Transportation Synthesis Report
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Levels of Service in Winter Maintenance Operations: A Survey of State Practice

Prepared for
Clear Roads Pooled Fund Study

Prepared by
CTC & Associates LLC
WisDOT Research & Library Unit
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Request for Report

Level of service is a measure used by transportation agencies to develop guidelines, classify routes and coordinate winter maintenance activities. The Clear Roads winter maintenance pooled fund is interested in learning how snowy states are using levels of service to provide for motorist safety and make effective use of limited resources. As the lead state for the Clear Roads pooled fund, Wisconsin DOT asked us to document the state of the practice for the use of levels of service in winter maintenance operations.

Summary

We conducted a brief survey of three groups—SNOW-ICE listserv members, Clear Roads technical advisory committee representatives, and attendees of the 2007 National Winter Maintenance Peer Exchange—consisting of the following questions:

1. What are your agency's service level classifications?
2. What performance measures are used to determine if operations have met level of service guidelines for each classification?
3. How are routes monitored to determine if LOS guidelines are being met?
4. How much time is devoted to monitoring activities?

Fourteen state DOTs, one township and one Canadian agency responded to the survey, with one state DOT providing two responses. (See **Survey Results** on page 3.)

Key findings from the survey include:

Service Level Classifications

- Half of the agencies (50 percent) use **service level classifications that relate to average daily traffic counts**.

- **Other approaches** to establishing service levels include corridor significance (Michigan DOT), a single classification—bare pavement—for all roads (Maryland State Highway Administration), and a

classification scheme that places Interstates in one class and all other roads in a second class (Massachusetts Highway Department).

Performance Measures

- More than two-thirds of the agencies **(69 percent) use bare pavement, bare lane, bare wheel path, clear condition**, or **roadways cleared shoulder-to-shoulder** as a performance measure.

- **Other performance measures** used by agencies include customer feedback, return to near normal winter conditions, movement of traffic at a restricted rate, and enhanced traction.

- One-quarter of the agencies **(25 percent) do not use performance measures.**

- An in-progress Indiana DOT research project seeks to **establish a standard performance measure**.

Route Monitoring

- Agencies may use **multiple approaches to monitor routes**. Only two agencies reported that they do not monitor routes.

- Almost two-thirds of the agencies **(63 percent) use management staff to monitor routes** to determine if LOS guidelines have been met.

- Almost one-third of the agencies **(31 percent) use field personnel to monitor routes**.

- **Other approaches** to route monitoring include post-storm meetings used by Minnesota DOT to discuss material usage and regain times and Ontario's use of contract monitors to ensure contractor compliance with LOS guidelines. The township of Hamilton, N.J., and Washington State DOT use geographic information system mapping technology to monitor winter operations in real time.

- Some states use **reporting systems to track and assess LOS data:**
  - Kansas DOT uses its Road Condition Reporting System to record LOS data. At the end of the season, LOS data is compared with data from the National Weather Service to determine if the effort expended by winter maintenance operations staff matched the severity of the winter.

  - The Maryland State Highway Administration compiles LOS data through its Emergency Operations Reporting System.

  - Minnesota DOT uses an automated timesheet program to track LOS data and generate a new performance measure, Frequency of Meeting Target, which shows how many times winter operations activities met or exceeded expectations. Reports are generated using the agency's Work Management System to compare regain times to material usage per lane mile.

  - Washington State DOT continues to expand implementation of an automated data collection system by equipping winter maintenance trucks with precision material controllers and data collection devices that update a central internal database through cell phone, IP radio or Wi-Fi technology. The new system is expected to allow winter operations managers to more effectively determine road conditions over a given time period.

Time Devoted to Monitoring

- While respondents found it difficult to specify the amount of time devoted to monitoring, almost two-thirds of the agencies **(63 percent) monitor conformance with LOS guidelines during or after each winter storm event**.

- Almost one-third of the agencies **(31 percent) report no set schedule or procedure** for monitoring activities or **devote little or no time** to monitoring conformance with LOS guidelines.

Survey Results

The full text of each survey response is provided below. For reference, we have included an abbreviated version of each question before the response; for the full question text, please see the Summary on page 1 of this report.

Indiana

Contact: Kirk Carpenter, Snow and Ice Program Director/Supervisor I, (317) 234-5048, KCarpenter@indot.IN.gov.
(See Appendix A for Indiana DOT's roadway classifications and service objectives.)

1. **Service level classifications:** See Appendix A for INDOT's Snow and Ice Control Policy. [Class I = Interstate routes and roadways with Average Daily Traffic (ADT) volumes over 10,000 vehicles per day, as well as other high priority roadways, including but not limited to those serving hospital facilities and other emergency service providers; Class II = Routes with traffic volumes between 5,000 and 10,000 ADT; Class III = Routes with traffic volumes of less than 5,000 ADT.]
2. **Performance measures:** Currently, there is no set performance measure standard. INDOT is currently engaged in a research project with Dr. Bob McCullouch of Purdue University in an effort to establish a standard performance measure.

   [See http://rip.trb.org/browse/dproject.asp?n=17950 for the entry in TRB's Research in Progress database. This research project seeks to develop a performance standard that uses sensors at monitoring stations and weather conditions to identify the start of a winter event; changes in traffic flow/speed during and after the event; and the time when normal traffic flow and speed returns. The standard will take collected traffic data and compare it with the winter event severity index and winter event timeline. Various levels of service will be defined that should occur during the winter activity timeline. The time to a desired LOS is based on subjective analysis.

   Researchers will also develop a reporting tool, which uses INDOT geographic information systems maps to display the results, to report winter event severity and condition of traffic flow. Researchers have completed a literature review and evaluated environmental sensors, and are awaiting installation of the sensors to use in the upcoming winter. A winter storm index is also being developed, which will be based on previous work at INDOT and Accuweather research.]

3. **How are routes monitored?** It's up to the unit foreman, district and subdistrict managers. Again, there is no set procedure.
4. **Time devoted to monitoring?** See answer to # 3.

Iowa

Contact: Dennis Burkheimer, Winter Operations Administrator, (515) 239-1355, Dennis.Burkheimer@dot.iowa.gov.
(See Appendix B for Iowa DOT's general guidelines and procedures for snow and ice removal operations.)

1. **Service level classifications:** A, B and C.
2. **Performance measures:** A and B level: Return to near normal winter conditions within 24 hours of the storm end. C level: Bare wheel path within 24 hours of the storm end, returned to near normal winter conditions within three days.
3. **How are routes monitored?** Self reported by Maintenance supervisors at each garage.
4. **Time devoted to monitoring?** Monitoring of operations is done by garage supervisors, District personnel and Central Office during winter storms.

Kansas

Contact: Troy Whitworth, (785) 296-7140, troy@ksdot.org.
(See Appendix C for Kansas DOT's route classifications.)

1. **Service level classifications:** Category I Routes: Multilane highways and two-lane highways with AADT over 3,000; Category II Routes: Two-lane highways with AADT 1,000 to 3,000; Category III Routes: Two-lane highways with AADT near or under 1,000.
2. **Performance measures:** We currently have no performance measures employed at this time.

3. **How are routes monitored?** We utilize field personnel to monitor road conditions and enter LOS data into a Road Condition Reporting System (RCRS). At the end of the season we go back and get winter index information from the National Weather Service combined with the LOS data entered in the field. From this information we can see if the effort expended during the winter matched the severity of the winter.
4. **Time devoted to monitoring?** LOS on routes is monitored during each event. The data on LOS is not compiled until the end of the season. It is difficult to get the winter index information and RCRS information compiled in a timely manner.

Maine

Contact: Brian Burne, Highway Maintenance Engineer, (207) 624-3571, Brian.Burne@maine.gov.
(See Appendix D for Maine DOT's corridor priorities and levels of service. These documents are older versions of Maine DOT's policies. Documents that include the urban Interstate level are in the process of being modified.)

1. **Service level classifications:**
   Priority 1+ = Urban Interstate over 20,000 winter ADT.
   Priority 1 = Other Interstate and major arterials.
   Priority 2 = Lower volume arterials and high-volume collectors.
   Priority 3 = All remaining collectors.
2. **Performance measures:** Time until bare pavement, primarily; however, cycle times, plow route length, equipment, target attainable traffic speeds, and salt allotments all differ by the priority level.
3. **How are routes monitored?** Not very technical—just observation by managers.
4. **Time devoted to monitoring?** Varies—at least a few hours per storm for probably a dozen people (between both the regions and HQ).

Maryland

Contact: Marc Lipnick, Quality Assurance Team Leader, Office of Maintenance, (410) 582-5566, mlipnick@sha.state.md.us.

1. **Service level classifications:** The Maryland State Highway Administration (SHA) has one service level for all roads—bare pavement. Bare pavement is defined as a dry or wet road, free of frozen precipitation. The level of service is the same whether the road is a metro-area Interstate or a rural two-lane highway.
2. **Performance measures:** SHA's performance measure is defined as bare pavement on all Interstate and primary roads within four hours of the ending of frozen precipitation. The performance measure does not address secondary roads, although their level of service is the same as primary and Interstate highways.
3. **How are routes monitored?** SHA routes are monitored for LOS at the maintenance shop level. Maintenance shop managers and snow route team leaders report conditions to data entry personnel at each shop. The data from all of the shops fighting a winter storm is compiled by SHA's Office of Maintenance (OOM), through SHA's Emergency Operations Reporting System (EORS).
4. **Time devoted to monitoring?** Maintenance shop managers and team leaders are continuously monitoring road and weather conditions throughout a winter storm. OOM will spend several hours after a storm has ended reviewing shop data. OOM will identify and resolve any data that appears to be out of range. It uses RWIS data to help in this validation process.

Massachusetts

Contact: Paul G. Brown, Director of Snow and Ice Operations, (617) 973-7792, Paul.Brown@state.ma.us.

1. **Service level classifications:** We have two at the present time. The Interstate highways receive the highest level, which is bare almost all the time; we have high-volume and high-speed Interstates. The second level is something less than that.
2. **Performance measures:** We use the amount of feedback from our customers as an indicator of how we are doing.
3. **How are routes monitored?** We are a state that has privatized our operations, so supervision is constant by MassHighway's personnel. We have managers as well as depot personnel on the roads throughout the whole storm event. Our people are out before, during and after.

4. **Time devoted to monitoring?** The whole time is spent monitoring, including myself, in the most congested areas and areas in which problems usually arise.

Note: *MassHighway is currently updating its Snow and Ice Policy; a copy of the revised document will be provided when completed.*

Michigan
Contact: Tim Croze, Pavement Maintenance Engineer, crozet@michigan.gov.
(See Appendix E for Michigan DOT's State Highway Winter Operations manual.)

1. **Service level classifications:** MDOT assigns winter operations LOS using the Corridors of Highest Significance outlined in Michigan's Long Range Transportation Plan 2005-2030. Within this plan all corridors are assigned to 1 of 5 categories based on the corridor's significance to the state of Michigan. MDOT uses the corridors that were determined to have International/National and Statewide significance as the basis for the winter maintenance LOS Priority #1 Orange Routes. The Regionally and Locally Significant Corridors are the basis for the Priority #2 Blue Routes.
2. **Performance measures:** Visual observations. [LOS Priority #1 Orange Routes: Pavement surface over its entire width generally bare of ice and snow; Priority #2 Blue Routes: Pavement surface generally bare of ice and snow wide enough for one-wheel track in each direction. MDOT's State Highway Winter Operations manual defines a "generally bare of ice and snow" pavement as a travel lane surface that is free from drifts, snow ridges, and as much ice and snow pack as practical.]
3. **How are routes monitored?** The garage supervisor is responsible for ensuring that the LOS is being met on all corridors within their area.
4. **Time devoted to monitoring?** Garage supervisors are expected to monitor road conditions during snow events and ensure the LOS criteria is being followed. The time involved is dependent on the storm duration and severity.

Minnesota
Contact: Steven J. (Rocky) Haider, Maintenance Business Planning Administrator, (651) 366-3557, steve.haider@dot.state.mn.us.
(See Appendix F for Minnesota DOT's Bare Lane training PowerPoint and a 2008-2009 end-of-season report. Maps denoting snow and ice data for the 2008-2009 season are provided as a separate attachment to this TSR.)

1. **Service level classifications:** Super Commuter, Urban Commuter, Rural Commuter, Primary and Secondary are determined by AADTs for each road segment.
2. **Performance measures:** Bare Lane is Mn/DOT's performance measure. The data for the Bare Lane is entered in a screen developed in our automated timesheet program to give us time and date storm started and ended, time and date we lost Bare Lane and when we regained, under definition, Bare Lane. Operators or designated entry personnel enter this data. The Bare Lane PowerPoint will explain further. A new measure, Frequency of Meeting Target, shows how many times we met expectations and were over expectations.
3. **How are routes monitored?** After every snow event our districts hold post-storm meetings to discuss material usage and regain times. We generate reports using our Work Management System (WMS) to compare regain times to material usage per lane mile for all plow routes.
4. **Time devoted to monitoring?** See above.

Missouri
Contact: Tim Jackson, Maintenance Liaison Engineer, (573) 526-1884, timothy.jackson@modot.mo.gov.
(See Appendix G for Missouri DOT's priority route classifications.)

1. **Service level classifications:** Clear, Partly Covered, Covered and Closed. [Route classifications: First Priority Routes (Continuous Treatment Routes): All major highways and those designated minor, urban and community routes. This also includes all designated incident bypass routes. Second Priority Routes: All other minor highways not included in the first priority routes.]
2. **Performance measures:** Priority one routes are to be returned to a clear condition as soon as possible after the end of the storm. Priority two routes are to be plowed open to two-way traffic and treated with salt and/or

abrasives on hills, curves, intersections and other areas as needed as soon as possible after the end of the storm. We measure the time, in hours, it takes to meet these objectives.
3. **How are routes monitored?** District maintenance personnel and supervisors monitor and report on the performance objectives.
4. **Time devoted to monitoring?** Unknown.

New Jersey (Township of Hamilton)

Contact: Richard M. Balgowan, Director of Public Works, (609) 890-3567, rbalgowan@hamiltonnj.com.
(See Appendix H for Hamilton's snow and ice control information.)

1. **Service level classifications:** We use two classifications for roads. They are Primary and Secondary.
2. **Performance measures:** We utilize both time (how long it took to complete spreading) and/or plowing and visual verification. For example, our performance measure for spreading all of our primary roads (one cycle) is 90 minutes. Visual verification is used to validate that we have achieved bare pavement and/or that any accumulating snow remains in a plowable condition.
3. **How are routes monitored?** We utilize a geographic information system for our winter operations, which allows us to both monitor our operations in real time and also evaluate how long it took to complete spreading and/or plowing of a specific route. We also utilize supervisor reports as visual verification that the quality of the job was satisfactory.
4. **Time devoted to monitoring?** We monitor our snow and ice control operations for the duration of the event.

New York

Contact: Michael H. Lashmet II, Snow and Ice Program Engineer, (518) 457-5796, mlashmet@dot.state.ny.us.
(See Appendix I for New York DOT's snow and ice control guidelines.)

1. **Service level classifications:** Regular Level of Service and Modified Level of Service (see pages 10 and 11 of Appendix I). [From page 10 of Appendix I: Regular Level of Service should be provided on all classes of highway between 4:00 AM and 10:00 PM Monday thru Friday, and at all times on highways having Average Daily Traffic ADT of 50,000 vehicles per day or more. Modified Level of Service should be provided on all classes of highway between 10:00 PM and 4:00 AM Monday thru Friday, and all day Saturday and Sunday, except for highways with an ADT of 50,000 vehicles per day.]
2. **Performance measures:** Goal is to have roadways cleared shoulder-to-shoulder within two hours of end of storm.
3. **How are routes monitored?** Patrols by highway maintenance supervisors and radio reports from plow operators.
4. **Time devoted to monitoring?** Patrols done as time permits. No set schedule to accomplish this.

North Dakota

(See Appendix J for an excerpt from North Dakota DOT's Statewide Snow and Ice Control Plan.)

Contact: Larry Gangl, District Engineer, (701) 227-6510, lgangl@nd.gov.

1. **Service level classifications:** We have six service levels: Urban Areas, Rural Interstate, Interregional, State Corridor, District Corridor, District Collector.
2. **Performance measures:** We use desired recovery time. For example, on urban areas the desired recovery time is 1 to 3 hours.
3. **How are routes monitored?** The routes are monitored by our supervisors; it is a visual assessment.
4. **Time devoted to monitoring?** There is no set time, but we monitor each storm event.

