved through planning, preparation, and execution of good tactical procedures. This chapter outlines elements that affect those three functions.

2-2.0 GUIDELINES STATEMENT

Mn/DOT is committed to providing the public with the level of service for snow and ice control that is described within the operation guidelines of this manual. These recommended levels of service should be interpreted as standard operating procedures. In certain situations, however, the District Maintenance Engineer or designee may exercise judgment when maintenance requirements differ from these guidelines.

Customer surveys were conducted in 1994, 1996, 2000 and 2005, covering year round maintenance operations. In 1999, an exclusive snow and ice operations survey was conducted. Two factors used from this survey were level of importance and level of satisfaction. The results from the 1999 survey were used to develop Mn/DOT's current Snow and Ice Performance Measures. These measures are located in Table 2-3.02A.

2-3.0 OPERATION GUIDELINES

The District Maintenance Engineers have developed these operation guidelines. Approval of this manual was obtained through the Office of Maintenance with guidance from the Maintenance Operations Engineer. Suggestion for changes to the guidelines can be referred to the Maintenance Operations Engineer in the Office of Maintenance.

These guidelines apply to all roadways (e.g. Collector and Distributor roads), interchanges, High Occupancy Vehicle (HOV) Lanes, HOV bypasses, High Occupancy Toll (HOT) Lanes and Bus Shoulders. Frontage roads, rest areas, and other clean-up operations are not included (Section 2-4.0 for Clean-up Operation Priorities).

2-3.01 Classifications and Lane Miles

Priorities are assigned to the trunk highway system according to traffic volumes. Five different volume ranges have been established as noted in Table 2-3.02A. The most recent Mn/DOT Traffic Flow Maps contain the Average Annual Daily Traffic (AADT) for each segment of roadway. However, in urban areas local traffic flow maps and counts may be used.

When the road classifications are studied in detail, many roads will have short segments of different classifications over their length. Providing different maintenance priorities to short segments of the same roadway is unpractical for our maintenance personnel. Therefore, the District Maintenance Engineer or designee must make adjustments in actual field operations to assure continuity throughout the District and at the boundaries with other Districts.

The following guidelines are followed for determining lane miles within the classifications.

1. Turn lanes, shoulders, median openings and frontage roads are not included. In addition, ramps not on routes classified as Super Commuter with complex interchanges, roadways for weigh scales, rest areas and information centers are not considered.

2. The most recent traffic flow maps are used; these maps are prepared by the Mn/DOT Office of Transportation Data & Analysis, except within corporate limits of cities where more detailed AADT maps are used, if available.

3. Current mileage plus mileage that is anticipated to be added by the winter season is taken into consideration.

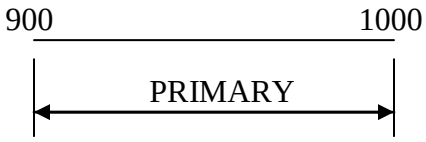
4. All computations are carried out to the hundredths place holder for route classification level. Final totals are all rounded off to the nearest whole number as follows:

   0.50 = 1
   0.49 = 0

5. A roadway segment is defined as the distance between two points on a trunk highway which are identified on the Traffic Flow Map by the AADT count.

6. When the AADT count on both ends of a roadway segment is within one classification, the lane miles are identified accordingly.

Example:

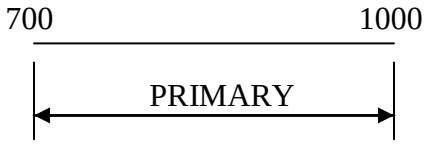


7. When the AADT count on both ends of a roadway segment is not within one classification, the following procedure is used:

a. The average AADT is determined. If the average is within the higher classification, the entire segment is identified as the higher classification.

Example:

1000
+ 700
1700 ÷ 2 = 850 > 800; therefore, according to Table 2-3.02A this segment should be identified as **PRIMARY**.

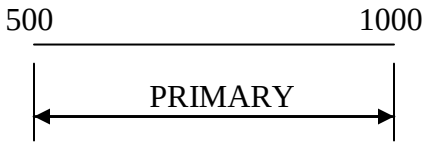


b. If the average AADT is in the lower classification but within 10% of the higher classification, the lane miles of that segment is identified as the higher classification. The following table has been provided to help illustrate these ranges and allowances:

Classification	ADT	10% Allowance	Lower Limit of Average ADT
Super Commuter	Above 30,000	3,000	27,000
Urban Commuter	10,000 – 30,000	1,000	9,000
Rural Commuter	2,000-10,000	200	1,800
Primary	800 – 2,000	80	720
Secondary	Below 800	n/a	n/a

Example:

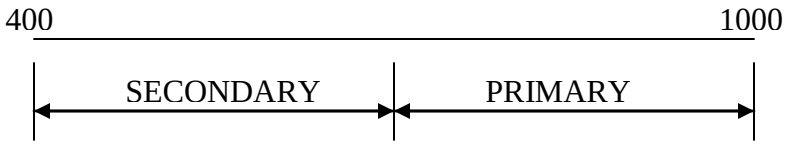
1000
+ 500
1500 ÷ 2 = 750 > 720; therefore, according to Table 2-3.02A this segment should be identified as **PRIMARY**.



c. If the average AADT is in the lower classification and not within 10% of the higher classification, an estimate is made as to where the AADT changes from the higher to the lower classification and the lane miles are identified accordingly. This point of change in AADT is usually at an intersecting road.

Example:

1000
+ 400
1400 ÷ 2 = 700 < 720; therefore, according to Table 2-3.02A this segment should be identified as **SECONDARY**.



2-3.02 Operational Guidelines

Snow and Ice removal from the roadway is an emergency operation and normally takes precedence over other work. This means that the roadway should be cleared of snow and ice in accordance with Table 2-3.02A.

Snow and ice removal operations begin when conditions, or forecasted conditions, may result in the loss of "bare lane." Bare lane is defined as: driving lanes will be free of ice and snow between the outer edges of the wheel paths and have no greater than 1 inch accumulation on the center of the roadway (Figure 2-3.02A). Snow and ice removal operations are to continue throughout the event to reach and maintain bare lane. This should continue as long as adequate visibility permits and reasonable results are obtained. Once bare lane has been obtained and maintained, clean-up operations can be started. The goal of Mn/DOT's snow and ice removal operations is to obtain end of clean-up operation (Figure 2-3.02B).

Bare Lane Regain Time or "Regain Time" is the time from the end of the event until bare lane is obtained. It is also called the Bare Lane Indicator (Figure 2-3.02C). The Bare Lane description is the same for all routes. The Target Regain Time is dependent on the classification of roadway (Table 2-3.02A). It is the operator's responsibility to record the Event End and Bare Lane Regained date and time. The District Maintenance Engineer or designee will select an individual to record the Event Start and Loss of Bare Lane date and time.

The District Maintenance Engineer or designee may determine that a change in the level of service is warranted for a period of time. Conditions that may cause a change in the level of service, as stated in Table 2-3.02A are:

- Breaks between shifts during off peak hours to reduce operational costs.
- Continued service to avoid snow compaction problems.

The District Maintenance Engineer or designee may also determine that discontinuation in service is warranted for safety reasons. Some conditions that may cause discontinuation in service are:

- Limited visibility, which would make operations hazardous to personnel.
- Extremely cold temperatures (< -40˚F).

During winter storms a winter maintenance schedule requiring split shift work hours may be employed in order to provide the level of service recommended. Each District will develop a schedule of effort necessary to achieve Target Regain Times.