Contact: Brent Muscha, NDDOT Maintenance Division, (701) 328-1037, bjmuscha@nd.gov.

1. **Service level classifications:** See Appendix J.
2. **Performance measures:** NDDOT is in the process of implementing performance measures.
3. **How are routes monitored?** Routes are monitored by District management (eight districts in ND).
4. **Time devoted to monitoring?** Management is continually monitoring activities and conditions during an event. Depending on the severity of the event, this consumes most of their time.

Ontario, Canada
Contact: Mike Houle, Ministry of Transportation, Ontario, Canada, Mike.Houle@ontario.ca.
(See Appendix K for Ontario's levels of service, winter maintenance summary, and performance measures.)

1. **Service level classifications:** We have five service level classifications based on Average Winter Daily Traffic.
2. **Performance measures:** Many. For winter level of service we measure route circuit times and the time to bare pavement at the end of each winter event (Bare Pavement System). Attached are examples of performance measures in our maintenance contracts.
3. **How are routes monitored?** Field observations by our monitors; use of GPS-based technology through the Automated Vehicle Locator and electronic controllers in salt spreading equipment; contractor self-reporting.
4. **Time devoted to monitoring?** The Province of Ontario maintenance program is 100 percent outsourced to the private sector. We have 160 contract monitors that ensure contract compliance, including meeting LOS.

Washington
Contact: Jay Wells, Maintenance and Operations Superintendent, WellsJ@wsdot.wa.gov.
(See Appendix L for Washington State DOT's roadway treatment goals.)

Note: *The information below was taken from the document "Roadway Treatment Goals," provided by Washington State DOT.*

1. **Service level classifications:** 1, 2, 3, 4 and 5. Levels are differentiated by application of pretreatment, and types and amounts of chemicals applied.
2. **Performance measures:** Road condition ratings for the use of sand on the travel lane to enhance traction and chemical treatments on the travel lane to attempt to provide a bare pavement surface are assigned different point values that relate to LOS ratings of A to F. Roads that are closed periodically or for the duration of the winter season are not rated.
3. **How are routes monitored?** There are no specified days or times during which road conditions should be documented. Maintenance personnel document road conditions as they drive over previously treated roads in the course of their daily work. Observations are documented on the winter maintenance personal digital assistant application/database.

   A statewide data collection and mapping system reflects data captured from maintenance trucks' onboard sensors and components. Geographic information system mapping technology displays truck icons that show current equipment location, travel direction, and the function the truck is performing (i.e., chemical treatments, plowing, etc.) along with the current road conditions (icy, compact snow and ice, bare and wet, clear).
4. **Time devoted to monitoring?** Unknown.

Wisconsin
Contact: Mike Sproul, (608) 266-8680, michael.sproul@dot.wi.gov.
(See Appendix M for Wisconsin DOT's LOS guidelines.)

1. **Service level classifications:** See guideline 30.36 (Appendix M). [Category 1 = Major urban freeways and most highways with six lanes and greater; Category 2 = High volume four-lane highways (AADT >= 25,000) and some four-lane highways (AADT < 25,000), and some 6-lane highways; Category 3 = All other four-lane highways (AADT < 25,000); Category 4 = Most high volume two-lane highways (AADT >= 5,000) and some 2-lanes (AADT < 5,000); Category 5 = All other two-lane highways.]
2. **Performance measures:** We have no performance measures for this purpose.
3. **How are routes monitored?** They are not monitored.
4. **Time devoted to monitoring?** N/A

Wyoming
Contact: Ken Shultz, State Maintenance Engineer, (307) 777-4458, ken.shultz@dot.state.wy.us.
(See Appendix N for Wyoming DOT's LOS guidelines.)

1. **Service level classifications:** See Appendix N (excerpts from Chapter 14 of WYDOT's Maintenance Manual). [Level I (A and B); Level II; Level III (A and B); Level IV.]

2. **Performance measures:** See Appendix N. From Chapter 14 of WYDOT's Maintenance Manual:
   - Level IA: Bare roadway surface free from drift, snow ridges, and have as much ice and snow pack removed as practical so that it can be traveled safely at reasonable speeds.
   - Level IB: Minimum service necessary that allows traffic to move safely at a restricted rate. Plowing methods and frequency should be sufficient to minimize any snow ridges and dangerous drifting.
   - Level II and Level IIIA: Provide service up to 16 hours a day for traffic observing reasonable winter driving precautions and speeds.
   - Level IIIB: Provide minimum service as resources become available.
   - Level IV: Seasonally closed roads.
3. **How are routes monitored?** There is no formal monitoring done to determine if the guidelines are met. We currently measure outputs only in this case.
4. **Time devoted to monitoring?** Very little time is devoted to formal monitoring activities related to these performance measures.

INDIANA DEPARTMENT OF TRANSPORTATION

Driving Indiana's Economic Growth

100 North Senate Avenue
Room N901
Indianapolis, Indiana 46204-2216 (317) 232-5488 FAX: (317)232-5551

Mitchell E. Daniels, Jr., Governor
Karl B. Browning, Commissioner

DATE: December 12, 2008

MEMORANDUM:

TO: District Deputy Commissioners
District Highway Maintenance Directors

OPERATIONS
MEMORANDUM NO. 08-01
Maintenance

FROM: James Poturalski, Deputy Commissioner
Highway Management

Michael B. Cline, Deputy Commissioner
District Operations & Traffic Management

SNOW AND ICE CONTROL

Department Objective:

The Indiana Department of Transportation (INDOT) will utilize available resources to keep all INDOT roads and bridges open and passable during winter storm events.

Three classifications of INDOT roads are identified to prioritize allocation of INDOT resources and to outline INDOT's snow and ice control service objectives.

Classifications

The three classes of INDOT roadways are identified as follows:

CLASS I

Interstate routes and roadways with Average Daily Traffic (ADT) volumes over 10,000 vehicles per day, as well as other high priority roadways, including but not limited to those serving hospital facilities and other emergency service providers.

CLASS II

Routes with traffic volumes between 5,000 and 10,000 ADT.

CLASS III

Routes with traffic volumes of less than 5,000 ADT.

Service Objectives

The following snow and ice control service objectives are identified for each of the three roadway classifications:

CLASS I

INDOT shall provide service to mainline pavements, ramps, and turn lanes to remove snow and ice from pavement surfaces by plowing and chemical applications to achieve bare pavement conditions. Once bare pavement conditions are achieved, minimal plowing of shoulders should commence. All other cleanup will be deferred to normal working hours. Class I routes should be serviced approximately every 2 hours.

CLASS II

INDOT shall provide service to mainline pavements, ramps, and turn lanes to remove snow and ice from pavement surfaces by plowing and chemical applications to achieve bare pavement conditions. All other cleanup will be deferred to normal working hours. Class II routes should be serviced approximately every 2.5 hours.

CLASS III

INDOT shall provide service to remove snow and ice from mainline pavements to provide partial bare pavement. Final cleanup will generally be deferred to normal working hours. Class III routes should be serviced approximately every 3 hours.

GENERAL NOTES

Winter Storm Event cleanup activities begin after the storm ends and after the identified service objectives have been achieved. Normally, cleanup activities should be performed during normal working hours; however, under some circumstances, such as when another winter storm is approaching or sudden drop in temperature is anticipated, cleanup activities may occur during overtime hours.

Cleanup activities include plowing and spot use of materials to remove snow and ice from the driving surface. This work also includes plowing back shoulders, crossovers and approaches, cleaning and opening of frozen drains, and equipment cleanup.

It is impractical to develop specific rules for every winter storm event situation due to the numerous variables involved in winter storms. The judgment of the District Highway Maintenance Director, Sub-District Managers,

and the Unit Foremen will govern the type, quantities and application schedules used for INDOT's snow and ice control services.

It is the intent of INDOT to use the appropriate amount of deicing and anti-icing chemicals needed to maintain and/or restore bare pavement conditions before, during and after winter storm events.

For the purposes of this document, bare pavement is defined as a condition under which the roadway's driving surface is cleared of loose snow and ice. The driving surface may have isolated patches of snow, ice, or slush.

For the purposes of this document, partial bare pavement is defined as a condition under which the roadway's driving surface is partially cleared of loose snow and ice. The driving surface may have some bare pavement, but the bare pavement may be limited to that portion of the pavement in the vehicular wheel paths.

I N S T R U C T I O N A L M E M O R A N D U M

IOWA DEPARTMENT OF TRANSPORTATION
HIGHWAY DIVISION
OFFICE OF MAINTENANCE

CHAPTER: SNOW AND ICE CONTROL	**NO:** 8.100
TITLE: SNOW AND ICE REMOVAL OPERATIONS	
APPROVED:	**ORIGINATION DATE:** October 15, 1984
	REVISION DATE: September 18, 2006

I. Purpose:

To provide guidance to field personnel with regard to establishing criteria and priorities for snow and ice removal operations.

II. Definitions:

A. Reasonably Near Normal Surface - A pavement surface that is sufficiently free of snow, ice, frost or slush to permit maintaining reasonable vehicle control when the vehicle is operated within the framework of existing laws and regulations. Some isolated spots or strips of packed snow or ice may be present.
B. Service Level - The maintenance classification given to a section of highway as identified on the current Office of Maintenance Service Level Map and as amended by agreement with counties.
C. Anti-Icing- Operations when overtime is authorized.
D. Phase 1 - Operations when overtime is authorized.
E. Phase 2 - Operations that are normally conducted during regular working hours.

III. References:

A. Iowa DOT Standards for Maintenance Activities (Functions 675, 676, 677, 678, 679, 680, 681 and 682)
B. Iowa DOT Policies and Procedures Manual (PPM) 610.02, 610.13, 610.17, 800.02, and 800.04

IV. General Guidelines:

A. Snow and Ice Control operations should be performed as set out in the Iowa DOT Standards for Maintenance Activities and as set out in agreements negotiated with counties and cities.
B. Crew shifts including supervisors should be limited to a maximum of 12 continuous hours of work, except that employees may work 16 hours on their first shift going into a storm that has been forecast to be of lengthy duration.

C. When the Iowa DOT's Weather Advisory Service forecasts a prolonged storm moving into the area, consideration should be given to splitting crew shifts. The Highway Maintenance Supervisor (HMS) will determine whether or not to split shifts and will inform the District Maintenance Manager (DMM) if requested. If it is decided to use split shifts, part of the crew may be sent home to rest, with the anticipation that they will be called back to work later.

D. During clean-up operations, the Department is not required to load or haul snow from primary road extensions, but may do so if considered necessary by the DMM to maintain traffic flow. Some loading or hauling of snow may be necessary at bridges, interchanges or other locations where snow storage capacity is limited.

V. Procedures:

A. Snow and Ice Removal Operations

1. To make the most effective use of resources available, a system of service levels has been established. It is the objective to conduct operations on Service Level A, B, and C highways capable of achieving the following, whenever practical. The general priorities for the various operations are as follows:

Priority No.	Phase	Description of Work
1.	1	Begin treatment of frost and ice on bridge decks within 3 hours after the Department has actual notice of the condition. Response should be based on the service level assigned to each segment of the highway system.
2.	1	Begin treatment of frost on roadways and freezing rain within 3 hours after the Department has actual notice of the condition. This work is to be scheduled on the basis of the service level priorities assigned to each segment of the highway system.
3.	1	Begin treatment or plow isolated frost, ice, and snow on pavement surfaces within 3 hours after the Department has actual notice of the condition. The work is to be scheduled on the basis of the service level priorities assigned to each segment of the highway system.
4.	1	Clear blockages and lane restrictions on the basis of the Service Level priorities assigned to each segment of the highway system.
5.	1	On Service Level A-B highways. Ramps, main drives through rest areas, and paved, public used crossovers with turn lanes, achieve a reasonably near normal surface condition within 24 hours after a storm ends.

6.	1	On Service Level C highways, achieve a reasonably bare inside wheel path within 24 hours after a storm ends.
7.	1	Remove snow from the traffic side of extended or continuous traffic barriers and from attenuators in gore areas to expose the barriers during regular working hours. Overtime for this work may be approved by the HMS.
8.	2	Remove snow from driveways and parking areas of weigh stations and rest areas. Overtime for this work may be approved by the HMS. No sand or salt is to be used on driveways and ramps within 40 feet of the scale platform.
9.	2	On Service Level C highways, achieve a reasonably near normal surface condition within three working days after Phase I operations are completed.
10.	2	On Service Level A-B highways, plow shoulders as necessary during regular working hours within three working days after a reasonably near normal surface condition is attained on these highways.
11.	2	On Service Level C highways, plow shoulders as necessary during regular working hours as time permits.
12.	2	Remove snow from curbs and gutters of bridges and from the traffic side of traffic barriers and attenuators at spot locations during regular working hours as time permits.
13.	2	Remove snow from raised medians and islands as necessary to delineate traffic lanes during regular working hours as time permits.

B. Snow and Ice Removal Operations on State Highways maintained by others.
   1. On State highways maintained by others, all snow and ice removal operations will be performed to the level of service as determined by the Department or the entity performing the maintenance.

C. Operational Limitations
   1. Snow and ice removal operations may be suspended during periods of extremely poor visibility with notification to District Maintenance Managers and law enforcement as provided in DOT PPM 800.02.
   2. When limited benefits are expected from continued snow ice operations the HMS may elect to suspend operations until weather conditions improve and resources can be better utilized. Notification will be made to District Maintenance Managers and law enforcement as provided in DOT PPM 800.02.
   3. Weather conditions following storms, drifting, blockages, lane restrictions, lack of resources, or abnormal conditions may preclude achieving the objectives outlined above.

4. Phase 2 operations may require special procedures such as transferring snow from one side of a roadway to the other or using rotary snow plows to widen out heavily drifted areas. The affected areas should be returned to the appropriate service level condition as soon as practical after the operation has been completed.

7.11 - POLICY

The Highway System is divided into three classifications for snow and ice control as shown on the ***"Kansas Snow and Ice Control Classifications"*** maps (see Figures 7-1, 7-2, and 7-3) with some adjustment for route continuity. Classifications are:

Class I Routes – Multi-lane highways and two-lane highways with traffic volumes over 3000 Annual Average Daily Traffic (AADT).
Class II Routes – Two-lane highways with traffic volumes from 1,000 to 3,000 AADT.
Class III Routes – Two-lane highways with traffic volumes near or under 1,000 AADT.

The category descriptions, level of service and priorities for each classification are outlined in the following "Snow and Ice Control Policy/Level of Service Chart".

SNOW AND ICE CONTROL – POLICY/LEVEL OF SERVICE

CLASSIFICATION	LEVEL OF SERVICE	PRIORITIES
Category I Routes		
Multi-lane highways and two-lane highways with traffic volumes over 3,000 Annual Average Daily Traffic (AADT).	All through lanes on divided roadways and both lanes on two-lane roads will have bare/ wet wheel paths with intermittent bare pavement.	1. Aid for emergency vehicles responding to calls (if requested) 2. Interstate 3. Urban Commuter 4. Rural Commuter 5. Freeways and Expressways 6. Higher AADT highways, or as storm conditions dictate
Category II Routes		
Two-lane highways with traffic volumes from 1,000 to 3,000 AADT.	Both lanes on two-lane roads will have intermittent bare/wet wheel paths.	1. Aid for emergency vehicles responding to calls (if requested) 2. Known problem areas (hills, curves, bridges, stop signs, etc.) 3. Higher AADT highways, or as storm conditions dictate
Category III Routes		
Two-lane highways with traffic volumes near or under 1,000 AADT.	One wheel path in each lane on two-lane roads will have intermittent bare/wet wheel paths.	1. Aid for emergency vehicles responding to calls (if requested) 2. Known problem areas (hills, curves, bridges, stop signs, etc.) 3. Higher AADT highways, or as storm conditions dictate

Activities should, where possible, be directed to anticipate storm impacts and proactively maintain the indicated level of service.

Communication should be encouraged between Subarea Supervisors and Area Superintendents of adjoining facilities, especially across area and district boundaries, to promote cooperation and provide assistance, when needed.

Ramps, widenings and interchanges shall have the same level of service as the accompanying traveled way.

Once the level of service for a given route has been achieved and is likely to sustain itself, equipment and resources may be reduced or reassigned to assist on other routes.

Clean-up operations should usually be performed during regular working hours. During clean up, snow will be removed from shoulders, gores and in front of longitudinal barriers (bridge hubguard, guard fence, concrete safety barriers, attenuators, bridge walkways).

Clearing storage space for later snowfall or to keep drifting snow off the roadway should be done during regular business hours, unless more immediate action is needed for the level of service.

KDOT will not be responsible for removing (from entrances) windrowed snow, which may result from winter operations. However, a reasonable effort should be made to not block driveways and side roads.

B. Route length and cycle times should reflect the priorities of the following table:

ROADWAY CLASSIFICATION	**CYCLES PER SHIFT**	**ROUTE LENGTH (lane miles/truck)**
Category I Routes	4	30 – 34**
Category II	3	50 – 60**
Category III Routes	2	76 – 90**

**Each truck is responsible for a route or section of highway at an approximate average speed of 12 – 18 mph.

MAINE DEPARTMENT OF TRANSPORTATION
6-28-2006
Maintenance & Operations Corridor Priorities

Introduction:

Due to the variable nature of the weather events that necessitate emergency crew response and the fact that budgets and resources are limited; the Department has defined priority levels for all of the state and state-aid corridors. These priorities identify the order in which the highway corridors will receive attention when choices must be made and will also help to define the level of maintenance each priority level will receive under various activities.

Priority Levels:

Priority I

Priority I corridors consist of the interstate system and other specifically designated state highway corridors that serve as critical connectors between the state's larger urban areas. This priority level will include most of the National Highway System (NHS) and other arterial corridors that carry the majority of the state's traffic.

Priority II

Priority II corridors are comprised of those state highway corridors that are a part of the NHS or the remaining arterial system, but are not classified as Priority I corridors. This priority level will also include those state highway or state-aid corridors that serve as the critical connectors, commerce routes, or higher-volume commuter routes.

Priority III

Priority III corridors include all other state highways not listed as Priority I or Priority II roads and are generally characterized by the lower-volume state highways. This priority level will also include the majority of the state-aid corridors. This priority level is dominated by those corridors classified as minor or major collectors.

Priority IV

Priority IV corridors include all other state-aid corridors that are not classified as Priority I, Priority II, or Priority III corridors. These corridors are comprised of the lowest volume state-aid corridors and will normally carry an average annual daily traffic volume (AADT) of around 1000 or less.

Corridor maps, color-coded for each or the priorities described above, have been prepared and are available.

MAINE DEPARTMENT OF TRANSPORTATION
10-1-2007
SNOW AND ICE CONTROL POLICY

I. PURPOSE

The purpose of this policy is to define the operational procedures for snow and ice control. It defines the levels of service that the Bureau of Maintenance and Operations will strive to provide in order to achieve the safest roadway conditions that are reasonably possible with the available resources. Since storms vary dramatically and occur over a variety of roadway and traffic conditions, this plan is intended to be flexible to accommodate the variety of conditions that are encountered. It is a guide structured to fit average conditions.

II. LEVEL OF SERVICE

General

Snow and ice control operations are limited by the resources available for winter maintenance operations (specifically: budget, personnel, equipment and materials). Due to these limited resources, the level of service for snow and ice control is associated with the corridor priorities that have been established by the Bureau of Maintenance and Operations. For each level of service, target route lengths will dictate the normal cycle times that can be expected based upon average conditions and local geographic and/or geometric factors will dictate whether particular routes need to be longer or shorter than average. In addition, during a winter storm event, there will typically be reduced levels of service for all routes between the hours of 10:00 P.M. and 4:00 A.M, depending upon specific storm conditions.

Priority I Corridors

Snow will be plowed and salt (in addition to other chemicals as conditions require) will normally be used as needed during the storm to maintain a brine layer on the pavement surface to prevent snow and ice from bonding to the road. Following a winter event, bare travel lanes shall be provided as soon as practicable and on these roads before all others. In most cases, this will occur within six (6) daylight hours. The suggested maximum travel speed during the storm for the Interstate system is 45 M.P.H. The suggested maximum travel speed during the storm for all other Priority I roads is 40 M.P.H. During a winter storm event, average cycle times for the plows will be between 1 to 1½ hours. Between the hours of 10:00 P.M. and 4:00 A.M, these cycle times may double, depending upon the type of storm. The average plow route length for this class of road is approximately 10 centerline miles.

Priority II Corridors

Snow will be plowed and salt (in addition to other chemicals as conditions require) will normally be used as needed during the storm to maintain a brine layer on the pavement surface to prevent snow and ice from bonding to the road. Following a winter event, bare travel lanes shall be provided as soon as practicable and on these roads after the Priority I roads. In most cases, this will occur within eight (8) daylight hours. The suggested maximum travel speed during the storm for Priority II roads is 35 to 40 M.P.H. During a winter storm event, average cycle times for the plows will be between 1½ to 2 hours. Between the hours of 10:00 P.M. and 4:00 A.M, average cycle times for the plows may

double, depending upon the type of storm. The average plow route length for this class of road is approximately 12 centerline miles.

Priority III Corridors

Snow will be plowed and salt will be used as needed during the storm to keep the roads open to traffic and provide a good surface on which to operate. After the storm, one-third bare pavement, in the middle of the road, will be provided as soon as practical. Bare travel lanes shall be provided as soon as practicable on these roads and after the Priority I and Priority II roads. In most cases, this will occur within twenty-four (24) hours. The suggested maximum travel speed during the storm for Priority III roads is 35 M.P.H. During a winter storm event, average cycle times for the plows will be between 1½ to 2 hours. Between the hours of 10:00 P.M. and 4:00 A.M, average cycle times for the plows may double or triple, depending upon the type of storm. The average plow route length for this class of road is approximately 14 centerline miles.

Priority III Corridors, Sand Routes

Priority III Corridors, Sand Routes, are those priority III corridors that will have a deicing strategy used for snow and ice control due to very low traffic volumes, poor pavement condition, low average temperatures or gravel surfaces.

Snow will be plowed and winter sand will be applied as necessary to provide an acceptable surface upon which to operate. The road surface may be snow covered during and following the storm. After the storm, one-third bare pavement, in the middle of the road, will be provided as soon as practical. The suggested maximum travel speed during the storm for Priority III, Sand Routes, is 30 M.P.H. During a winter storm event, cycle times will be similar to other Priority III roads. The average plow route length for this class of road is approximately 14 centerline miles.

III. MATERIALS

The following materials are those that are primarily used by the MaineDOT for snow and ice control on State Highways throughout Maine. This section describes the general purpose of each material and the typical use that is expected under normal conditions. Choice of materials will depend on experienced consideration of the following variables (listed in priority order): pavement temperature, nature of the particular snow and ice event, air temperature and wind velocity, traffic volume, time of day/year, and the availability of resources.

1) **Salt (NaCl) –** Unless otherwise designated for specific routes, salt (whether rock salt or solar salt) is the primary material used on the majority of roads maintained by the MaineDOT. The purpose of the salt is to prevent the bonding of snow and ice onto the pavement surface. Unless salt is pre-wetted with chemicals (other than salt brine), the effective working pavement temperature is generally taken to be around 15 degrees F or greater.
2) **Winter Sand** – Winter sand shall consist of coarse, clean, sharp sand or other granular material that passes through a square meshed ½ inch screen and is mixed with salt at a rate of 80 to 100 pounds per cubic yard. Winter sand is to be used for the purpose of providing temporary traction for specific locations such as hills, curves, intersections or crash scenes when salt will not work fast enough. If a

specific route is designated a “Sand Route”, winter sand, as opposed to salt, shall be the primary material used to treat the highway surface.

3) **Salt Brine** – Salt brine is a 23% solution of salt in water that is used to either “pre-wet” solid materials that are applied from the plow trucks or to “pre-treat” the highways in advance of a storm event. Unless salt brine is mixed with additives, the effective working temperature is the same as salt in its solid form – approximately 15 degrees F or greater.
4) **Liquid Calcium Chloride (CaCl) / Liquid Magnesium Chloride (MgCl)** – Liquid calcium and magnesium chlorides are used to pre-wet the solid materials that are applied by the plow trucks to lower the effective working temperature of salt and to help keep the solid materials on the road during the application process.

IV. MATERIAL APPLICATION PROCEDURES

Solid Materials

Salt (NaCl, Sodium Chloride)
Salt shall normally be applied to the lane being plowed in a narrow strip along the wheel path closest to the centerline of the normal section of highway and as high as possible on banked curves. The rate of application shall normally be selected from the attached “Salt Application Rates” chart and will be based upon the pavement temperature; snow-ice conditions encountered, and anticipated trends. Initial applications should normally be 25% higher than the average rate indicated by the chart. Generally, salt will be used when the pavement temperatures are 15 degrees F or higher. When pavement temperatures are less than 15 degrees F and not rising, sand will be used when necessary. During cold storms, when the pavements are dry and the snow is blowing off the travel lanes, the application of salt or sand is to be avoided for as long as possible since it will hasten the formation of ice on the pavement. When ice does begin to form under these conditions, considerable judgment will be required on whether to use salt that is heavily pre-wetted with either liquid magnesium chloride ($MgCl_2$) or calcium chloride ($CaCl_2$), or sand.

Abrasives (Winter Sand)
Abrasives should generally be used where low traffic volume and/or low pavement temperature will not allow salt to work properly. Abrasives should be applied at a rate of from 600 pounds [272 kg] per lane mile to 900 pounds [408 kg] per lane mile. Rates at or near the high end of the range may be used on hills, curves and intersections. Rates at or near the low end of the range may be used on straight sections. Abrasives should be spread within the limits of the pavement as near to 2/3 of the full pavement width as possible. Depending on road surface conditions, highway geometry, traffic and local policy, spreading speeds should be in the range of about 10 to 20 MPH. Abrasives are to be prewetted similar to salt if the proper equipment is available.

Liquid Materials

Pre-treating

For corridors designated for salt brine pre-treating (normally the interstate system and other Priority 1 roads), an application rate of 40 or 50 gallons per lane mile shall be used when pavement temperatures *during the storm* are anticipated to be 20 degrees F or greater. Application shall occur on designated routes 6 to 8 hours prior to the projected start of the storm, however, up to 12 hours may be permissible based on timing of the storm and cost considerations. When pavement temperatures are difficult to reasonably predict and a cold storm may result (a storm with pavement temperatures of less than 20 degrees F), pre-treating should not be done as it will create more difficult conditions and greater expense. Pre-treating may also be used to spot treat bridge decks and other problem areas located on any priority corridor whenever weather forecasts indicate the possibility of glazing.

Pre-wetting

Pre-wetting is the application of liquids onto solid materials as they are spread onto the road by the plow trucks. The normal liquid application rate shall be 10 gallons per ton (5% liquids). In general, if salt brine and liquid $MgCl_2$ or $CaCl_2$ are both available, the salt brine shall normally be used when the pavement temperatures are above 20 degrees F and the liquid $MgCl_2$ or $CaCl_2$ shall be used when below. If a crew only has the facilities for a single liquid chloride product, it should be the liquid $MgCl_2$, $CaCl_2$ or other similar chloride product that will lower the effective working temperature. If liquid $MgCl_2$ or $CaCl_2$ are the only products available, pre-wetting at temperatures above 20 degrees F is discretionary, based upon whether or not the storm is providing enough moisture on the road surface to minimize wasting solid materials through bounce and scatter.

V. OFF-HOUR PATROLS

Night Patrol

Night Patrol is used in the more remote portions of the state where hazardous road conditions may otherwise go unnoticed for several hours due to problem areas and micro-climates. The night patrol hours are typically from 10:00 PM until 6:00 AM the following morning, seven days a week. The Region management may call out the patrol earlier if a storm is imminent.

The schedules of work for the night patrol and necessary swing persons will be so arranged as to provide sufficient coverage and to insure a total of at least 40 hours per Night Patroller. All individuals assigned to night patrol duty in the field shall carry a Truck Driver classification.

Each night patrol is assigned a definite set of highways to cover and the Night Patroller is to establish communication from this area with the night radio operators. The radio operators are to keep the Night Patroller posted of any issues in the Night Patroller's area. Short icy sections can be handled from either the night patrol vehicle or with one of the trucks located at the maintenance lot. Patrollers should be supplied with the same general information as to locations of personnel and telephone numbers as the night radio operators.

Night patrol trucks should be equipped with the following items:

1 Flashlight
1 Ax
2 Shovels
1 Tow Chain
1 Can of Gasoline
1 Blanket
4 Torches
1 Part of a load of sand
1 First-Aid Kit (12 Unit)

On nights when road conditions warrant calling out crews, the crews shall be called out on a limited basis when they are needed. In the event of a general storm, the highway crew supervisor or crew leader shall be notified through the radio operator.
The Night Patroller will report road and weather conditions hourly to the night radio operator. The Night Patroller shall keep the Highway Crew Supervisors informed as to who was called out and for how long.

Storm Patrol

Storm Patrol is used in more populated areas with more predictable weather patterns. When a winter storm or other inclimate weather is forecast, a designated crew member may be assigned a specific patrol area for the evening(s) affected. During the period of this assigned patrol, the Storm Patroller's role becomes the same as that of a Night Patroller.

Early Morning Shift

Early Morning Shift is used to assure that the higher-volume, higher-speed, Priority I corridors are ready for the start of the morning commute throughout the winter months. The standard Early Morning Shift hours that are to be utilized are Monday through Friday, eight hours per day, beginning at 3:30 AM. Although Early Morning Shift is intended for the high volume, higher speed Priority I corridors, a Region Manager may designate specific, isolated exceptions to implement an early morning shift to cover any other areas with unique weather patterns.

On average, each Early Morning Shift Patroller should cover approximately 20 median miles of interstate (40 centerline miles of highway) when the AADT of the corridor involved is approximately 15,000 or more. If the corridor is a specially designated exception or the AADT is between approximately 10,000 and 15,000, the Region Manager may use discretion to assign larger coverage areas per patroller based upon specific crew and travel considerations. If the AADT is less than 10,000, an early morning shift is not normally required.

The Early Morning Shift is staffed by crew personnel from the Truck Driver or Equipment Operator classification for each designated coverage area. The Early Morning Shift Patrollers are assigned a specific patrol route that is to be followed every morning. If an active Night Patrol can be assigned to cover an Early Morning Shift area from 3:30 a.m., then that area is considered covered in accordance with this policy.

Early Morning Shift patrols shall address immediate hazards that may exist (such as icy patches, debris, etc…) as they are identified. Other less immediate issues (pot holes, roadkill, damaged signs, etc…) are to be noted and reported to the Crew Supervisor at the start of the regular crews working hours. During the Early Morning Shift, the patroller's role becomes the same as that of a Night Patroller until their patrol area is covered. If the entire area is confirmed ready for the commute and weather conditions do not indicate the potential for poor conditions to develop, the Early Morning Shift Patroller shall return to the maintenance facility to address specific tasks previously assigned by the Crew Supervisor.

VI. EQUIPMENT

Washing Equipment

Snow and ice control equipment are to be thoroughly washed as soon after use as practicable. Particular attention is to be paid to the areas of equipment in contact with sand, salt and liquid chlorides. With heated power washers, truck washing will normally be accomplished outdoors in designated areas.

Overnight Loads

In general, trucks shall not be left loaded overnight since it subjects the equipment to unnecessary wear. However, in the event that a winter storm is forecast at some point during the approaching night, a crew may load a portion of their trucks to enable a quicker response to the storm. Such loading shall be in compliance with the following:

- Load size shall not exceed a level-load of salt or a half-load of sand.
- If the storm does not occur, the truck(s) loaded in advance shall be unloaded and washed out the following day.
- Loading shall only occur just prior to the night of the forecast storm (i.e. it is not appropriate to load on a Friday for a storm that is forecast for Saturday night or Sunday).
- Loading under this exception is not intended to allow all trucks at a camp to be loaded in advance.

Plow Blade Policy

Sweepers (front plows):

A single layer of carbide blades in all cases

Wings:

One of the following configurations may be used:

Two layers of steel (gravel shoulders)
One layer of carbides (paved shoulders)
One layer of used carbides faced with one layer of steel (paved or gravel)

Additional Notes:

- There shall never be three or more <u>full</u> layers of blades on any plow.
- If any plow has a section that wears faster than the rest, <u>a single used carbide section</u> may be placed on top of any of the above blade configurations <u>in the location of highest wear</u> to try to equalize the total wear on the plow blades.
- New trucks coming out of Fleet will be provided with a single set of carbides on all plows and wings.