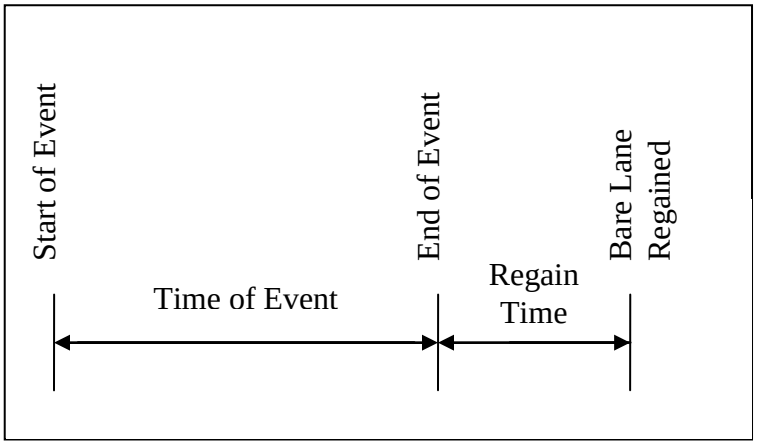
Table 2-3.02A
Bare Lane Indicator Guidelines

Classification	AADT	Target Regain Time	Bare Lane Description
Super Commuter	Over 30,000	0-3 hrs.	Bare Lane is defined the same for all classifications as follows:
Urban Commuter	10,000 – 30,000	2-5 hrs.	All driving lanes are 95% free of snow and ice between the outer edges of the wheel paths and have less than 1 inch of accumulation on the center of the roadway (Figure 2-3.02A, Bare Lane – Indicator Value). This is the condition at which most drivers feel safe and comfortable when driving at posted speeds.
Rural Commuter	2,000 – 10,000	4-9 hrs.	
Primary	800 – 2,000	6-12 hrs.	
Secondary	Under 800	9-36 hrs.	The Bare Lane Regained date and time should be logged when this condition is obtained.

Bare Lane – Indicator Value
Figure 2-3.02A

End of Clean-up Operation
Figure 2-3.02B

Bare Lane Indicator
Figure 2-3.02C



2-4.0 CLEAN-UP OPERATION PRIORITIES

Clean-up operations may start as soon as bare lane has been obtained and maintained and the event has subsided unless adverse weather warrants a change.

All safety features along the roadway shall be cleaned up as soon as possible so they function properly. Priority A clean-up will be completed according to the Snow and Ice Operation Schedule.

2-4.01 Snow and Ice Operation Schedule

2-4.01.01 Priority A

1. Remove compacted snow from impact attenuators, bridge crash rails, Jersey barriers, plate beams or similar types when it averages 2/3 the height of the barrier.

2. Sight distance and median opening (e.g. crossroads, crossovers, u-turns, etc.) clean-up should be accomplished as conditions warrant (Figure 2-4.01.01A). Each District may designate other intersections for sight distance and median opening clean-up if prompt attention is required.

3. If inadequate snow storage exists such that the flow of traffic is impeded, then the operations of removing snow by plowing or hauling should be conducted on the same schedule as mainline operations.

Note: Crews for Priority A Clean-up will continue working the same schedule as the mainline (split shift), but may not require overtime.

2-4.01.02 Priority B

The clearing of full width shoulders and cable guardrail will be accomplished during the normal work schedule.

2-4.01.03 Priority C

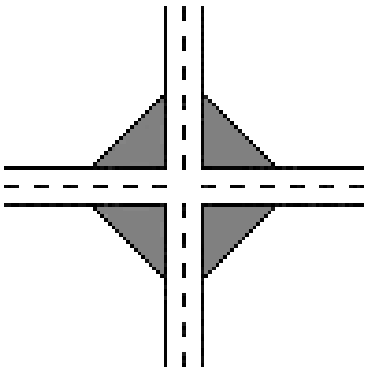
Drift prevention for future storms will be accomplished during the normal work schedule.

2-4.01.04 Priority D

Regaining snow storage space for future storms will be done during the normal work schedule.

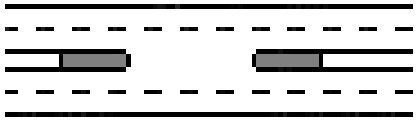
Clean-up Examples

Figure 2-4.01.01A



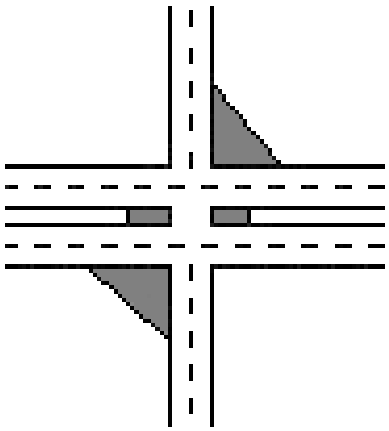
- A -

2-Lane Trunk Highway to Trunk Highway Intersection



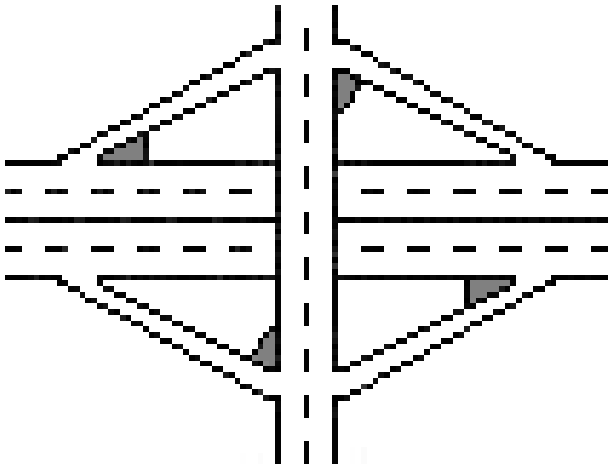
- B -

Median Opening



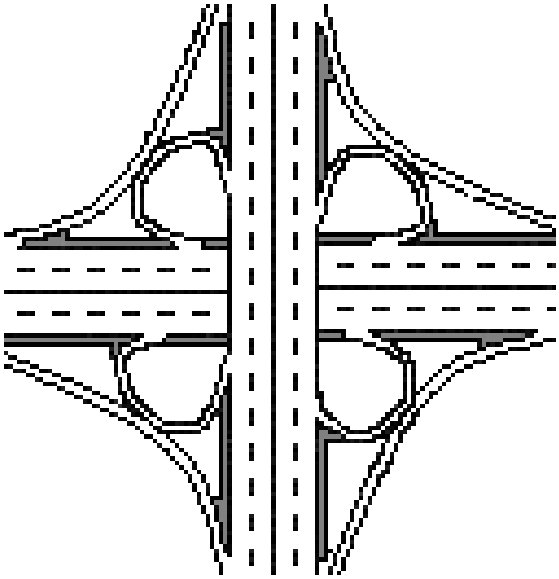
- C -

4-Lane with 2-Lane



- D -

Diamond



- E -

Cloverleaf

2-5.0 WINTER MAINTENANCE PLAN OF OPERATION

In order to prevent unnecessary delays and confusion during snow and ice removal operations, each district must be adequately prepared prior to the first storm of the season. A winter maintenance plan of operation should be developed for the efficient utilization of maintenance snow and ice workers, material and equipment. This plan should be completed such that all maintenance workers have sufficient time to review the portions which affect them prior to the initial winter season storm. The following sections are intended to serve as a guideline for the preparation of a winter maintenance plan. Since it is a guideline, each district is not required to include all the recommendations within the plan; however, at the same time, the plan is not limited to what is included in the guideline.

2-5.01 Objective of the Plan

This section describes the objectives of the snow and ice removal plan. Items which should be considered are:

1. The primary purpose of snow and ice removal.

2. To provide adequate snow and ice removal within available resources.

3. To provide a reference for all personnel on the policies and procedures of snow and ice control.

2-5.02 Organization

This section should be devoted to explaining how the organization of the district functions in regard to a snow and ice emergency. Significant elements to be considered have been provided in Sub-sections 2-5.02.01, 2-5.02.02 and 2-5.02.03.

2-5.02.01 Personnel

The overall organization of district personnel should be described. Flow charts display this information efficiently and accurately. Details regarding chain of command, responsibilities of each position, and number of employees in each functional class should be shown or listed.

2-5.02.02 Union Contracts

A statement on how current union agreements will govern working schedules, overtime, and related subjects should be included.

2-5.02.03 Physical Facilities

A brief description of all physical facilities operated by the district should be included. Sub-areas, truck stations and material storage areas (Figure 1-2.02A) should be plotted on a map. Useful data regarding each location (i.e. number and class of trucks used for snow and ice control for each truck station, capacity of salt storage for each location, etc.) should be recorded.

2-5.03 Operation Plan

2-5.03.01 Mn/DOT Policy Position Statements and Guidelines

The plan should include all Mn/DOT Policy Position Statements and Guidelines regarding clear roads, namely Mn/DOT Policy Position Statement - Highways No. 83-2 and Mn/DOT Policy Guideline - Highways No. 83-2-G-1. Additional information concerning these and other Mn/DOT Policies may be accessed on Mn/DOT's internal web site at http://ihub.policies.dot.state.mn.us/Main.asp.

2-5.03.02 Personnel Functions

Specific tasks that must be accomplished during any snow emergency should be pre-assigned to various personnel. The operation plan should list the duties of all classifications of personnel involved in snow and ice control. In addition, all split shifts and night patrols should be defined and duties assigned.

2-5.03.03 Communications

An effective communication system is a very important portion of a winter maintenance operation plan. The AASHTO publication, Guide for Snow and Ice Control, states "For organizations that staff trucks with only one person, crew-level communications are particularly important. Snow and ice operations are physically demanding, sometimes performed alone in remote areas, and are potentially dangerous. At the crew level, the ability to communicate on matters of public safety, accidents, incidents, work coordination, personal safety, weather conditions, road conditions, and work progress is absolutely vital."

The plan should identify who is responsible for the coordination and preparation of the Road Condition Reports (Section 2-9.0). In addition, a system for notifying employees of a snow emergency should be developed and included in the plan. A method of reporting mechanical difficulties or the need for emergency parts during non-working hours should also be included.

2-5.03.04 Levels of Service

Portions of the maintenance manual regarding the recommended level of service (Table 2-3.02A) for each roadway classification should be reproduced in the plan. Each operator should understand all the recommended levels of service with the associated coverage and cycle times. In addition, the clean-up operation priorities (Section 2-4.0) should be shown in the plan.

2-5.03.05 Individual Routes

One of the most important aspects of the operation plan is the assignment of snow removal routes by district. Each individual route should be designated in a table and/or map. Examples have been provided in Figure 2-5.03.05A and Figure2-5.03.05B. Information contained may include:

a. Route identification
b. Name of operator(s) assigned
c. Equipment assigned (i.e. capacity of vehicle, sand/salt)
d. Shift assignments
e. Shifts per segment
f. Number of roadway segments on the route
g. Classification of roadway segments on the route
h. Number of lanes for each segment
i. Total lane miles for each classification
j. Number of interchanges by classification
k. Plow speed for each segment
l. Salting/Sanding speeds
m. Posted speed limit for segment
n. Special instructions

Individual Route
Figure 2-5.03.05A

Individual Route
St. Cloud Truck Station
Route 214

TH: 10 & 301

RP: **TH 10** – RP 177.743 to RP 196.590 **TH 301** – RP 0.00 to RP 1.059

Lane Miles Info: **TH 10** – 36.83 miles **TH 301** – 2.12 miles

Turn around points: **TH 10 –** South Benton Interchange to Tom Thumb in Becker
TH 301 – TH 10 to CR 8 stop sign

Loading Sites: St. Cloud Truck Station, City of St. Cloud, and Clearwater loading site

Fuel Stops: St. Cloud Truck Station and any gas station with fuel card

Equipment Requirement:
Class 35 – 12' right hand plow, 10' wing, sander, brine tank, 11' underbody
Class 33 – 12' left hand reversible plow, 10' wing, sander, brine tank
760 loader and snow blower
620 motor grader
725 versatile and snow blower

Field Notes: Plow and sand TH 10 from St. Cloud, St. Germain, to Becker, all turn lanes, shoulders and TIC Rest Area.

Storm Activities: Widen shoulder; plow median openings, blow median openings out with snow blower, and clean and service equipment.

Hazards:
Curves
Light poles
Signal poles
Curbs – TH 23 & TH10 interchange, in rest area, Pork Chop curbs on TH 10 at Super America & Cub Foods entrances
RXR tracks N of St. Germain & on TH 301
Stop lights in Clear Lake, St. Germain, & TH10 & 15th SE
Clover-leaf
Guardrail & Flex beams:

	Eastbound	**Westbound**
	RP 177.428	RP 177.249
	RP 178.514	RP 178.260
		RP 178.105

Base on District 3B
Individual Route
03/18/2005

Winter Maintenance Schedule
Figure 2-5.03.05B

SNOW & ICE SCHEDULE
Effective October 18, 2004 through April 15, 2005

Route No.	Truck Station	Employee	Call No.	Employee Assignment	Route	Assignments	Lane Miles	Route Class
TP3PR223	St. Cloud	(E) Lunceford L. (L) Golebeski M.	M-118	204566	I-94	TH 15 to CR 159 – St. John's RP 156.299 to 166.632 I-94 & CR 75 Interchange at St. John's I-94 & CR 2 Interchange I-94 & TH 23 Interchange Super Commuter Interchange	41.33 +3.24 (3^{rd} ln) +3.76 (CR 75) 3.56 **51.89**	SC
		(E) Kiley M. (L) Cripe W.	M-114	94197				
TP3PR224	St. Cloud	(E) Brevik K. (L) Laudenbach D.	M-120	202367	I-94	TH 15 to TH 24 at Clearwater RP 166.632 to RP 178.276 I-94 & TH 24 Interchange	46.58	SC
		(E) Dingman M. (L) Soenneker M.	M-121	200056		I-94 & CR 75 Interchange at St. Augusta Super Commuter Interchange	6.24	
TP3PR225	St. Cloud	(E) Swenson D. (L) Bengston J.	M-119	99043	TH 95	TH 23 to Jct. of Old TH 169 RP 000.000 to RP 021.619	43.24	RC
TP3PR226	St. Cloud	(E) Mehr D. (L) Horsman D.	M-112	96416	TH 15	1 mile S of I-94 to TH 55 RP 145.239 to RP 132.880	24.72	RC
TP3PR227	St. Cloud	(E) Mehr D. (L) Horsman D.	M-111	96414	TH 24	TH 10 to TH 55 RP 047.844 to RP 030.738	34.21	UC
TP3PR227	St. Cloud	(E) Mehr D. (L) Horsman D.	M-111	96414	WC 128	TH 10 to TH 55 RP 047.844 to RP 030.738	1.00	PR
TP3PR229	St. Cloud	(E) Stang C. (L) Keiss K.	M-103	97399	TH 23	14th Ave SE to Foley at Jct. TH 25 (right lane) RP 208.134 to RP 220.925	25.58	RC
		(E) Wruck J. (L) Hilsgen G.	M-109	202516		14th Ave SE to TH 95 (left lane) RP 208.134 to 212.200	8.13	
TP3PR231	Foley	(E) Beckerman M. (L) Mendel F.	M-113	201536	TH 25	Jct. TH 10 to Morrison County Line RP 081.241 to RP 117.124	71.77	RC

Note: All routes will follow Mn/DOT Guidelines and may need to assist other routes as needed.
(E) denotes early/first shift
(L) denotes late/second shift.

Base on District 3B
Winter Maintenance Schedule
03/18/2005

2-5.04 Implementation

The final and most significant portion of any winter operation plan is how the plan is actually implemented. Information on implementation procedures are provided in the preceding sub-sections (2-5.04.01, 2-5.04.02, 2-5.04.03, and 2-5.04.04).

2-5.04.01 Equipment

In order to provide adequate service to the public, equipment should be inspected routinely to assure optimum performance. In addition, to assure consistent application of materials on the roadway, all applicators (e.g. spreaders, sprayers, etc.) should be calibrated yearly as specified by the manufacturer.