Maine DOT Salt Application Treatment Recommendations (2007)

PAVEMENT TEMPERATURE RANGE, AND TREND	INITIAL OPERATION				SUBSEQUENT OPERATIONS			COMMENTS
	pavement surface at time of initial operation	maintenance action	Chemical Application		maintenance action	Chemical Application		
			liquid Pre-Wet Gals/Ton	Rock Salt Lbs/lm		liquid Pre-Wet Gals/Ton	Rock Salt Lbs/lm	
Above 32°F, steady or rising	Wet, slush, or light snow cover	Plow as needed and monitor pavement temps.	Salt Brine 10 gals/ton	0-150	Plow as needed and monitor pavement temps	Salt Brine 10 gals/ton	0-150	1) Monitor pavement temperature closely for drops toward (32°F) and below 2) Treat icy patches if needed with Rock Salt at (150 lb/lane-mi); plow if needed
28-32 °F	Wet, slush, or light snow cover	Plow as needed; reapply solid pre- wetted chemical when needed	Salt Brine 10 gals/ton	150-250	Plow as needed; reapply solid pre- wetted chemical when needed	Salt Brine 10 gals/ton	100-200	1) Applications will need to be more frequent at lower temperatures and higher snowfall rates
20 to 28°F	Wet, slush, or light snow cover	Plow as needed; reapply solid pre- wetted chemical when needed	Salt Brine, $MgCl_2$ $CaCl_2$ 10 gals/ton	250-350	Plow as needed; reapply solid pre- wetted chemical when needed	Salt Brine, $MgCl_2$ $CaCl_2$ 10 gals/ton	200-300	1) Applications will need to be more frequent at lower temperatures and higher snowfall rates
15 to 20°F	wet, slush, or light snow cover	Plow as needed; reapply solid pre- wetted chemical when needed	$MgCl_2$ $CaCl_2$ 10 gals/ton	350-450	Plow as needed; reapply prewetted solid chemical when needed	$MgCl_2$ $CaCl_2$ 10 gals/ton	300-400	1) Applications will need to be more frequent at lower temperatures and higher snowfall rates
Below 15°F steady or falling	Dry or light snow cover	Plow as needed			Plow as needed			1) It is not recommended that chemicals be applied in this temperature range 2) Abrasives can be applied to enhance traction 3) On higher speed corridors, if glazing occurs and sand will not stay in travel lanes, higher applications of rock salt may need to be applied with consent from Region Management.

NOTES:

CHEMICAL APPLICATIONS. (1) If snow is blowing off the roadway and glazing or pack is not occurring, do not apply materials. (2) Time initial and subsequent chemical applications to *prevent* deteriorating conditions or development of packed and bonded snow. (3) Apply chemical ahead of traffic rush periods occurring during storm. (4) Higher volume corridors will often require an additional 50 lbs per lane mile above recommended amounts. (5) Snowfall greater than 1" per hour will often require an additional 50 lbs per lane mile above recommended amounts.

PLOWING. If needed, *plow before chemical applications* so that excess snow, slush, or ice is removed and pavement is wet, slushy, or lightly snow covered when treated.

TEMPERATURE TRENDS: If temperature trend is rising, use lower end of application range and conversely, if temperature trend is dropping use higher end of application range.

PRE-WETTING: If salt brine is not available, liquid calcium or magnesium chloride may be used if bounce and scatter will be a problem, (i.e. conditions not wet enough)

FROST AND BLACK ICE: If frost or black ice is forecast and pavement temps will be above 20 degrees F, pre-treat with salt brine at 50 -60 gals per lane mile on designated corridors. Areas not designated for pre-treatment should apply as necessary at a rate of 150-250 lbs per lane mile.

FREEZING RAIN/SLEET: Freezing rain and sleet will dilute treatments sooner and may require more frequent re-application.

Lane Mile Application Rates and Corresponding Miles Treated

	Application Rate/Lane Mile											
	75	100	125	150	175	200	225	250	275	300	350	400
# of Tons	LANE MILES YOU CAN TREAT											
1	26.6	20.0	16.0	13.4	11.4	10.0	8.8	8.0	7.2	6.6	5.8	5.0
2	53.4	40.0	32.0	26.6	22.8	20.0	17.8	16.0	14.6	13.4	11.4	10.0
3	80.0	60.0	48.0	40.0	34.2	30.0	26.6	24.0	21.8	20.0	17.2	15.0
4	106.6	80.0	64.0	53.4	45.8	40.0	35.6	32.0	29.0	26.6	22.8	20.0
5	133.4	100.0	80.0	66.6	57.2	50.0	44.4	40.0	36.4	33.4	28.6	25.0
6	160.0	120.0	96.0	80.0	68.6	60.0	53.4	48.0	43.6	40.0	34.2	30.0
7	186.6	140.0	112.0	93.4	80.0	70.0	62.2	56.0	51.0	46.6	40.0	35.0
8	213.4	160.0	128.0	106.6	91.4	80.0	71.2	64.0	58.2	53.4	45.8	40.0
9	240.0	180.0	144.0	120.0	102.8	90.0	80.0	72.0	65.4	60.0	51.4	45.0
10	266.6	200.0	160.0	133.4	114.2	100.0	88.8	80.0	72.8	66.6	57.2	50.0

ATTACHMENT A

WINTER HIGHWAY MAINTENANCE PROCEDURES

CREWS

Crews working on anti-icing routes are expected to be able to apply salt just prior to (salt brine pre-treating) or near the start of a storm in order to prevent the bond of snow or ice with the pavement. This will frequently require calling out a crew well before precipitation begins to have the crew ready.

Crew Supervisors are to be called out 60 to 90 minutes prior to when a storm is expected to begin. The decision to call out the crew shall be based on the latest information to be gained from adjacent regions and crews, night patrol, and evaluation of reports from weather services, other agencies and the general public and will be made by the Crew Supervisor.

During weekends, holidays, and other than regular working hours during weekdays, only sufficient personnel and equipment shall be used to comply with the Snow and Ice Control Policy.

Call outs for routes not using an anti-icing strategy shall be deferred until the start of the storm.

During off hours, the decision to call out crews or to discontinue snow and ice control operations will be based on providing winter driving conditions as described in the Snow and Ice Control Policy. Only the most essential work required to maintain the highways in accordance with the Snow and Ice Control Policy shall be done.

Length of Continuous Duty

Snow and ice control operations for all employees may be limited in some circumstances. Severe storms, traffic conditions, beat characteristics and personal illness could cause an operator to become fatigued fairly quickly. As a result of these circumstances, supervisors may elect to limit the length of duty. This decision should be based on discussions with the operator, Assistant Superintendent and observation of the operator's physical and mental condition. If the supervisor and/or Assistant Superintendent conclude the operator is not capable of continuing with plowing operations, the operator shall be assigned to a non-plowing task during normal working hours or sent home, if outside normal working hours.

Cold weather hazards and proper work clothing

Employees should be aware of cold weather hazards including frostbite and hypothermia. Frostbite is a common injury caused by exposure to the cold. Before frostbite occurs, skin becomes slightly flushed, pink in color, then changes to white or grayish yellow. Pain sometimes occurs, followed by a feeling of intense cold and numbness. To prevent frostbite, avoid prolonged exposure to wind and extreme cold temperatures. Clothing should be warm, layered, and loose fitting.

Hypothermia is the rapid and progressive physical and mental collapse resulting from loss of body heat. It is caused by exposure and combination of cold, exhaustion, wind chill, or getting wet. Common symptoms are uncontrollable shivering, drowsiness or exhaustion, slurred speech and sometimes unconcern for your physical being.

To prevent hypothermia, dress warm using the layer system. Stay dry, beware of the wind factor, and realize that it does not have to be below zero degrees Fahrenheit [-18° C] for hypothermia to occur. Try to avoid perspiring. Carry a high carbohydrate food or drink such as fruit, granola bars or juice for quick energy and body fuel.

RADIO OPERATIONS

The Northern Region Office will start continuous radio operations on Saturday, November 11, 2006 at 7:00 A.M. The Southern, Mid Coast, Western and Eastern Regions will be covered from the Augusta Operations Center.

Suggested Work Schedules for Region Office Radio Operators

Regular Operator
Sat.
Sun.
Mon. 7:30 a.m. - 3:30 p.m.
Tues. 7:30 a.m. - 3:30 p.m.
Weds. 7:30 a.m. - 3:30 p.m.
Thurs. 7:30 a.m. - 3:30 p.m.
Fri. 7:30 a.m. - 3:30 p.m.

Operator A
Sat. 7:30 a.m. - 3: 00 p.m.
Sun. 6:00 a.m. - 3:00 p.m.
Mon. Off
Tues. Off
Weds. 3:00 p.m.-12:00 a.m.
Thurs. 3:00 p.m.-12:00 a.m.
Fri. 3:00 p.m.-12:00 a.m.

Operator B
Sat. 12:00 a.m. - 7:30 a.m.
Sat/Sun 3:00 p.m. - 12:00 a.m.
Sun. 3:00 p.m. - 12:00 a.m.
Mon. 3:00 p.m. - 12:00 a.m.
Tues. 3:00 p.m. - 12:00 a.m.
Weds. Off
Thurs. Off
Fri. Off

Operator C
Sun. 12:00 a.m. - 6:00 a.m.
Mon. 12:00 a.m. - 7:30 a.m.
Tues. 12:00 a.m. - 7:30 a.m.
Weds. 12:00 a.m. - 7:30 a.m.
Thurs. 12:00 a.m. - 7:30 a.m.
Fri. 12:00 a.m. - 7:30 a.m.
Sat. Off

Each group of operators should be supplied with the following information: Location of permanent winter crews and camp telephone numbers, supervisor's names, places of residence and telephone numbers, a list of plowing and sanding crews describing the sections each crew covers and the highway crew supervisor's or patroller's telephone number, the Augusta Operations Center's number (624-3339).

Radio operators will receive reports from night patrol and night radio operators will usually telephone crew personnel to respond. Night patrollers may also directly call out crew personnel.

Radio operators are to gather information on road and weather conditions hourly from night patrollers and maintain current information in the CARS/511 system. In addition, as specific conditions may warrant, radio operators may also be required to report conditions to the Augusta Operations Center on a given cycle. The information furnished to the Augusta Office should contain an account of any storm occurring during

the night, whether action was required, and the general road and weather conditions at the time of the report. Identify any section of highway where travel can be considered difficult.

Night radio operators may receive telephone requests for information as to travel conditions. In these instances, the public should be encouraged to call 511 or access www.511me.gov for traveler information.

During the winter months, radio traffic will be very heavy on all radio circuits. Trucks should generally stay on the local truck channel, rather than be on the repeater channel. Whenever possible, weather and road conditions should be reported in accordance with 10 codes contained in the "MDOT Radio Call Numbers Booklet". Night patrollers are not required to confine themselves to the codes if they believe additional information should be given.

PATROL PROCEDURES FOR ASSISTING STRANDED MOTORISTS

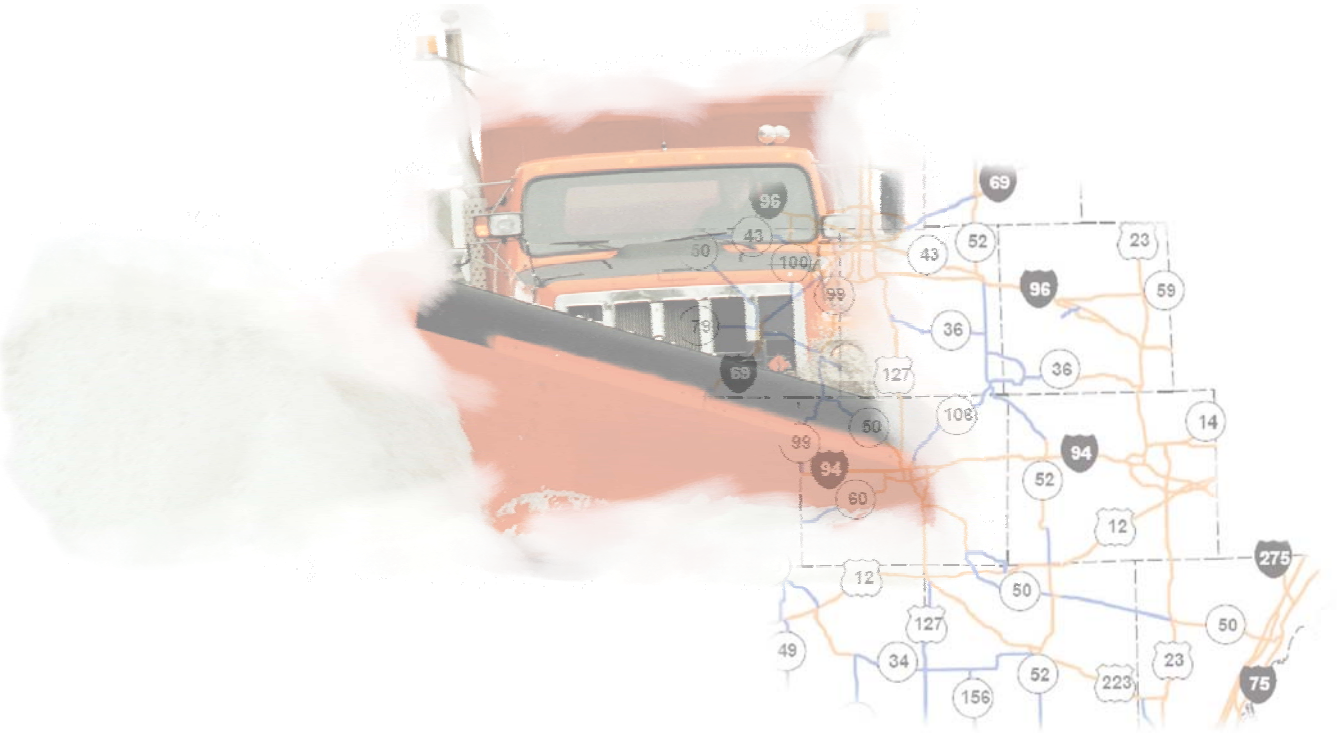
A disabled private vehicle should not be towed or repaired by MaineDOT personnel. Have the motorist give the name of a towing service or garage that they wish to have contacted and provide that information to the radio operator or Operations Center.

Before stopping to give any car or person assistance, radio your night radio operator or the Operations Center, identify your location, describe the perceived problem and also provide a description of the vehicle or license plate number (if possible). Check back with the radio operator or Operations Center to keep them informed of the situation and when you are finished providing assistance.

Patrol personnel may supply a small amount of gasoline (not to exceed two gallons) to motorists only under emergency conditions (such as a car out of gas a long distance from a garage or filling station or during severe weather conditions). Under no circumstance is a Department employee to accept payment or any gratuity for the small amount of gasoline furnished, or for any other assistance provided.

It is important to remember that the primary purpose of an off-hour patrol is not roadside service for highway users. The foregoing instructions cover only such courtesies that one motorist would naturally extend to another.

State Highway



Winter Operations

Michigan Department of Transportation — October 2008

MDOT
Michigan Department of Transportation

OFFICE MEMORANDUM

DATE: August 9, 2007

TO: Region Engineers
TSC Managers
Region Associate Engineers - Delivery

FROM: Jon W. Reincke
Engineer of Maintenance

SUBJECT: Winter Maintenance Operations

At the July 12, 2007 EOC meeting, approval was given to rollout the new Winter Maintenance Operations Guidelines and associated initiatives. The Maintenance Division has the responsibility to carry the winter operations program forward from this point.

Attached you will find a portfolio of material to help get you oriented and underway. These documents will also be available on the Maintenance Webpage. Most of the regions have begun working on their winter maintenance corridor maps. There is a critical due date of October 1, 2007 to have your region corridor maps sent in to us for verification, coordination, and approval. Please refer to the implementation instructions.

A CD is in your portfolio and contains a PowerPoint presentation to educate and communicate with your direct forces, contract counties, law enforcement agencies, and first responders. It is not intended for the news media or public announcements or presentations. It is for internal use only.

In the next few months, division staff will meet with the State Police at the Lansing Headquarters to present them with our changes in winter operations. We will let you know when that occurs so you can schedule your follow-up meetings with your local post commanders and others.

We are also negotiating with CRAM to add a Winter Maintenance section in the new 2008 contract. This will obligate contract counties to participate in the process of winter operations planning.

I envision winter operations to continually improve under this milestone guideline and through the support of our newly established Roadway Operations Unit. Please include our staff in your Winter Operations Workshops so they become an active part of your team and can assist you throughout the implementation and evaluation process. Our central office contacts are Tim Croze at 517-322-3394 and Scott Johnson at 517-322-3323.