As part of the yearly inspection of vehicles each District should consider conducting a trial operation. This "test run" is very helpful in detecting problems with equipment and refreshing operators' techniques.

2-5.04.02 Snow Plowing

This section of the plan should serve as a guide to the operator for acceptable snow plowing procedures. The following types of information should be included:

a. Work schedules
b. Procedures for plowing across railroad tracks
c. Procedures for plowing different types of roadway and shoulder surfaces
d. Procedures for different types of events (e.g. rain, freezing rain, snow, etc.)
e. Pre-event procedures
f. Post-event procedures
g. Procedures to prevent drifting
h. Procedures when the road is blocked
i. Clean-up procedures for markers and signs
j. Clean-up procedures for drainage structures
k. Procedures for plowing multi-lane highways and interchanges
l. Procedures for plowing snow on median openings (e.g. crossroads, crossovers, u-turns, etc.)
m. Procedures for widening and snow storage operations
n. Internal commutation procedures
o. Responsibilities of the operator when stalled or disabled vehicles are present

2-5.04.03 Material Usage

In order to meet the objectives of effective snow and ice removal, guidance on usage of various chemicals (e.g. winter sand, salt, calcium chloride, etc.) is a necessity. It is the responsibility of the district to minimize the use of chemicals while continuing to provide the driving public with safe roadways. The plan should include procedures for the use of materials. The use of materials should be specified considering the variables of type of precipitation, pavement temperature, air temperature forecast, percentage mix (salt/sand), classification of roadway, and location (i.e. intersection, hill, etc.). Procedures for completing material usage forms should also be explained. Examples of application rates and material usage reporting are provided in Section 2-8.0, Chemical Management.

2-5.04.04 Safety

All operators must be informed to keep safety in mind at all times. The plan should include recommended procedures designed to reduce accidents. The recommended procedures should address the following:

- Safety equipment (e.g. high flags, seat belts, flares, etc.)
- Accident reporting
- Procedures for safe traffic control (MUTCD)
- Snow plow safety training

2-6.0 EQUIPMENT

2-6.01 Preparation and Inspection

In order to provide adequate and necessary snow and ice control, equipment should be operational and available for use. Information pertaining to State and Federal inspection regulations is available in the Fleet Management Chapter of this manual.

Trucks should be in good working order with necessary parts available. Snow plows and wings should be mounted on the trucks and inspected for proper operation.

1. Auxiliary equipment, such as tire chains, shovels, lights, etc., should be available and operational.

2. All snow and ice control equipment should be inspected thoroughly before the winter season. To assist in this procedure, a checklist of some type should be used. An example of such a checklist is shown in Figure 2-6.01A.

3. Each piece of equipment should be inspected prior to each use for proper operation to determine if any deficiencies exist. To assist in this procedure, a checklist of some type should be used. An example of such a checklist is shown in Figure 2-6.01B and 2-6.01C.

Before the usage of snow and ice equipment is required, an inspection of all routes should be conducted. These pre-season route checks should be used to observe and note the following:

1. Location and proper markings of impact attenuators, bridge crash rails, Jersey barriers, plate beams or similar types of barriers.

2. Bridge expansion joints, expansion joint plow guards, manhole covers or other obstacles that might be unseen due to snow and become a hazard during snow and ice removal operations.

3. Route changes or revisions that may have occurred since last season.

4. Reduced overhead clearances and lane widths.

5. Broken or missing curb sections.

The District Maintenance Engineer or designee should provide a complete list of pre-season policies and procedures to maintenance personnel.

2-6.02 Calibration

Calibration is an integral part of the winter season preparation and should be conducted on all snow and ice equipment. Calibrating this equipment provides consistent control of application rates throughout the District, thus helping to reduce material costs while supplying uniform levels of service to all roadways within a given classification.

Equipment's level of complexity may vary greatly, but regardless of that level these systems will always have at least one thing in common: calibration. When calibrating equipment all guards and shields shall be in place. Calibration may be required for any number of reasons, including, but not limited to:

- The beginning of snow and ice season.

- Changes made to the hydraulic system.

- Augers having extensive wear, requiring replacement or resurfacing.

- Changing material type (e.g. salt/sand mix vs. salt or sand only)

This manual does not provide instruction/calibration methods for snow and ice removal equipment. Calibration of equipment should be performed as prescribed by the manufacturer.

WINTER EQUIPMENT INSPECTION
Figure 2-6.01A

WINTER EQUIPMENT INSPECTION

TRUCK # _____ **TRUCK STATION** _____ **OPERATOR** _____

	COMMENTS
PLOW # _____	
Cutting Edge/Bolts	
Safety Chains & Hooks	
Plow Ram & Hose	
Hydraulic Leaks	
Lift Chains	
Plow Pins	
Plow Operation & Balance	
Check for cracks or repairs	
A-Frame Hinge Bolts	
WING # _____	
Cutting Edge/Bolts	
Lift Cable & Chains	
Check Rams & Hoses	
Cable Condition	
Hydraulic Leaks	
Sheave (outer wing pivot)	
Push Pole & Storage Hook	
Wing Post – Damage	
Wing Operation	
Wing Slide	
Check wing for cracks or repairs	
SANDER # _____	
Auger Flights	
Bearing & Chain	
Hoses & Hydraulic Leaks	
Sander Cover Hold Down	
Sander Operation	
Check sanders for cracks or repairs	
UB PLOW# _____	
Cutting Edge/Bolts	
Plow Ram & Hoses	
Mounting Bolts	
Plow Operation	

ADDITIONAL COMMENTS: _____

Based on District 8
Winter Equipment Inspection

OPERATOR CHECKLIST
Figure 2-6.01B

OPERATOR CHECKLIST

Unit # _____ **Underbody #** _____ **Mileage** _____
Plow # _____ **Sander #** _____ **Inspector** _____
Wing # _____ **Date** _____

	PASS	FAIL	COMMENTS
LIGHTS:			
All Interior			
All Exterior			
Headlights – High/Low/Indicator/Plow			
Signal Lights and 4-Way Flashers			
Brake Lights			
Snow Equipment Lights			
Strobe Lights High/Low			
Backup Alarm			
GLASS:			
Windshield			
Cracks, Chips or Pitting			
Wiper Operation and Blades Condition			
Doors			
Window Operation			
Cracks or Chips			
Mirrors			
Condition of all Mirrors			
INTERIOR:			
Seat			
Floor Mat			
Cab Cleanliness			
Seat Belts			
Heat Operation (when applicable)			
SAFETY EQUIPMENT:			
1st Responder Kit			
1st Aid Kit			
Roadside Reflectors			
Fire Extinguisher			
Service Book			
Personal Injury and Accident Report Packet (updated '03)			
Current CVI Sticker – record month and year			
Pre-Post Trip Book			

OPERATOR CHECKLIST (Cont.)
Figure 2-6.01C

	PASS	FAIL	COMMENTS
TIRES:			
Air pressure			
Condition of Tires			
Re-torque Lug Nuts			
SNOW EQUIPMENT:			
Cables and Pulleys			
Hydraulic Leaks			
All Bolts and Pins			
Box Shaker Operation (when applicable)			
Sander Plate Installed			
Clean and Lubricate Sander Chain			
Brine System Operation			
Calibrate Dickey John			
BATTERY:			
Cleanliness			
Water Level (when applicable)			
Clean Connections			
SERVICE LIST: CHECK AND ADJUST			
PTO – Gear Box Fluid Level			
Hydraulic Fluid Level			
Differential Fluid Level and Vent			
Transmission Fluid Level			
Engine Oil Fluid Level			
Coolant Fluid Level and Freeze Protection			
Power Steering Fluid Level			
Front Wheel Hub Fluid Level			
Windshield Water Fluid Level			
Fuel Filter Date/Mileage			
Pre-Post Trip Book			
Record Clutch Free Travel (when applicable)			
Broken Spring(s)			
Grease all Zerks including the Pintle hitch and on 1997 and newer trucks the front hitch lock pin. (Note any faulty grease Zerks and/or Zerks that won't take grease.)			
Clean Cab Interior, Exterior and Underside of Box			

Additional Comments: _____

_____

_____

Based on District 8
Operator Checklist

2-7.0 MATERIALS

The primary materials used in maintaining roads throughout the winter season are abrasives and chemicals. Variable combinations of these materials are used to combat any storm. The following abrasives and chemicals are provided in the order of increasing initial cost. This only accounts for the product and delivery cost; clean up of these materials can be costly in terms of collection (i.e. sweeping, screening and properly disposing) and protecting the environment.

2-7.01 Abrasives

2-7.01.01 Treated Winter Sand

Sand is the primary abrasive material used in reducing slipperiness and providing traction. Treatment of the sand with chlorides is done to prevent freezing in storage and as an aid to anchor the material to the road surface when spread. The salt (a chloride) content of stockpiled winter sand should not exceed ten percent by volume. Normally, winter sand consisting of five percent salt will provide a free flowing condition for distribution.

2-7.02 Chemicals

2-7.02.01 Sodium Chloride (NaCl)

Salt is normally shipped in bulk as crushed and screened rock salt. Due to economics and availability, salt is the principal deicing material used in winter maintenance work. It is extremely effective at temperatures above 20°F; however, the melting action is reduced at lower temperatures. The effective working temperature of salt can be lowered by pre-treating or pre-wetting with other chemicals (i.e. Magnesium Chloride, Calcium Chloride, etc.).

2-7.02.02 Magnesium Chloride ($MgCl_2$)

Magnesium Chloride is bulk delivered in liquid form. It is used primarily for anti-icing and pre-wetting operations due to its extensive range of effective working temperature. The lower bound for the effective working temperature of magnesium chloride is near -10°F.

2-7.02.03 Calcium Chloride ($CaCl_2$)

Calcium chloride is available in three forms - regular flake (Type I), concentrated flake or pellet (Type II), and liquid. Type I and II flakes are shipped in moisture proof bags while pellets and liquid are shipped in bulk. Used undiluted in the solid form, it is very effective on severe icing conditions down to temperatures approaching -20°F.

2-7.02.04 Potassium Acetate (KAc)

Potassium acetate is a non-corrosive, biodegradable, liquid chemical. Due to the high cost, it is primarily used in conjunction with automated bridge deicing systems or small areas where limited chloride usage is permitted.

2-7.02.05 Experimental Chemicals

All experimental chemicals must undergo a thorough screening process prior to use on any Mn/DOT maintained roadway. This process can take several months; however, an initial field testing may be granted before the screening process is complete. This process is overseen by the Maintenance Research and Training Engineer. A clear and concise outline for submitting an experimental chemical for evaluation is provided in the Research Project Guide on "Basic Field Evaluation for De-icing and Anti-icing Chemicals".

Additional information and forms concerning experimental chemicals are available on the Maintenance Operations Research (MOR) website at http://www.dot.state.mn.us/maint/research-chemical.html. Questions about the experimental chemical proposal process should be directed to the Maintenance Research and Training Section. The address and telephone number for the Maintenance Research & Training Engineer are:

Mn/DOT Maintenance Research and Training Engineer
Mail Stop 722
395 John Ireland Boulevard
Saint Paul, MN 55155-1899

Phone: (651) 282-2281
Fax: (651) 296-6758

2-7.03 Material Testing

The complexity and number of materials used to fight snow and ice continues to increase at a steady rate, heightening the need for quality control. Field personnel are the first and most important link in receiving and testing materials. Testing and inspecting each delivery will help to ensure the quality and quantity of the material being received.

The AASHTO publication, Guide for Snow and Ice Control, states that material loads should be visually inspected to assure that the material remains clean and free of extraneous matter, free from hard caking, does not segregate, and remains suitable for the intended purpose. Granular materials are also subject to regular laboratory testing as prescribed in the material contracts. Additional information on these testing methods can also be obtained from the Maintenance Operations Engineer.

When testing liquid chemicals, the Mn/DOT publication "FIELD TESTING for Anti and De-ice Chemicals" provides standardized methods for field testing and sampling along with information on proper chemical handling procedures and required personal protection. In addition, this publication covers the required process for sending samples to the Mn/DOT Materials and Research Lab.

If problems or praises arise with the material being delivered by the vendor, a "Vendor Performance Report" should be filed with the Department of Administration. Additional information on why and how to file a "Vendor Performance Report" is available online at the Department of Administration, Material Management Division website at www.mmd.admin.state.mn.us/mn02005.htm. The Vendor Performance Report form can be accessed online at www.mmd.admin.state.mn.us/pdf/perform.pdf.

2-7.04 Storage

Proper storage of anti-icing and deicing materials can be a difficult task without proper planning and preparation. When properly designed and maintained, a storage facility will provide increased safety at a decreased cost for the traveling public, employees, and the environment.

If Mn/DOT property is damaged, by the vendor, a Vendor Performance Report must be immediately filed with the Department of Administration, Material Management Division. This form can be accessed online at www.mmd.admin.state.mn.us/pdf/perform.pdf. Storage facilities should be inspected after each delivery for property damage (e.g. damage to gates, damage to salt storage shed, severe rutting of unpaved surfaces, etc.).

The Facilities Management Services Section should be contacted for questions regarding proper building design and maintenance. The web site for Facilities Management Services can be accessed at www.dot.state.mn.us/maint/facilities.html.

2-7.04.01 Abrasives

As mentioned previously, abrasives should be treated with chlorides to prevent freezing in storage. ***Minnesota Rule 7060.0600 prohibits discharge of waste into the subsurface that may result in polluting ground water.*** Therefore, all deicing chemicals and treated winter sand should be located in a covered storage building. However, deicing chemicals have the first priority for inside storage. Any winter sand which cannot be stored inside must be covered with a moisture-proof material. Criteria for inside and outside storage facilities are as follows:

2-7.04.02 Granular Chemical Storage

a. Bag storage

Chemicals shipped in bags should be stored in a dry place, preferably in an enclosed building. Storage for more than a year is not recommended. Storage should be arranged to utilize the older bags first. Outside storage is allowed, provided the bags are covered with a moisture-proof material and securely fastened down. For any type of storage, precautions should be taken to ensure a clean and dry work area.

b. Bulk storage

Bulk storage of chemicals should incorporate designs to minimize contact with moisture. When choosing a site for bulk storage, the hydrologic and geologic properties of the site must be considered in order to minimize the effect of the chemical on ground and surface water. The site should also be situated at a location which is advantageous from an operational viewpoint.

Higher percentage salt-sand mixtures should be blended only when use is anticipated. Chemicals should be put into storage immediately to prevent the formation of brine.

Storage within an enclosed building is the preferred method. The building should be designed to meet the following criteria:

1. Protection from direct precipitation
2. Provide adequate space for loading and unloading
3. Shield from the prevailing wind
4. The floor should be impervious and

    a. slope towards the center of the pile if the site is not designed with a self-contained salt brine runoff collection system.

    b. slope away from the chemical pile and out of the building to a point of collection if the site is designed with a self-contained salt brine runoff collection system.

The collection system should be designed to receive all runoff from the stockpile area. After collection, the runoff should be disposed of by pumping and hauling to an appropriate site. Before any site is chosen for ultimate disposal, the district should receive approval from the appropriate regulatory agency. In general, methods of preventing pollution, both visual and chemical, are preferred and more effective than any collection and disposal system.

Outside storage of chemicals, during the winter season, is allowed provided the stockpiles are on an inward sloping impervious surface (e.g. bituminous or concrete) and covered with a moisture-proof material. The pads should be large enough to store the largest piles and provide sufficient room for loading and unloading operations. Each district must use a covering which provides adequate protection. The covering must be tied down carefully and the bases sealed to prevent infiltration of wind and surface water.