We look forward to working with all of you on this new winter operations initiative.

_____
Engineer of Maintenance

Attachments
BOHD:M:JWR:ksk
cc: L. Tibbits T. Croze
J. Friend S. Johnson
G. Mayes Winter Operations Team

Team Members: D. Budd, T. Croze, J. Gailitis, J. Gutting, T. Irvin, T. Little, C. Mannor, G. Mayes, R. McKinney, M. Metiva, B. Ness, S. Palmer, J. Reincke, R. Roberts, W. Thompson, L. White

State Highway Winter Operations

Winter Maintenance Operations Guidelines

Michigan Department of Transportation — October 2008

Last Update: October 2008

Winter Maintenance Operations Guidelines

A. General

The purpose of the Winter Operations Guidelines are to provide guidance to the Region's, TSC's, contract agencies, and direct maintenance organizations to achieve consistent road surface conditions during and after winter storms. The guidelines are designed to maximize efficiency and assign an appropriate Level of Service (LOS) for trunklines statewide.

B. Assigning Winter Operations LOS

MDOT assigns winter operations LOS using the Corridors of Highest Significance outlined in the *State Long Range Transportation Plan 2005-2030*. The plan focuses on the link between transportation and Michigan's economic vitality and quality of life; and designates corridors based on the primary origin/destination they serve; and are directly tied to international, national, statewide, regional, and local significance.

To remain consistent with the *State Long Range Transportation Plan 2005-2030*, MDOT uses the International/National and Statewide categories as the basis for the winter maintenance LOS Priority #1- Orange Routes. The Regionally and Locally Significant Corridors are the basis for the Priority #2- Blue Routes.

Corridor significance takes into account the following factors: Average Daily Traffic (ADT), commercial ADT, population, employment, tourism, airports, carpool lots and intermodal freight.

The *State Long Range Transportation Plan* defines a Corridor of High Significance (International/National and Statewide routes) as a multi-modal system of

transportation infrastructure along geographic corridors that provide a high level of support to international, national, and state economies. The Regionally and Locally Significant Corridors are defined as a multi-modal system of transportation infrastructure along geographic corridors that provide a high level of support to a specific region or sub-region of Michigan's economy.

C. Service Levels

As mentioned previously, MDOT separates state trunkline into two distinct winter maintenance LOS categories: Priority #1- Orange Routes and Priority #2- Blue Routes. The definitions of these routes follow below.

Priority #1- Orange Route

Provide maintenance service as appropriate under prevailing weather conditions, with a goal of providing a pavement surface over its entire width generally bare of ice and snow. This work may be accomplished using overtime as necessary.

Clearing the pavement bare of ice and snow over its entire width will be a continuous process during and after the snow event using overtime as necessary.

Priority #2- Blue Route

Provide maintenance service as appropriate under prevailing weather conditions, with a goal of providing a pavement surface generally bare of ice and snow wide enough for one-wheel track in each direction. This work may be accomplished using overtime as necessary during a winter storm event.

Clearing the pavement bare of ice and snow over its entire width will be accomplished as soon as reasonably possible after the winter storm event, without working overtime.

D. Communication/Coordination

The Winter Letter of Understanding and Winter Shift Schedule defines the shifts, shift times and night patrol activities, respectively, for contract agencies and MDOT Direct Maintenance forces. The shift and night patrol schedules, along with the starting and ending times, will influence the effectiveness of the winter maintenance operations and activities.

Timing of winter maintenance activities at jurisdictional boundaries (contract agency and/or MDOT Direct Maintenance forces) is dependent on effective communication and coordination. Coordination of starting times for adjacent agencies should be evaluated and adjusted (if practical) to minimize any time differential between the start and completion of winter maintenance at jurisdictional boundaries.

Communications between agencies is necessary to facilitate maximum effectiveness throughout the routes; therefore, it is extremely important that a communications plan be established and followed,

E. Definition of "Generally Bare of Ice and Snow"

A pavement that is "generally bare of ice and snow" is defined as a travel lane surface that is free from drifts, snow ridges, and as much ice and snow pack as practical. It should not be confused with a "dry pavement" or "bare pavement" which is essentially free of all ice, snow and any free moisture. This "dry/bare pavement" condition may not exist until the weather conditions improve to the point where this pavement condition can be provided.

Under this definition, motorists can expect some inconvenience and will be expected to modify their driving practices to suit road conditions. This is supported by *The Michigan Motor Vehicle* code section 627.(1) which states, "A person driving a vehicle on a highway shall drive at a careful and prudent speed not greater than nor less than is reasonable and proper, having due regard to the traffic, surface and width of the highway and of any other condition then existing."

F. Effort During the Storm

The severity of a winter storm event, roadway temperatures, and availability of resources along with other factors will dictate what condition the roadways are in and subsequently when bare/wet or bare/dry pavement can be obtained.

During the winter storm event, maintenance forces will plow and apply surface treatments as necessary. Only enough de-icing agents should be used to keep the total accumulation workable, thereby minimizing bonding during the winter storm event. (See Treatment Tables 1 through 6)

It is acknowledged that using greater salt and de-icing agent application rates than those provided for in this guideline has the potential to achieve bare/wet conditions more quickly during and after a winter storm event. However, when balancing concerns for the environment, availability of resources, budgets, and common practices among the snow-belt states, the current application rates are appropriate and should be adhered to.

G. Clean-up

After the winter storm event has ended, the effort will switch to cleanup with the intermediate goal of bare/wet pavement and finally the ultimate goal of bare/dry pavement. The time to achieve these goals will depend on the limitations imposed by climate conditions, availability of resources, and environmental concerns.

H. Exceptions

The priority service levels are intended as a guide in winter maintenance operations and shall be adhered to as much as possible. However, exceptions may be deemed appropriate based on local conditions.

Exceptions to these guidelines may include:

- Reducing service level efforts due to extreme conditions which would include:
  - > Limited visibility for operators;
  - > Length and severity of the storm;

> Budget restrictions or unavailability of de-icing chemicals.

- Allowing breaks between shifts during off traffic peak hours to reduce operational costs and operator fatigue.
- Continuing service level effort to prevent snow compaction or other hazardous conditions.
- Allowing extraordinary means when impending weather or an influx of traffic, such as a sport event or holiday is anticipated.

I. Service Uniformity

Customers place a high value on minimizing unexpected changes in pavement surface condition. Therefore, even when exceptions, as listed above, are made, uniformity of service level should be continually sought. This means that winter plow routes should end at logical locations where a motorist might anticipate a change in priority service level. These locations might include:

- High volume interchanges where traffic volumes significantly change;
- Leaving or entering municipalities;
- Dramatic or well defined changes in topography; or
- Speed changes.

Providing continuity of service across jurisdictional boundaries will require close coordination between state garages, contract counties and regions.

J. Winter Highway Maintenance Map

Each region will be allowed to suggest exceptions to their plan annually. Exceptions must be justified in writing to the Engineer of Operations by August 15 of each year and will be reviewed by Central Maintenance. The Engineer of Operations will make recommendations on each change to the Chief Operations Officer (COO) by

September 1. The COO will approve or deny the requested exceptions by September 15.

Table 1: Light Snow Storm

Michigan Department of Transportation

Pavement Condition		Initial Operation				Subsequent Operations			Comments
Temperature	Surface Condition	Maintenance Action	Chemical Spread Rate			Maintenance Action			
			Liquid	Prewet Salt	Dry Salt		Prewet Salt	Dry Salt	
Above 32°F Pavement temperature steady or rising	Dry, wet, slush or light snow cover	None; see comments				None, see comments			1) Monitor pavement temperature closely. 2) Treat icy patches with dry salt at 100 lbs/lane mile or prewet salt at 50-75 lbs/lane mile, blade if needed.
Above 32°F Pavement temperature is falling to near 32°F	Dry	Anti-ice	Anti-Ice app. rates depend on chemical used			Blade as needed; apply salt when needed	50-75 lbs/lane mile	100 lbs/lane mile	1) Application will need to be more frequent at lower temperatures and higher snowfall rates. If the blade/treatment frequency cannot be maintained, the spread rate can be increased to 150 lbs/lane mile of dry salt or 75 to 100 lbs/lane mile of prewet salt.
15°F to 32°F Pavement temperature remaining in range	Dry	Anti-ice	Anti-Ice app. rates depend on chemical used			Blade as needed; apply salt when needed	50-75 lbs/lane mile	100 lbs/lane mile	
	Wet or slush	Apply dry salt		50-75 lbs/lane mile	100 lbs/lane mile				
	Light snow cover	Apply dry salt or prewetted salt							
10°F to 15°F Pavement temperature remaining in range	Dry, wet, slush or light snow cover	Apply dry salt or prewetted salt		100-150 lbs/lane mile	200 lbs/lane mile	Blade as needed; apply salt when needed	100-150 lbs/lane mile	200 lbs/lane mile	
Below 10°F Pavement temperature steady or falling	Dry or light snow cover	Blade as needed				Blade as needed	200 lbs/lane mile down to 0°F		1) It is not recommended that dry salt or prewetted salt be applied in this temperature range. 2) Abrasives can be applied to enhance traction. (5)

Notes:

1) If suggested application rates are lower than what the spreading equipment can handle, apply the minimum amount possible.
2) Time initial applications to prevent deteriorating conditions or the development of packed and bonded snow.
3) Apply liquid or salt ahead of traffic rush periods occuring during a storm.
4) If needed, blade before salt applications so that excess snow, slush, or ice is removed.
5) Abrasives will adhere to the road surface better it they are prewetted.

Table 2: Light Snow Storm With Periods of Moderate to Heavy Snows

Michigan Department of Transportation

Pavement Condition		Initial Operation				Subsequent Operations			Comments
Temperature	Surface Condition	Maintenance Action	Chemical Spread Rate			Maintenance Action	Salt Spread Rate		
			Liquid	Prewet Salt	Dry Salt		Light Snow	Heavier Snow	
Above 32°F Pavement temperature steady or rising	Dry, wet, slush or light snow cover	None; see comments				None, see comments			1) Monitor pavement temperature closely. 2) Treat icy patches with dry salt at 100 lbs/lane mile or prewet salt at 50-75 lbs/lane mile, blade if needed.
Above 32°F Pavement temperature is falling to near 32°F	Dry	Anti-ice	Anti-Ice app. rates depend on chemical used			Blade as needed; apply salt when needed	**Dry salt:** 100 lbs/LM **Prewet salt:** 50-75 lbs/LM	**Dry salt:** 200 lbs/LM **Prewet salt:** 100-150 lbs/LM	1) Application will need to be more frequent at lower temperatures and higher snowfall rates. If the blade/treatment frequency cannot be maintained, the spread rate can be increased to 150 lbs/lane mile of dry salt or 75-100 lbs/lane mile of prewet salt. 2) During light snow fall that occurs after heavier snow periods reduce dry salt rate to 100 lbs/lane mile or 50-75 lbs/lane mile for prewet salt; continue to blade and apply salt as needed.
15°F to 32°F Pavement iemperature remaining in range	Dry	Anti-ice	Anti-Ice app. rates depend on chemical used			Blade as needed; apply salt when needed	**Dry Salt:** 100 lbs/LM **Prewet Salt:** 50-75 lbs/LM	**Dry Salt:** 200 lbs/LM **Prewet Salt:** 100-150 lbs/LM	
	Wet or slush	Apply dry salt		50-75 lbs/lane mile	100 lbs/lane mile				
	Light snow cover	Apply dry salt or prewetted salt							
10°F to 15°F Pavement temperature remaining in range	Dry, wet, slush or light snow cover	Apply dry salt or prewetted salt		100-150 lbs/lane mile	200 lbs/lane mile	Blade as needed; apply salt when needed	**Dry Salt:** 200 lbs/LM **Prewet Salt:** 100-150 lbs/LM	**Dry Salt:** 200 lbs/LM **Prewet Salt:** 100-150 lbs/LM	
Below 10°F Pavement temperature steady or falling	Dry or light snow cover	Blade as needed				Blade as needed	200 lbs/lane mile down to 0°F	200 lbs/lane mile down to 0°F	1) It is not recommended that dry salt or prewetted salt be applied in this temperature range. 2) Abrasives can be applied to enhance traction. (5)

Notes:

1) If suggested application rates are lower than what the spreading equipment can handle, apply the minimum amount possible.
2) Time initial applications to prevent deteriorating conditions or the development of packed and bonded snow.
3) Apply liquid or salt ahead of traffic rush periods occuring during a storm.
4) If needed, blade before salt applications so that excess snow, slush, or ice is removed.
5) Abrasives will adhere to the road surface better it they are prewetted.

Table 3: Moderate or Heavy Snow Storm

Michigan Department of Transportation

Pavement Condition		Initial Operation				Subsequent Operations			Comments
Temperature	Surface Condition	Maintenance Action	Chemical Spread Rate			Maintenance Action			
			Liquid	Prewet Salt	Dry Salt		Prewet Salt	Dry Salt	
Above 32°F Pavement temperature steady or rising	Dry, wet, slush or light snow cover	None; see comments				None, see comments			1) Monitor pavement temperature closely. 2) Treat icy patches with dry salt at 100 lbs/lane mile or 50-75 lbs/lane mile for prewet salt, blade if needed.
Above 32°F Pavement temperature is falling to near 32°F	Dry	Anti-ice	Anti-Ice app. rates depend on chemical used			Blade as needed; apply salt when needed		100 lbs/lane mile	
30°F to 32°F Pavement temperature remaining in range	Dry	Anti-ice	Anti-Ice app. rates depend on chemical used			Blade as needed; apply salt when needed	50-75 lbs/lane mile	100 lbs/lane mile	1) If desired blade/treatment frequency cannot be maintained, the spread rate can be increased to 200 lbs/lane for dry salt or 100-150 lbs/lane mile for prewet salt mile to accommodate longer operational cycles.
	Wet or slush	Apply dry salt		50-75 lbs/lane mile	100 lbs/lane mile				
	Light snow cover	Apply prewetted salt							
15°F to 30°F Pavement temperature remaining in range	Dry	Anti-ice	Anti-Ice app. rates depend on chemical used			Blade as needed; apply prewetted salt when needed	100-150 lbs/lane mile	200 lbs/lane mile	1) If the recommended treatment frequency is not keeping up with the storm, the spread rate can be increased to 400 lbs/lane mile for dry salt or 200-300 lbs/lane mile for prewet salt to accommodate longer operational cycles. 2) Do not apply liquid salt onto heavy snow accumulations or packed snow.
	Wet or slush	Apply dry salt			150-200 lbs/lane mile				
10°F to 15°F Pavement temperature remaining in range	Dry, wet, slush or light snow cover	Apply dry salt or prewetted salt		100-150 lbs/lane mile	200 lbs/lane mile	Blade as needed; apply prewetted salt when needed	100-150 lbs/lane mile	200 lbs/lane mile	1) If the recommended treatment frequency is not keeping up with the storm, the spread rate can be increased to 400 lbs/lane mile for dry salt or 200-300 lbs/lane mile of prewet salt to accommodate longer operational cycles.
Below 10°F Pavement temperature steady or falling	Dry or light snow cover	Blade as needed				Blade as needed	200 lbs/lane mile down to 0°F		1) It is not recommended that dry salt or prewetted salt be applied in this temperature range. 2) Abrasives can be applied to enhance traction. (5)

Notes:

1) If suggested application rates are lower than what the spreading equipment can handle, apply the minimum amount possible.
2) Time initial applications to prevent deteriorating conditions or the development of packed and bonded snow.
3) Apply liquid or salt ahead of traffic rush periods occuring during a storm.
4) If needed, blade before salt applications so that excess snow, slush, or ice is removed.
5) Abrasives will adhere to the road surface better it they are prewetted.