2-7.04.03 Liquid Chemical Storage

The use of liquid chemicals for anti-icing, deicing, prewetting and pretreating has greatly expanded the number of snow and ice fighting options available to the Department. These tools have allowed for the decrease in chemical application rates, impacts to the environment and operational costs, but with liquid chemical usage and storage comes dynamic policies and procedures. Mn/DOT recognizes this and the potential for problems when using and storing liquid chemicals; therefore, several studies have been conducted.

The first study was conducted in 1972 and was updated 1989 with the most recent study being performed in 2001. The study conducted in 1972 and the update released in 1989 dealt with the bulk storage of granular material and controlling salt brine that was inadvertently created by runoff. The 2001 study examines requirements for aboveground storage tanks, recommended practices and acceptable salt brine production systems and general housekeeping practices for salt piles and truck washing operations. The findings generated from the 2001 study are found in Appendix 2A. Key points concerning aboveground storage tanks and recommended practices for salt brine production systems from the 2001 study are as follows:

a. Aboveground Storage Tank

The Minnesota Pollution Control Agency (MPCA) requires that any aboveground storage tank with a capacity of 110 gallons or more be registered.

- The MPCA can be contacted at 1-800-657-3864 for aboveground storage tank notification forms.

The Minnesota Rules Chapter 7151 requires that aboveground storage tanks greater than 1,100 gallon capacity or greater than 110 gallon capacity and located within 500 feet of surface water, have a safeguard to contain release from the tank.

- Surface water includes, but is not limited to, lakes, ponds, streams, ditches and wetlands.

- Safeguard requirements can be met with the use of a secondary containment system, which can be achieved with either a double-walled tank or by surrounding the tank with an impermeable dike and floor. The containment area should have a capacity of 110% of the largest tank's volume.

Exemption to *Minnesota Rules Chapter 7151* requirements: Stainless steel tanks containing substances other than petroleum products or hazardous materials, indoor tanks and tanks less than or equal to 1,100 gallons that are not located within 500 feet of surface water.

- To be classified as an indoor tank, it must be located within an enclosed structure with an impermeable floor, possess a secondary containment system or not allow a release to escape the building through doorways or floor drains.
    - A building may be considered a secondary containment system if the floor drains discharge to a permitted wastewater facility or permitted on site wastewater containment facility.
    - Example: A single-walled tank would not be considered an indoor tank if the structure's floor drains are connected to a drain field and no impermeable dike system is in place.
- All tanks must comply with current labeling requirements (i.e. capacity of the tank, substance being stored and, when pertinent, a unique number for each tank).

Liquid storage tanks should be drained and cleaned prior to the delivery of new product or annually, which ever occurs first. The liquid and/or precipitate/sediment that are collected should be disposed of in accordance with current requirements.

Information regarding aboveground storage tank requirements can be obtained via the Office of Environmental Services. The web site for Environmental Services can be accessed at www.dot.state.mn.us/environment.

b. Salt Brine Production System

This system should be housed in a location other than the maintenance garage due to its highly corrosive nature. A sump should be placed within the mixing area to collect salt brine that may be accidentally spilled. This includes spillage from filling truck tanks, ruptured hose and runoff within the transfer area. The sump should be self-contained to prevent contamination of native soil, surface water and/or ground water. Brine collected from the sump may be disposed of in the truck brine saddle tanks.

Information regarding building design for salt brine production structures can be obtained via the Facilities Management Services Section. The web site for Facilities Management Services can be accessed at www.dot.state.mn.us/maint/facilities.html.

2-8.0 CHEMICAL MANAGEMENT

The type and amount of each chemical to be used in snow and ice control operations should correspond to such variable factors as pavement temperature (rising or falling), type and amount of precipitation, wind velocity, wind direction, traffic volume, likelihood of trapping subsequent snowfall, amount and type of accumulation, weather forecasts, etc. Supervisors should make an effort to reduce chemical usage wherever possible. Chemical application should be restricted to amounts necessary to meet level of service requirements (Table 2-3.02A). Usage of chemicals shall comply with Minnesota Statute 160.215, which is reproduced below.

2-8.01 Minnesota Statute

Chapter 160.215; SNOW REMOVAL; USE OF SALT OR CHEMICALS RESTRICTED.

In order to:

1. **Minimize the harmful or corrosive effects of salt or other chemicals upon vehicles, roadways, and vegetation;**

2. **Reduce the pollution of waters; and**

3. **Reduce the driving hazards resulting from chemicals on windshields;**

road authorities, including road authorities of cities, responsible for the maintenance of highways or streets during periods when snow and ice are prevalent, shall utilize such salt or other chemicals only at such places as upon hills, at intersections, or upon high speed or arterial roadways where vehicle traction is particularly critical, and only if, in the opinion of the road authorities, removal of snow and ice or reduction of hazardous conditions by blading, plowing, sanding, including chemicals needed for free flow of sand, or natural elements cannot be accomplished within a reasonable time.

This statute does not arbitrarily prohibit the use of chemicals on the roadway. Chemicals and chemicals with abrasives may be used under the conditions specifically outlined in the law.

When, where or the amount of chemicals to be placed on a roadway cannot be predetermined precisely. Each circumstance involving a hazardous condition and the particular need for vehicle traction must be judged on its own merits with consideration for safety of the traveling public using that particular roadway at that particular time.

Mn/DOT is committed to using the minimum amount of chemical necessary to return the roadway to its designated level of service within the appropriate timeframe (Table 2-3.02A). Several ways of accomplishing this have been provided:

- Proper training and use of Mn/DOT's Road/Weather Information System (RWIS). This includes sensor outputs as well as atmospheric and road condition predictions. Additional information on how to access and use RWIS can be obtained from the following field guide, "RWIS – Basics, Field Guide to Scan Web 4.5.1."

- Effective use of shifts (split shifts) and/or extended hours. This will help ensure personnel are deployed at times appropriate to the action that is to be performed and work will be conducted during optimal anti-icing, de-icing or snow removal conditions.

- Use of proactive methods, such as anti-icing, when weather and pavement conditions are appropriate. Additional information pertaining to anti-icing and de-icing can be found in Section 2-8.02 and Section 2-8.03, respectively.

- Pre-wetting of granular chemicals and abrasives to increase effectiveness and reduce losses from application and traffic. Additional information is available in Section 2-8.03.01.

- Use of underbody blades and motor graders to remove compacted snow and slush.

- Use of alternate chemicals when available and conditions warrant. Information outlining available chemicals and possible conditions for utilization is available in the Table 2.8.01.01A.

- Calibration of all material spreaders to manufacturer's specifications.

- Accurate reporting of chemical and equipment use.

- Post-event reviews to refine best practices and ensure consistency

2-8.01.01 Application

Chemical and sand application rates are determined by the operator or as recommended by the maintenance supervisors. Operators must be trained to consider weather and road conditions when determining application rates. Application rate guidelines are provided in Table 2-8.01.01A; **rates found in this table are not fixed numbers and can/should be adapted to meet the roadway classification, weather conditions and experience of each district.** Operators can also refer to charts, information and other resources provided by programs such as Salt Solutions online at http://www.dot.state.mn.us/maint/training.html or Maintenance Operations Research (MOR) online at http://www.dot.state.mn.us/maint/index.html.

Supervisors should monitor road conditions and review chemical usage reports to ensure routes are meeting recommended level of service and recovery targets without excessive use of chemicals.

Table 2-8.01.01A
Application Rate Guidelines
(lbs/2-lane mile)

Pavement Temp. (ºF) and Trend (↑↓)	Weather Condition	Maintenance Actions	lbs/ 2-lane mile***			
			Salt Prewetted/ Pretreated With Salt Brine	Salt Prewetted/ Pretreated With Other Blends	Dry Salt*	Winter Sand (abrasives)
>30° ↑	Snow	Plow, treat intersections only	80	70	100*	Not recommended
	Frz. Rain	Apply chemical	80 – 160	70 - 140	100 – 200*	Not recommended
30° ↓	Snow	Plow & apply chemical	80 – 160	70 - 140	100 – 200*	Not recommended
	Frz. Rain	Apply chemical	150 -200	130 - 180	180 - 240*	Not recommended
25 - 30º ↑	Snow	Plow & apply chemical	120 – 160	100 - 140	150 - 200*	Not recommended
	Frz. Rain	Apply chemical	150 – 200	130 - 180	180 - 240*	Not recommended
25 - 30º ↓	Snow	Plow & apply chemical	120 – 160	100 - 140	150 - 200*	Not recommended
	Frz. Rain	Apply chemical	160 – 240	140 - 210	200 - 300*	400
20 - 25º ↑	Snow or Frz. Rain	Plow & apply chemical	160 – 240	140 - 210	200 - 300*	400
20 - 25º ↓	Snow	Plow & apply chemical	200 – 280	175 - 250	250 - 350*	Not recommended
	Frz. Rain	Apply chemical	240 – 320	210 - 280	300 - 400*	400
15º to 20° ↑	Snow	Plow & apply chemical	200 - 280	175 - 250	250 - 350*	Not recommended
	Frz. Rain	Apply chemical	240 - 320	210 - 280	300 - 400*	400
15º to 20° ↓	Snow or Frz. Rain	Plow & apply chemical	240 - 320	210 - 280	300 - 400*	500 for frz. rain
0 to 15º ↑↓	Snow	Plow, treat with blends, sand hazardous areas	Not recommended	300 - 400	Not recommended	500 - 750 spot treat as needed
< 0º	Snow	Plow, treat with blends, sand hazardous areas	Not recommended	400 -600**	Not recommended	500 - 750 spot treat as needed

Notes: *Dry salt is not recommended. It may blow off the road before the melting process can begin.
**Applied at the centerline of the roadway.
A blend of 6 – 8 gal/ton $MgCl_2$ or $CaCl_2$ added to NaCl can melt ice as low as -10º.
Salt brine should be mixed to a 23.3% concentration which is a salimeter reading of 85% and hydrometer reading of 1.176.

How to use Table 2-8.01.01A:

1. Select the row with the appropriate pavement temperature, temperature trend and weather conditions.
2. Select the column that is appropriate for the type of material being used.
3. Find the box where the row and columns intersect to find the application rate.
4. Compare values to the calibration chart for the appropriate truck.
5. Dial the correct setting for the rate indicated on the application rate guidelines.

2-8.02 Anti-icing

Anti-icing is a proactive measure for preventing the formation of the bond between a freezing precipitate (e.g. frost, freezing drizzle, etc.) and the pavement by the application of a freeze-point depressant chemical. Since anti-icing chemicals are bond inhibitors, the reduction in materials and effort needed to return the roadway to performance measure guidelines may be achieved with about $^{1}/_{10}$ the cost and ¼ the material. Application rate guidelines are provided in Table 2-8.02A; **rates found in this table are not fixed numbers and can/should be adapted to meet the conditions and experience of each district.** Information pertaining to anti-icing can be found in "Guidelines for Anti-icing." These guidelines can be accessed on the Office of Maintenance Operations web site at www.dot.state.mn.us/maint/research-chemical.html. In 2004, these guidelines were revised by the Mn/DOT Anti-icing Committee. An outline based on the information in these guidelines has been provided below:

- Anti-icing works best when combined with accurate road weather information.
- Anti-icing chemicals may be applied at or before the start of the event.
- Prewetted/pretreated salts can work at low application rates, but careful consideration must be given to traffic speed and volume. All granular chemicals should be applied as close to the event start time as possible.
- Liquid chemicals are less likely to be removed by traffic and in certain situations may be applied days in advance of an event.
- Anti-icing chemicals should be applied regularly on critical areas and bridge decks if conditions are conducive to producing frost or black ice.
- Re-application is not recommended if residual anti-icing chemical is present. These chemicals can remain on the roadway for up to five days after being applied depending on the amount of precipitation and/or traffic volume.
- When frost begins to move onto the traveled roadway from the shoulders, it is time to reapply anti-icing chemicals.
- Anti-icing should not be conducted during rush hour traffic periods.
- Anti-icing chemicals should be applied with stream nozzles. This will help to maintain strips of untreated pavement helping to reduce slipperiness.
- Anti-icing chemicals can be used as spot treatments (e.g. curves, intersections, etc.)

Table 2-8.02A
Anti-icing Application Rate Guidelines

Condition	Gallons/lane mile		
	**$MgCl_2$	**Salt Brine	Other Products
Regularly Scheduled Applications	15 – 20	20 – 35	follow manufacturers recommendations
Prior to Frost or Black Ice Event	15 – 20	20 – 35	
Prior to Light or Moderate Snow*	15 – 20	20 – 50	

Notes: *Used as a bond breaking agent
Prescribed pavement temperature range for chemical usage:
- Magnesium Chloride: -10°F to +28°F
- Salt Brine: +10°F to +30°F

**Chemicals may be used at lower temperatures with high traffic volume roads.

Anti-icing can be a time and resource saving tool, but it is not without draw backs. The major concern with an anti-icing chemical is dilution: the cause of refreeze. As the chemical application takes on water, the concentration of the solution dilutes causing a rise (↑) in the freezing temperature. This process is known as "Dilution of Solution." Anti-icing products will work until dilution causes the freeze point of the solution to equal the pavement temperature. When this occurs the active melting process will stop, resulting in refreeze if the pavement temperature is falling (↓). The four factors most effecting the duration between applications are pavement temperature, application rate, precipitation and beginning concentration. These factors help to explain why one application rate does not fit all storm events. When using anti-icing chemicals several precautions should be taken into consideration.

- When initially applying or after a prolonged dry period, anti-icing liquids should be applied at ½ the rate (not ½ the concentration). Liquids applied on dry roads mix with oil from vehicles and may cause slippery conditions.
- Applying too much anti-icing chemical may cause the roadway to become slippery. Less is better. Always follow application recommendations.
- Refreezing can occur when precipitation dilutes the anti-icing chemical.
- If magnesium chloride (MgCl2) or calcium chloride (CaCl2) is applied to a warm pavement surface (> 28º F) the roadway may become slippery.
- The application of liquid anti-icing chemicals prior to a forecasted rain or freezing rain may result in dilution of solution; a more effective technique may be the application of a granular anti-icing chemical.
- Do not anti-ice under blowing conditions in areas prone to drifting or other locations that salt would not be used.

2-8.03 Deicing

Deicing is a reactive measure of applying a chemical to a frozen precipitate (e.g. ice, snow, frost, etc.) that is already bonded to the pavement surface. Removing ice and snow that has already bonded to the pavement can be difficult and may result in damage to equipment and/or roads. Never attempt to melt all of the ice or snow on the road with deicing chemicals. This will result in a gross overuse of material. The amount of chemical applied to the roadway should loosen the bond between the roadway and the frozen precipitate so that snow removal equipment can be more effective.

2-8.03.01 Prewetting

Prewetting is the addition of a liquid to a material at the application point (i.e. the spinner or auger). This helps the material to adhere to the road, reducing bounce off, the sweeping effects of traffic and the wind. Because the placement of material is more effective, application rates can be reduced by as much as 30 percent. In the case of salt, prewetting allows the material to begin working immediately by providing the moisture needed to start the melting process. Prewetting can also lower the material's effective working temperature, depending on the solution being applied. When prewetting the following guidelines are recommended.

- Salt brine, calcium and magnesium chloride, and acetates may be used as prewetting agents.
- Apply liquid at the spinner or through a soaker pipe in the auger box.
- Application rates are dependent on the type of chemical being used (When using salt brine 8-14 gals/ton is recommended compared with just 6-10 gals/ton with $MgCl_2$.).