Table 4: Frost

Michigan Department of Transportation

Pavement Condition		Initial Operation				Subsequent Operations			Comments
Temperature	Traffic Condition	Maintenance Action	Chemical Spread Rate			Maintenance Action	Prewet Salt	Dry Salt	
			Liquid	Prewet Salt	Dry Salt				
Above 32°F Pavement temperature steady or rising	Any level	None; see comments				None, see comments			1) Monitor pavement temperature closely. Begin treatment as soon as pavement temperature begins to drop to 32°F and is at or below dew point.
28°F to 32°F Pavement temperature is falling to near 32°F	Less than 100 vehicles/hr	Apply salt		50-75 lbs/lane mile	100 lbs/lane mile	Apply salt when needed	50-75 lbs/lane mile	100 lbs/lane mile	1) Monitor pavement closely, if pavement becomes wet or if thin ice forms, increase application rate to 150 lbs/lane mile for dry salt or 75-100 lbs/lane mile for prewet salt.
20°F to 28°F Pavement temperature remaining in range and equal to or below dew point	Any level	Apply salt		50-100 lbs/lane mile	100 -150 lbs/lane mile	Apply salt when needed	50-100 lbs/lane mile	100-150 lbs/lane mile	1) Monitor pavement closely; if thin ice forms, increase application rate to 150 lbs/lane mile for dry salt or 75-100 lbs/lane mile for prewet salt. 2)Applications will need to be more frequent at higher levels of condensation. If traffic volumes are not enough to disperse condensation, it may be necessary to increase treatment frequency.
10°F to 20°F Pavement temperature remaining in range	Any level	Apply salt		75-150 lbs/lane mile	150 -200 lbs/lane mile	Apply salt when needed	75-150 lbs/lane mile	150-200 lbs/lane mile	1) Monitor pavement closely; if thin ice forms, increase application rate to 200 lbs/lane mile for dry salt or 100-150 lbs/lane mile for prewet salt. 2)Applications will need to be more frequent at higher levels of condensation. If traffic volumes are not enough to disperse condensation, it may be necessary to increase treatment frequency.
Below 10°F Pavement temperature steady or falling	Any level	Apply abrasives or prewet salt				Apply abrasives as needed (5)	200 lbs/lane mile down to 0°F		1) It is not recommended that dry salt or prewetted salt be applied in this temperature range.

Notes:

1) If suggested application rates are lower than what the spreading equipment can handle, apply the minimum amount possible.
2) Time initial applications to prevent deteriorating conditions or the development of packed and bonded snow.
3) Apply liquid or salt ahead of traffic rush periods occuring during a storm.
4) If needed, blade before salt applications so that excess snow, slush, or ice is removed.
5) Abrasives will adhere to the road surface better it they are prewetted.

Table 5: Freezing Rain

Michigan Department of Transportation

Pavement Condition	Initial Operation			Subsequent Operations			Comments
Temperature	Maintenance Action	Prewet Salt	Dry Salt	Maintenance Action	Prewet Salt	Dry Salt	
Above 32°F Pavement temperature steady or rising	None; see comments			None, see comments			1) Monitor pavement temperature closely. 2) Treat icy patches with dry salt at 100 lbs/lane mile or 50-75 lbs/lane mile for prewet salt.;
Above 32°F Pavement temperature is falling to near 32°F	Apply prewetted salt	50-75 lbs/lane mile	100 lbs/lane mile	Apply prewetted salt when needed	50-75 lbs/lane mile	100 lbs/lane mile	1) Monitor pavement temperature and precipitation closely.
20°F to 32°F Pavement temperature remaining in range	Apply prewetted salt	50-150 lbs/lane mile	100-200 lbs/lane mile	Apply prewetted salt when needed	50-150 lbs/lane mile	100-200 lbs/lane mile	1) Monitor pavement temperature and precipitation closely. 2) Increase salt rate toward higher indicated rate with increase in freezing rain intensity. 3) Decrease salt rate toward higher indicated rate with decrease in freezing rain intensity.
10°F to 20°F Pavement temperature remaining in range	Apply prewetted salt	100-300 lbs/lane mile	200-400 lbs/lane mile	Apply prewetted salt when needed	100-300 lbs/lane mile	200-400 lbs/lane mile	1) Monitor pavement temperature and precipitation closely. 2) Increase salt rate toward higher indicated rate with increase in freezing rain intensity. 3) Decrease salt rate toward higher indicated rate with decrease in freezing rain intensity.
Below 10°F Pavement temperature steady or falling	Apply abrasives			Apply abrasives as needed			1) It is not recommended that any type of salt be applied in this temperature range. 2) Abrasives can be applied to enhance traction. (4)

Notes:

1) If suggested application rates are lower than what the spreading equipment can handle, apply the minimum amount possible.
2) Apply liquid or salt ahead of traffic rush periods occuring during a storm.
3) If needed, blade before salt applications so that excess snow, slush, or ice is removed.
4) Abrasives will adhere to the road surface better it they are prewetted.

Table 6: Sleet Storm

Michigan Department of Transportation

Pavement Condition	Initial Operation			Subsequent Operations			Comments
Temperature	Maintenance Action	Prewet Salt	Dry Salt	Maintenance Action	Prewet Salt	Dry Salt	
Above 32°F Pavement temperature steady or rising	None; see comments			None, see comments			1) Monitor pavement temperature closely. 2) Treat icy patches with salt at 100 lbs/lane mile.
Above 32°F Pavement temperature is falling to near 32°F	Apply salt	50-75 lbs/lane mile	100 lbs/lane mile	Apply salt when needed	50-75 lbs/lane mile	100 lbs/lane mile	1) Monitor pavement temperature and precipitation closely.
28°F to 32°F Pavement temperature remaining in range	Blade as needed apply Salt	50-150 lbs/lane mile	100-200 lbs/lane mile	Blade as needed: apply salt when needed	50-150 lbs/lane mile	100-200 lbs/lane mile	1) Monitor pavement temperature and precipitation closely. 2) Increase salt rate toward higher indicated rate with increase in freezing sleet intensity. 3) Decrease salt rate toward lower indicated rate with decrease in freezing sleet intensity.
10°F to 28°F Pavement temperature remaining in range	Blade as needed apply Salt	100-300 lbs/lane mile	200-400 lbs/lane mile	Blade as needed: apply salt when needed	100-300 lbs/lane mile	200-400 lbs/lane mile	1) Monitor pavement temperature and precipitation closely. 2) Increase salt rate toward higher indicated rate with increase in freezing sleet intensity. 3) Decrease salt rate toward lower indicated rate with decrease in freezing sleet intensity.
Below 10°F Pavement temperature steady or falling	Blade as needed			Blade as needed; apply abrasives as needed	200 lbs/lane mile down to 0°F		1) It is not recommended that dry salt or prewetted salt be applied in this temperature range. 2) Abrasives can be applied to enhance traction. (4)

Notes:

1) If suggested application rates are lower than what the spreading equipment can handle, apply the minimum amount possible.
2) Apply liquid or salt ahead of traffic rush periords occuring during a storm.
3) If needed, blade before salt applications so that excess snow, slush, or ice is removed.
4) Abrasives will adhere to the road surface better it they are prewetted.

State Highway Winter Operations

Winter Operations Implementation Instructions

Michigan Department of Transportation — August 2007

Last Update: June 18, 2007

Winter Operations
Implementation Instructions

A. Each region will develop an annual winter operations plan closely conforming to the Winter Operations Guidelines. Exceptions not covered by the Winter Operations Guidelines are allowed with the approval of the Region Engineer in coordination with the Engineer of Maintenance. Exceptions will be due to circumstances related to the unique characteristics of the region and winter weather. When a region exception is approved, it will be described and added to the "Winter Operations Plan" specifically for that region.

B. The plan will consist of a map showing the Priority Level I corridors and Priority Level II corridors and a communication protocol. The corridors will be identified by color code. Orange will designate a Priority Level I corridor and blue a Priority Level II corridor. The beginning and end of each will be described in a way that is easily identifiable by maintenance personnel and the public. The communication protocol will be for the purpose of informing employees and stakeholders on Winter Operations.

The internal plan will focus on communicating winter operations planning with direct and contracted maintenance forces.

- Review winter plan (route priorities).
- Review winter maintenance guidelines.
- Review region exceptions.
- Provide instructions on communications between forces and how to coordinate work.
- Understand how others are operating.
- Understand how to call for assistance.

The plan will include detailed information for law enforcement agencies, and emergency service providers.

- Explain the region plan and what they can expect.
- Explain the different priority levels and where they apply.

C. The plan will be developed through coordination, agreement, and collaboration with each maintenance entity in the region. Winter Operations Plan adjustments may be necessary depending on resources, positioning of garages and "what makes sense". Consideration should be made for local government system function and priorities so that a full understanding of system prioritization is realized, accounted for and expectations are understood.

D. The region, in concert with the Maintenance Division's Roadway Operations Section, will coordinate the plan with surrounding regions. Adjustments will be made when necessary to assure the plan supports the objective of providing the appropriate level of service without regard to jurisdiction and boundaries. To develop the plan, several reiterations may be necessary in order to find the proper balance.

E. The Roadway Operations Section in the Maintenance Division will be scheduled to assist each region with training and guide the region in deploying new technology.

Route Priority Variance/ Anomaly

ACTION: **List all the routes, by adjacent county, that have a different priority than your county.**

County	Route	Prioritization	Resolution

Backup Plan

ACTION: **List and describe all the actions that will take place if some aspects of your plan can't be achieved during a winter event.**

Winter Operations Communication & Coordination Plan

Winter 2006/2007

County: _____

MDOT TSC: _____

Primary MDOT Contact: _____
(Name/Title)

Telephone#: _____

Superintendent: _____

Telephone#: _____

Foreman: _____ **Telephone:** _____

Foreman: _____ **Telephone:** _____

Foreman: _____ **Telephone:** _____

Foreman: _____ **Telephone:** _____

State Highway Priorities

Priority	Significance (1 or 2)	Route	Description/Location

Operation Details

Shift	Hours of Operation	# on Shift	Equipment/ Snow Plows Available

Primary Communication Device _____

De-Icing Materials _____

Road Patrol

Days	Hours	# on Road Patrol

Adjacent County Information

County	Primary Contact	Telephone	E-mail

Municipality Information (within county)

Municipality	Primary Contact	Telephone

2007
Winter Operations Summary Timeline

Revised June 18, 2007

January – March	April – June	July – September	October - December

Winter Operations Update

January:

- ❖ T. Anderson, R. Roberts, T. Little, S. Palmer - Highway Operations Conference
  - Present a powerpoint detailing Bay, Superior and Grand Region Winter Operations pilots and the basic schedule for completion.

February:

- ❖ B. Felt - Monday Memo
  - Communicates pilot information to all staff via Monday Memo

March:

- ❖ B. Felt & Regions - Develops and shares draft version of talking points for all stakeholders to utilize

Winter Operations Map Development and Stakeholder Engagement

April – May:

- ❖ Regions -
  - Report pilot project findings – lessons learned
  - Finish implementation instruction
  - Finish Winter Operations Guidelines
  - Region representatives meet with TSC's and guide process

June:

- ❖ Regions -
  - Remaining regions to begin working on Winter Maintenance Map development.
  - Meet and work with appropriate stakeholders to educate the stakeholders on what we are doing and determine route significance in their region.

- ❖ Bob Felt –
  - Will develop a brief electronic presentation for non-transportation audience that regions can use.
  - Talking points will be finalized.

Winter Operations Statewide Map Completion

July:

- ❖ Regions – Produce draft of winter maintenance maps
- ❖ T. Anderson – Take Winter Operations Guidelines to EOC

August:

- ❖ Regions & Maintenance Division -
  - Coordination of Region Maps (validate route priorities at region boundaries)

Region Winter Plan Development and Implementation

September:

- ❖ MDOT Director – sends letter to department staff and stakeholders regarding new winter operations
- ❖ Regions and Maintenance Division – Region winter workshops scheduled
  - Direct Forces
  - Contract Agencies

  Complete Winter Operation Plans in all Regions
- ❖ Regions – will use the completed Winter Maintenance map and meet with maintaining agencies and direct garages to develop a specific region communication and coordination plan to match the Winter Operations guidelines.
- ❖ Maintenance Division – Collect region plans and work with regions on performance measures

Winter 2007/2008

- ❖ Implement new guidelines on all state routes
- ❖ External communication prepared and ready for possible response to media, public, legislature, etc.

Completed Tasks

Click to view PowerPoint Presentation

Snow & Ice Event/Bare Lane Training

2008-2009

Snow and Ice Event & Bare Lane

- Event definition
- Questions and Answers
- Bare lane definition
- Reporting events/bare lanes
- Reporting passes (timesheet)
- 2008-2009 Snow and Ice Reports

Event

- A winter weather occurrence that consumes resources necessary to prevent, minimize or regain the loss of bare lanes.

Winter Weather Occurrence

- Freezing rain/drizzle
- Sleet
- Snow
- Drifting/blowing snow
- Frost
- Ice/black ice
- Refreeze
- Or any combination

Resources Consumed

- Labor
- Equipment
- Material

Resources Consumed

- *Material* - Usage of salt brine, sand, salt, and other chemicals will trigger an event. (except road patrol and anti-icing)
- *Equipment* - Usage of plows, wings, underbodys, and sanders will trigger an event. *Use of plow trucks alone in checking of road conditions is not considered a resource.*
- *Labor* - Is a resource provided that either materials or equipment are used.
- *Be sure to correctly record time, equipment, and materials by the end of your next shift.*

Prevent, Minimize, or Regain

- *Prevent* - Usage of resources before or during the event such as anti-icing, or the application of chemicals to prevent the loss of bare lanes.
- *Minimize* - Usage of resources/chemicals to reduce the effects or impact of bare lanes lost.
- *Regain* - Process/resources needed to regain the loss of bare lanes

Questions & Answers

- How can I be sure if it is an event or not?
- Ask yourself two questions.
- 1. Is it a winter weather occurrence
- 2. Were resources consumed as defined in the event definition.
- Both questions must be *YES* to have an event.

Questions & Answers

- Night or dawn patrol personnel out doing some spot sanding, is this an event?

- No,

- If additional crews are called in to do some spot sanding, this would trigger an event. *If night and dawn called in additional crews they would switch from activity 2408 to 2406*

Questions & Answers

- There is 70% chance of freezing rain. The A shift is called in at 3 a.m. They run the routes and find no precipitation, did not use their plows or any material. Event?

- No

Questions & Answers

- Can there be an event on one route and not on another?
- Yes,
- Due to surface temps, location, wind speed & direction or traffic, it is possible for this to happen. Each route can have different event start and end times.

Questions & Answers

- A. Can blowing snow or drifting snow be an event?
- Yes, if resources are needed, by event definition.
- B. When does a wind event end?
- When the drifting of snow no longer causes significant snow movement. Ask the question, "Would current conditions cause the loss of bare lanes"?

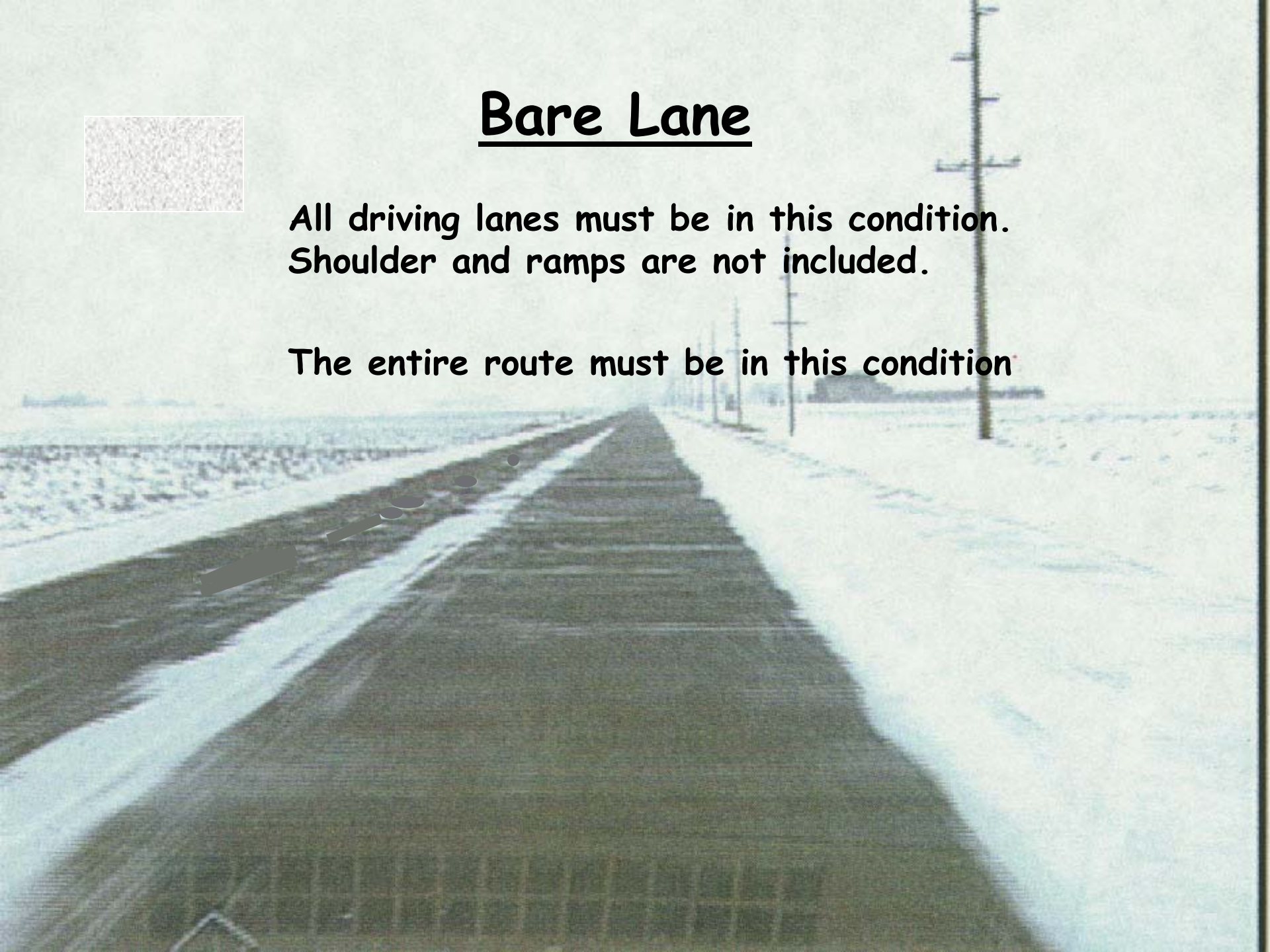
Bare Lane

- All driving lanes are 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.