2-8.03.02 Pretreating

Pretreating is the addition of a liquid to a material at the stockpile. This process can help material adhere to the road, but it is not nearly as effective as prewetting (only reducing application rates by 5 percent). Stockpiles can be pretreated with deicing chemicals either prior to delivery or on site. No additional equipment is required for this process, but stockpiles that have been pretreated have a higher risk of leaching. All stockpiles whether pretreated or not must be covered and placed on an impervious pad.

2-8.04 Winter Labor, Equipment and Material Usage Reporting

To effectively control the labor, equipment and material (LEM) usage on a roadway, accurate and timely records are a necessity. Currently, several different computer programs and systems are used to enter, compile and retrieve this information.

Each district is required to enter the daily usage of labor, equipment and material into the data collection system, Resource Consumption Application (RCA). This information is then compiled at the Data Warehouse and retrieved using Program & Project

Management System (PPMS). This program handles information quickly and efficiently allowing management to make informed decisions. Information on generating reports and user instructions for PPMS are available on Mn/DOT's internal website at http://ihub.ots/projdev/pmu/ppms. Each district should manually verify the results generated by PPMS on a monthly basis. Personnel within the organization should be granted access to the results of the usage of labor, equipment and material.

The Office of Maintenance Operations generates monthly Snow and Ice reports throughout the winter maintenance season. Winter maintenance reporting begins in early October and lasts until late April; the final report is released at the end of April. Results from these reports are available on the Maintenance Operations website at http://www.dot.state.mn.us/maint/operations-business.html.

2-8.05 Equipment Washing Operations

Class V Injection Well Rules state that floor drain wastes from building facilities that store, maintain or wash equipment may not be disposed of in in-ground treatment systems (such as a drain field).

Snow and Ice equipment should be washed on a regular basis to minimize corrosion, improve operation efficiency and extend its useful life. A relatively cost effective way to reduce the amount of wash water needed to clean equipment is by dry washing and using a pressure washer with hot water. All equipment wash water must be discharged to a permitted wastewater facility or permitted on site wastewater containment facility.

The AASHTO publication, Guide for Snow and Ice Control, provides the following guidance for equipment washing: "Agencies should also consider sharing of equipment washing facilities with other agencies to minimize cost and adverse environmental consequences. The use of commercial equipment washing facilities, such as truck washing businesses, should be considered since they are responsible for wash water collection and disposal."

Additional information regarding equipment washing operations can be obtained via the Facilities Management Services, Water Services Unit. The website for Environmental Services can be accessed at www.dot.state.mn.us/maint/facilities.html.

2-9.0 ROAD CONDITION REPORTING

Public demand for accurate up-to-date road information requires that a definite procedure be carefully followed at all times. Complete compliance with the procedure outlined is therefore necessary if we are to properly serve the public.

One of the most important functions of the Transportation Department is the furnishing of road information to the public. In order to be assured of uniformity of reporting and to avoid misunderstanding, the following procedures and schedule should be followed.

2-9.01 Condition Acquisitions Reporting System (CARS)

Mn/CARS is a comprehensive system used for logging roadway information, such as driving conditions, visibility, pavement condition, precipitation, wind conditions and the impact that these situations have on the transportation network.

2-9.01.01 Mn/DOT Staffing

a. In Greater Minnesota, each District/Sub-Area must have one key user and no fewer than two backup users identified per reporting site. The Transportation Operations Communications Center (TOCC) Service Level Agreement discusses in greater detail the staffing requirements (e.g. nights and weekend shift operations). Additional information about the TOCC agreement is available on The Office of Electronic Communications (OEC) website at http://www.dot.state.mn.us/oec/index.html.

b. In the Metro Area, updating of the Mn/CARS is the responsibility of the Metro District Maintenance Dispatch and the Office of Traffic Operation. Maintenance Dispatchers enter information pertaining to construction, road conditions and permit status. The Operation's staff manages traffic incidents on the Twin Cities metro freeways.

Suitable instructions should be furnished to all employees to assure proper and prompt reporting. Complete cooperation is required in furnishing the public with roadway condition information.

2-9.01.02 Daily Reporting

Each District/Sub-Area must have information entered into Mn/CARS no later than 8:30 a.m. (6:30 a.m. for the Metro Area) and at about 4:30 p.m. daily following the format as described in the Mn/CARS Data Input Guidelines (Appendix 2B). Conditions should be entered by county or multi-county and shall be in the terms as shown in the Operation Guide - Winter Weather Grid (Table 2-9.01.02A). Additional reports shall be submitted as conditions change.

2-9.01.03 Emergency Reports

In addition to the times mentioned above, each district must report whenever any emergency condition is developing (i.e. roads blocked, opened, etc.) and report it immediately. These situations should be entered into Mn/CARS only when it is likely to cause disruption to the traveling public and should be deleted from the system as soon as the incident is cleared. Information about incidents should be clear, concise, and consistent.

2-9.01.04 Miscellaneous Reports

Each identified key user must also enter information related to construction projects and permit restrictions. When providing detour information, the descriptive text should be clear, concise, and consistent. In addition, hyperlink(s) for the project and/or district web site(s) should be provided.

2-9.01.05 The State Patrol

In Greater Minnesota, this group provides the required staffing for incident management and the needed dispatchers for nights and weekend shift operations. Within the Twin Cities metro area, the State Patrol provides no support for Mn/CARS data entry. Each district should use information obtained from State Patrol personnel to supplement data obtained from other sources.

Table 2-9.01.02A
Operation Guide – Winter Weather Grid

Situation	Key Phrase	Cause	Traffic Impact
Driving Conditions	**Driving Conditions:** Driving Conditions Good • Roadways are bare pavement from shoulder to shoulder with no visibility problems. Causes of good conditions may include: passable, dry pavement and snow cleared. Driving Conditions Fair • Roads are passable with varying conditions. Drivers may encounter some blowing and drifting snow or some narrow or one-way traffic due to snow banks on either side. Bridge decks may be slippery. Difficult Driving Conditions • Heavy snow accumulation of 5 inches or more with considerable build up on road. Drivers will encounter slippery spots on the roads and bridge decks. Hazardous Driving Conditions • Roads may be blocked or impassable due to snow. Wind speeds of at least 35 mph prevail for an extended period of time. A National Weather Service warning may be issued. No travel is advised.	**Visibility:** Visibility Reduced Fog Patchy Fog Dense Fog White-out Blowing Snow Winter Snow • Near blizzard conditions Blizzard • Wind speeds of at least 35 mph plus considerable falling or blowing snow and a temperature of 10 degrees or lower expected to prevail for an extended period of time. Visibility is reduced to near zero. **Pavement Condition:** Wet pavement • Moisture on road surfaces Snow on roadway Treated pavement Plowed snow Icy patched Ice Build-up Black ice Frost • Condensation formations usually in low-lying area and bridge decks. Slush • Combination of water with partially melted snow and ice usually causing a wet road surface film. Roadway surface in poor condition Impassable Passable with care **Precipitation:** Snow Light Snow • Visibility of ¾ mile and snowfall of 2 inches in 12 hours Heavy Snow • Visibility of less than ¼ mile or snowfall of 4 inches in 12 hours Drifting Snow • Wind-driven snow that reduces visibility and causes significant drifting. Blowing snow may be snow that is falling and/or loose snow on the ground picked up by the wind. Rain and Snow Mixed Ice Glaze • Rain or drizzle when surface temperature is below freezing (32 degrees). Sleet • Rain drops that freeze into ice pellets before reaching the ground. Sleet usually bounces when hitting a surface and does not stick to objects. It can accumulate like snow and cause a hazard. Expected Snow Accumulation **Wind Conditions:** • Light Winds • Gusty Winds • Strong Winds • Crosswinds • Tornado • Strong Winds have Eased	Closed Blocked Ahead Right Lane Closed Left Lane Closed Right Shoulder Closed Left Shoulder Closed Single Lane Traffic Alternating Directions Off Ramp Closed On Ramp Closed Closed Intermittently Center Lane Closed Reduced to One Lane Reduced to Two Lanes Stop and Go Traffic Traffic Heavier Than Normal