Bare Lane

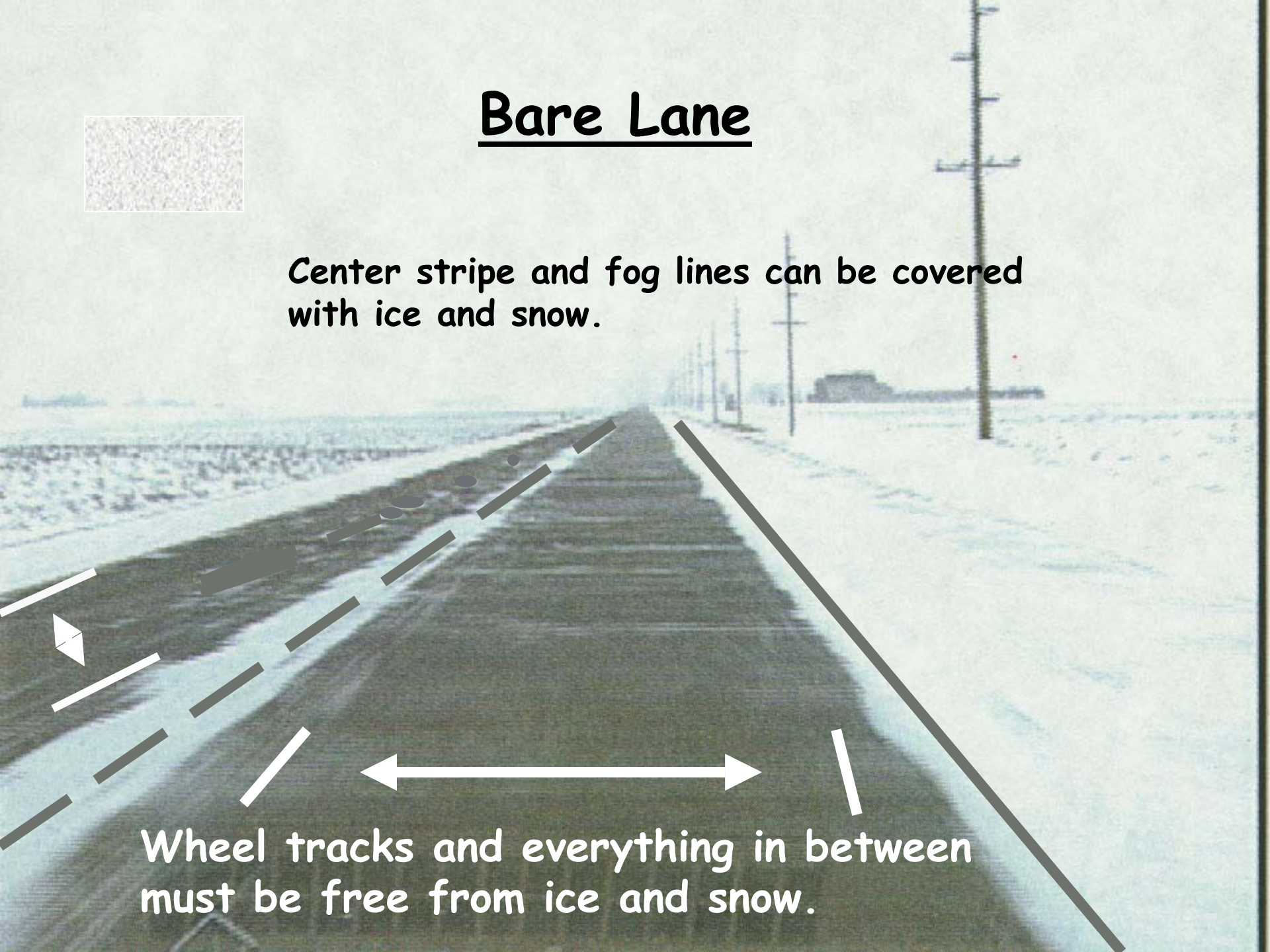
All driving lanes must be in this condition.
Shoulder and ramps are not included.

The entire route must be in this condition

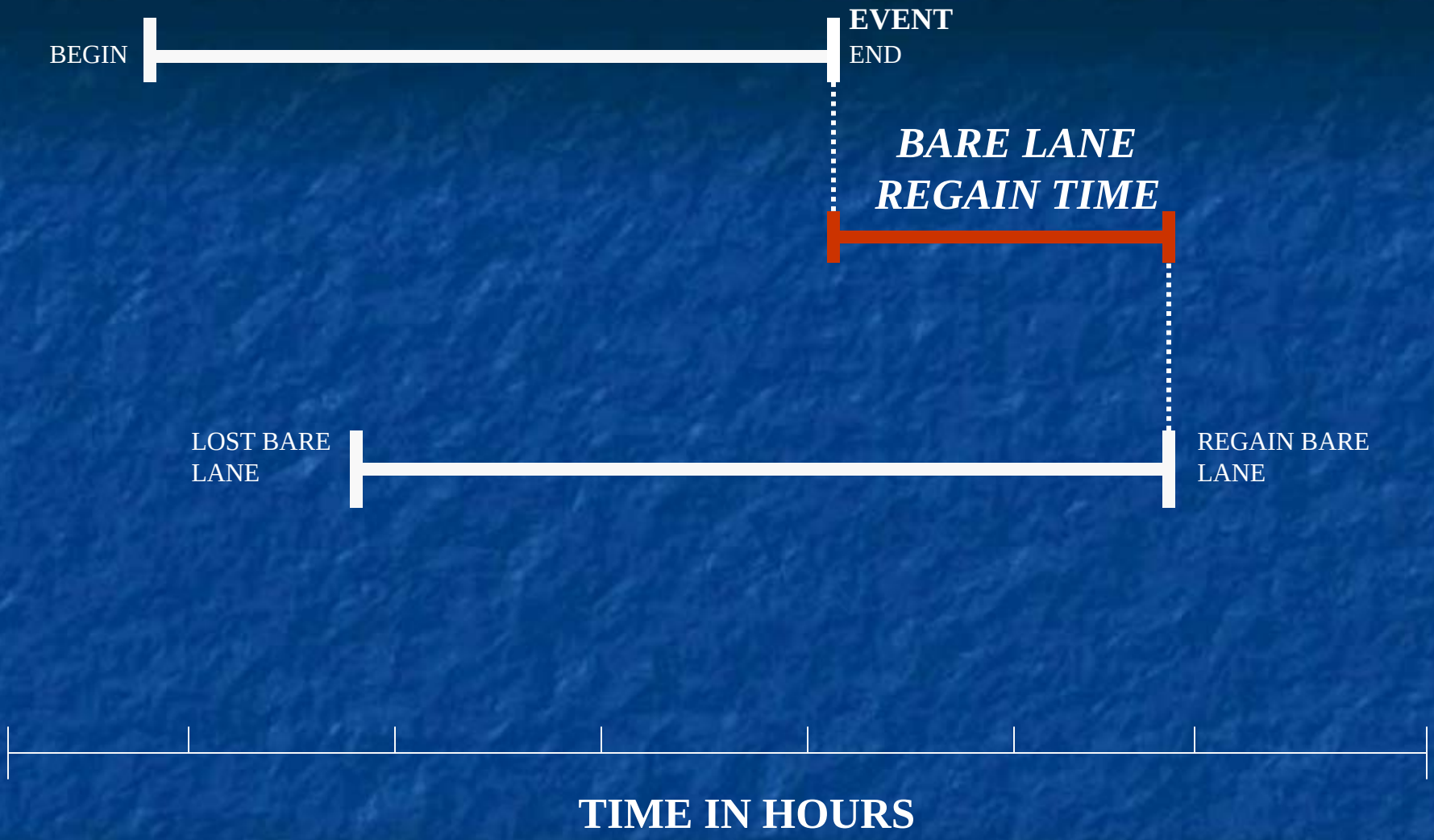


Bare Lane

Center stripe and fog lines can be covered with ice and snow.



Wheel tracks and everything in between must be free from ice and snow.



***RECORD IN 1\2 HOUR INCREMENTS**

*** USE REGULAR TIME - NOT 24 HOUR CLOCK**

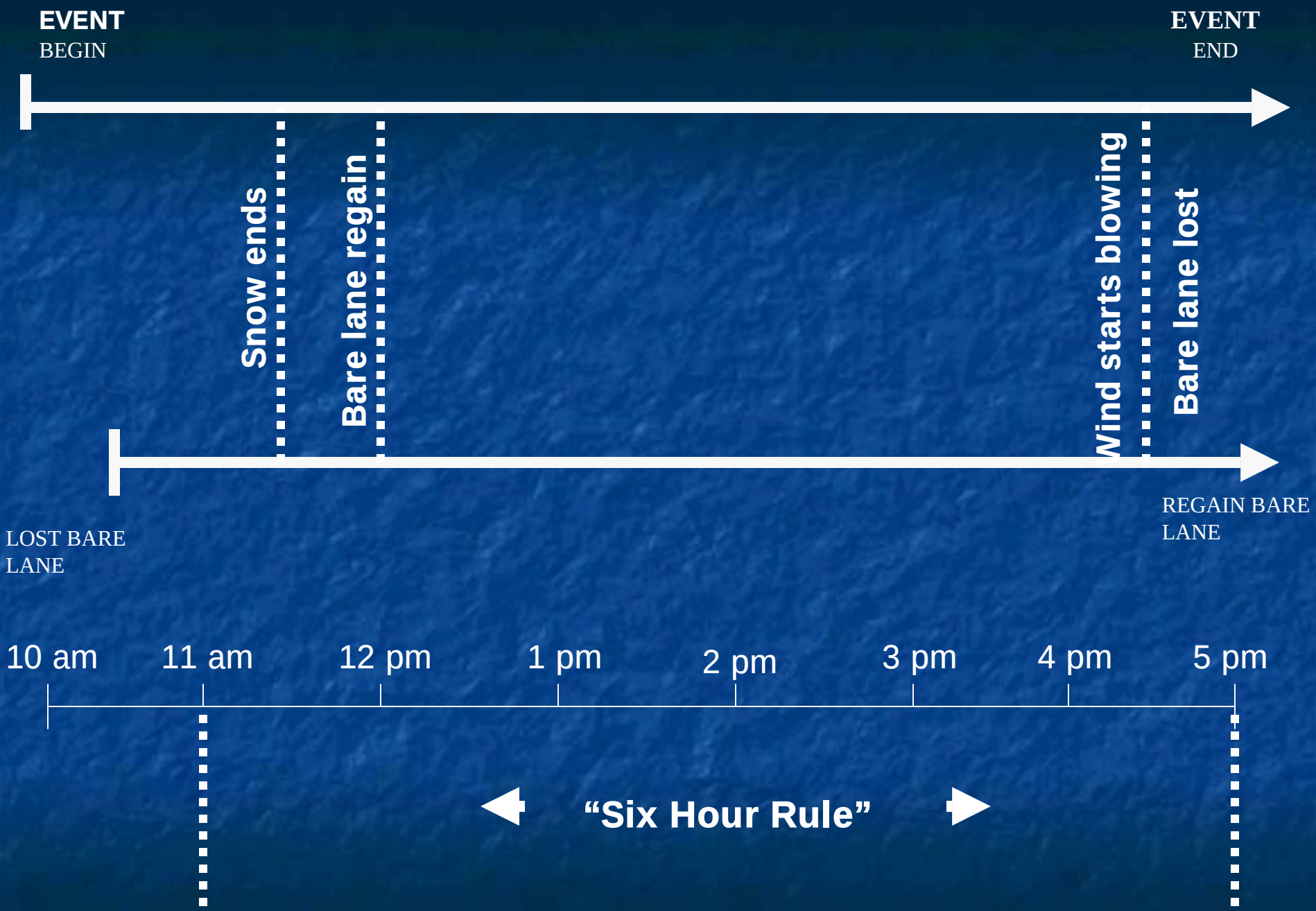
Event "Six Hour Rule"

- If event stops and restarts after six hours, it is then considered a new event.

Event "Six Hour Rule"
Example

- 11:30 am snow and wind ends. 12:00 pm bare lane regained. 4:30 pm wind starts to blow and bare lanes are lost once again.

- Because it is within the six hours the event will continue along with loss of bare lane.


EVENT
BEGIN
EVENT
END
Snow ends
Bare lane regain
Wind starts blowing
Bare lane lost
LOST BARE LANE
REGAIN BARE LANE
10 am
11 am
12 pm
1 pm
2 pm
3 pm
4 pm
5 pm
“Six Hour Rule”

Reporting Bare Lane Regain

- Must record bare lane regain in 1st event before you can start a second event.
- If bare lanes have not been regained before the start of a new event, all non-regained routes must be set to regain at the start of the new event.

Event/Bare Lane Reporting

- Events will be recorded even if bare lanes have not been lost, provided that resources have been used as defined in event definition…

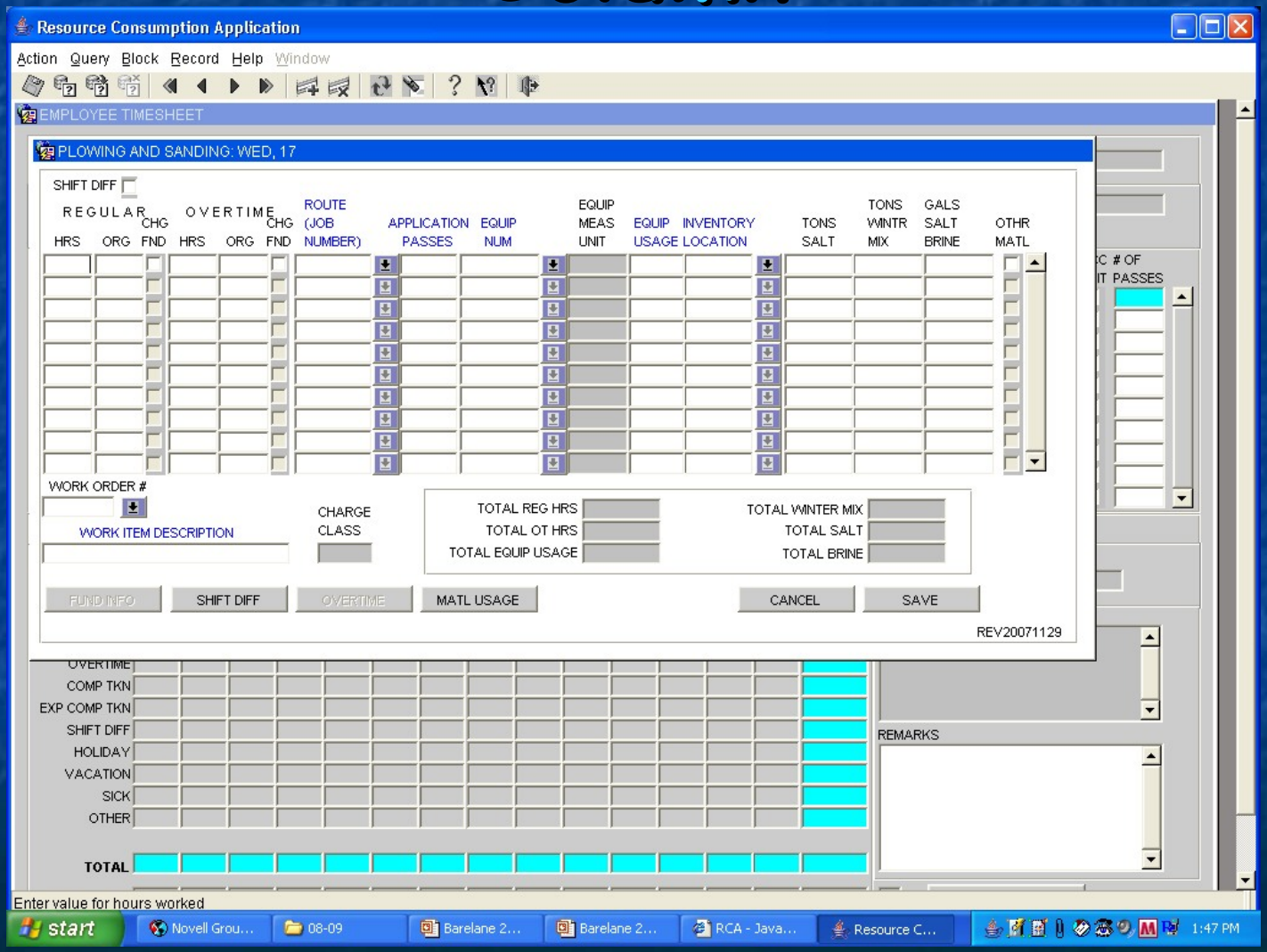
Event/Bare Lane Reporting

- Use best judgment when recording the start or end of an event and when recording bare lanes lost and regained.
- Use weather reports - RWIS - Patrol Dispatch –Dawn Patrol or your Supervisor to help with this task.

Application Passes

- The plowing passes column on the RCA Plowing & Sanding screen has been changed to Application Passes.
- Enter a "0" in this column.

Application Passes "Column"



2007-2008 Snow and Ice Report

Minnesota Department of Transportation
Office of Maintenance

Executive Summary
2007-2008 Snow and Ice

Materials, equipment and labor were consumed to meet Department Target Regain Times for the five maintenance roadway classes: Super Commuter 1 to 3 hours, Urban Commuter 2 to 5 hours, Rural Commuter 6 to 9 hours, Primary 6 to 12 hours and Secondary 9 to 36 hours. These times are measured from the end of a storm event to the time "bare lanes" are regained.

The bare lane criterion was established using customer market research which determined that drivers felt comfortable maintaining posted speeds when the driving lane were clear, even though the center line and edge lines were covered with small amounts of snow.

Additional labor, equipment and materials were used to attain bare "pavement" where all snow and ice were removed from all driving surfaces and pavement markings and to complete storm cleanup. District work plans addressed the procedures for meeting these goals.

ITEMS	QUANTITIES	$FY 2008
Snowfall for season	44.9	
Number of lane miles	30,317	
Statewide salt usage	226,783	
Statewide sand usage	57,190	
Statewide brine usage	2,565,641	
Total Material Costs		$11,882,303
Labor Costs (Regular and Overtime)		$7,990,538
Equipment Costs		$15,485,359
Statewide Average for Labor, Equipment and Material Costs Per Lane Mile		$1,166

SUMMARY OF STATEWIDE SAND AND CHEMICAL USAGE

Winter of	Snowfall* (inches)	Sand (Tons)	TotalChemical (Salt Tons**)	Winter of	Snowfall* (inches)	Sand (Tons)	TotalChemical (Salt Tons**)
1959-60		-	15,035	1983-84	99.0	303,133	126,665
1960-61		-	14,954	1984-85	72.4	255,862	116,939
1961-62		-	23,483	1985-86	69.5	320,014	152,543
1962-63		-	29,658	1986-87	17.3	258,638	115,593
1963-64		-	61,232	1987-88	68.7	300,270	150,043
1964-65		-	76,479	1988-89	70.1	355,456	201,170
1965-66		-	112,937	1989-90	35.5	396,062	150,019
1966-67	78.4	-	143,700	1990-91	43.3	301,408	178,491
1967-68	17.5	-	91,734	1991-92	81.5	334,453	185,216
1968-69	68.1	-	204,205	1992-93	47.4	371,904	191,303
1969-70	63.4	-	172,720	1993-94	39.7	397,798	160,805
1970-71	54.7	-	148,712	1994-95	58.0	277,484	166,499
1971-72	64.2	283,552	116,664	1995-96	75.0	339,931	231,206
1972-73	41.7	269,614	92,343	1996-97	73.0	369,289	251,159
1973-74	51.2	273,525	112,115	1997-98	45.0	262,018	229,723
1974-75	64.2	337,064	148,210	1998-99	56.5	229,263	212,263
1975-76	54.5	298,607	135,249	1999-00	36.2	153,271	171,087
1976-77	43.6	228,876	91,971	2000-01	75.8	301,583	222,894
1977-78	50.7	261,346	107,834	2001-02	65.5	121,798	240,428
1978-79	68.4	240,289	126,394	2002-03	35.0	106,478	180,561
1979-80	53.0	254,882	93,935	2003-04	66.3	111,210	230,918
1980-81	21.1	168,339	56,295	2004-05	26.5	100,105	233,434
1981-82	94.0	295,518	116,929	2005-06	44.4	90,780	273,261
1982-83	74.0	284,761	126,055	2006-07	35.5	51,716	182,386
				2007-08	44.9	57,190	226,783

*Snowfall recorded at Twin Cities International Airport
**Includes salt used in winter-treated sand and brine.

Average Service Level Regain Times, 2007-2008

District	Super Commuter	Urban Commuter	Rural Commuter	Primary	Secondary	All Service Levels Average
1	2.6	6	8.1	11.1	34.9	10.3
2		4	5.5	7.9	10.4	7.3
3	2.3	3.9	5.5	8.4	14.5	5.7
4		2.8	6.7	7.5	11.9	7.1
Metro	1.7	2.9	3.3			2.2
6	4.7	7.2	8.8	13.1		8.9
7	7.1	6.3	7.1	5.9	8.6	6.8
8			5.9	7.1	6.0	6.4
Statewide	2.5	5.3	6.9	8.2	12.9	7.1

Average Labor, Equipment and Material Costs Per Lane Mile By Service Level, 2007-2008

District	Super Commuter	Urban Commuter	Rural Commuter	Primary	Secondary	All Service Levels Average
1	$2,844	$2,506	$1,186	$910	$845	$1,441
2		$1,057	$831	$642	$571	$716
3	$1,671	$1,343	$1,058	$985	$714	$1,155
4		$1,348	$827	$571	$508	$748
Metro	$2,547	$2,236	$1,746			$2,383
6	$1,391	$2,020	$1,312	$1,213		$1,484
7	$925	$619	$508	$497	$434	$533
8			$735	$546	$401	$641
Statewide	$2,323	$1,500	$920	$720	$546	$1,072

*Road classifications not included in districts are left blank. Data is from the WMS program.

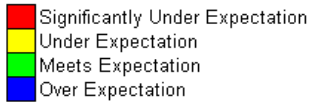
Adjusted Winter Maintenance Material Usage Report, 2007-2008 Season

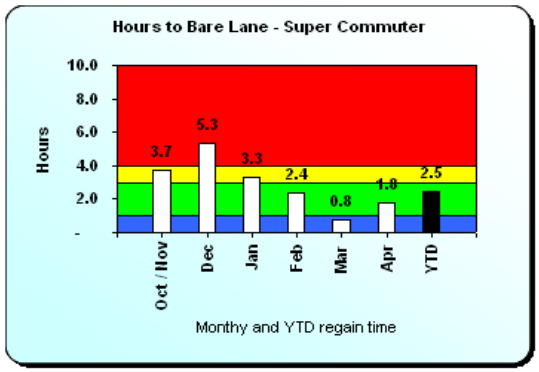
	Salt Usage (Tons)	Sand Usage (Tons)	Brine (Gallons)	Magnesium Chloride (Gallons)	Clear Lane (Tons)	CF7 (Gallons)	LCS (Gallons)
District 1	34,443	16,668	278,503				
District 2	12,678	10,318	113,787		45		
District 3	19,631	884	284,513	22			54,575
District 4	9,606	8,450	132,793	2,700	168	8,600	
Metro	80,055	480	186,998	6,723		5,348	111,596
District 6	40,917	13,965	903,225				9,065
District 7	20,024	1,907	482,367				13,412
District 8	9,429	4,518	183,455	3,313			
Statewide	**226,783**	**57,190**	**2,565,641**	**12,758**	**213**	**13,948**	**188,648**

*Includes all Snow and Ice Activities

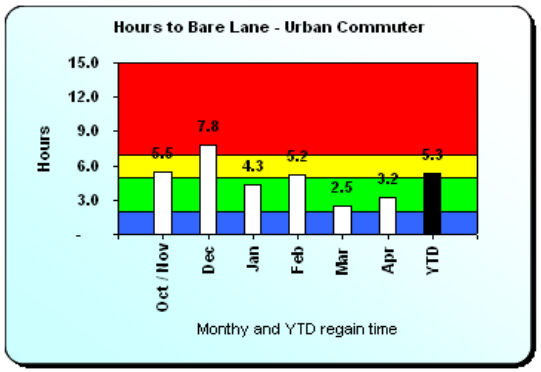
Maintenance: Snow & Ice Removal
Hours to Bare Lane - **Statewide**
Winter 2007 - 2008

Data Period 10/15/2007 to 4/15/2008

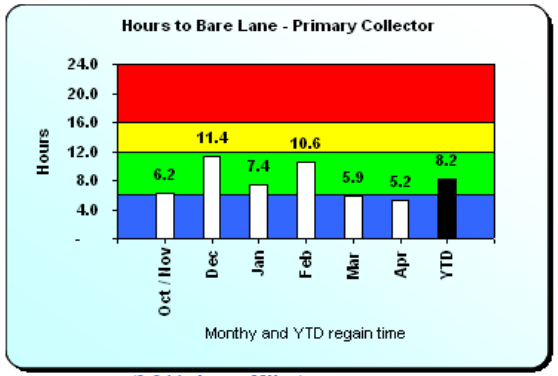




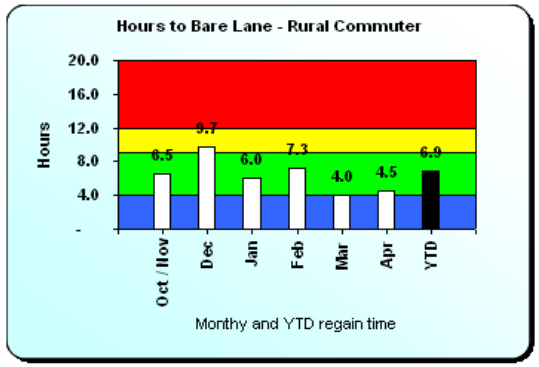
(4,482 Lane Miles)



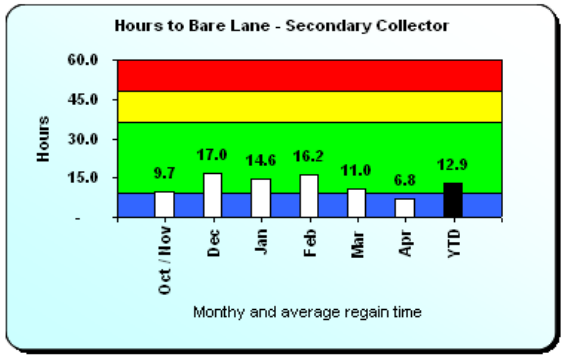
(5,590 Lane Miles)



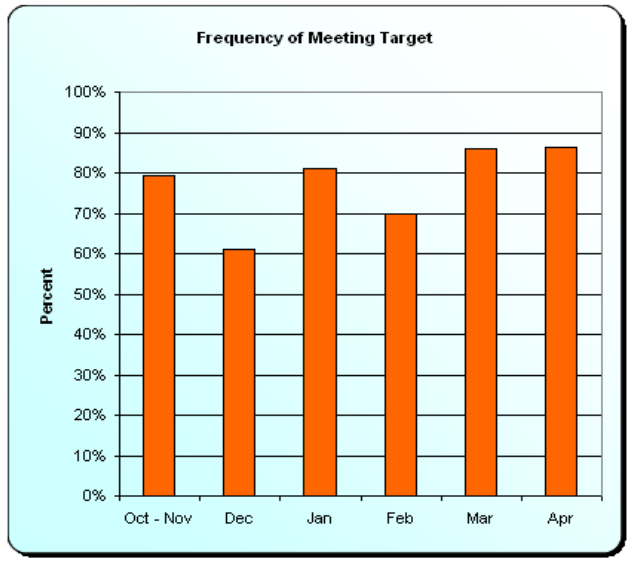
(2,211 Lane Miles)

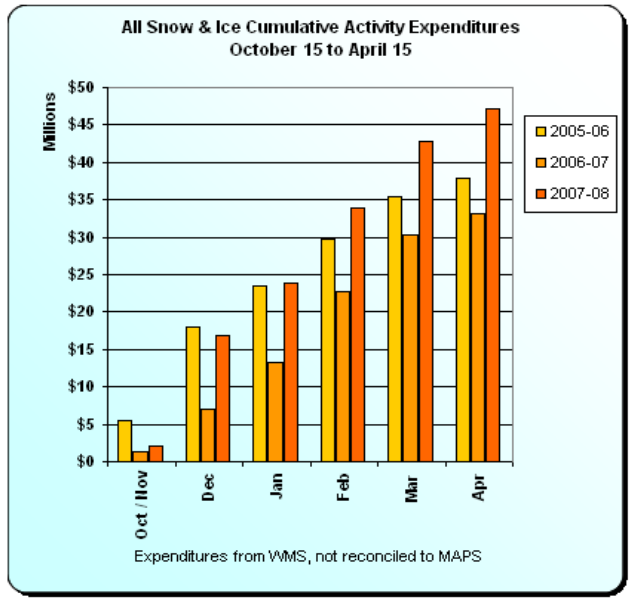


(11,397 Lane Miles)



(6,638 Lane Miles)





(30,317 Lane Miles)

Statewide Labor, Equipment and Material Costs per Service Level, 07-08 S&I Season

Data source is WMS using PPMS Reports

	Regular Hours	Regular Hours Cost	Overtime Hours	Overtime Hours Cost	Total Labor Cost	Equipment Cost	Material Cost	Total Cost
Super Commuter	60,948	$1,223,024	44,319	$1,318,951	$2,578,342	$4,195,071	$3,550,808	$12,971,463
Urban Commuter	51,232	$1,036,062	25,018	$765,349	$1,827,503	$3,546,029	$2,851,541	$8,225,074
Rural Commuter	72,582	$1,466,268	29,599	$903,201	$2,402,005	$5,041,834	$3,734,276	$1,178,115
Primary	30,827	$617,225	10,474	$318,146	$947,363	$2,165,975	$1,380,228	$4,493,567
Secondary	8,107	$160,811	2,391	$72,109	$235,325	$536,448	$365,449	$1,137,223
All Classes Total	223,696	$4,503,390	111,801	$3,377,756	$7,990,538	$15,485,357	$11,882,302	$28,005,442

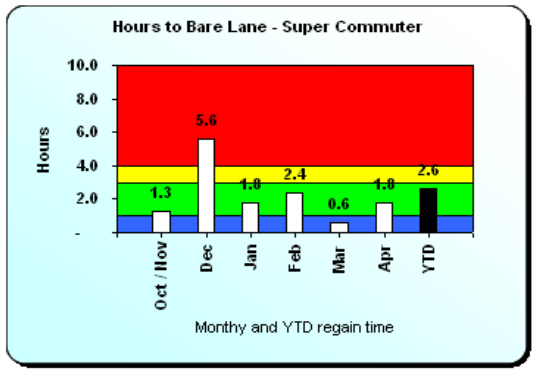
Note: The data above is costs for activity 2406, Plowing and Sanding, only.

Maintenance: Snow & Ice Removal
Hours to Bare Lane - **District 1**
Winter 2007 - 2008

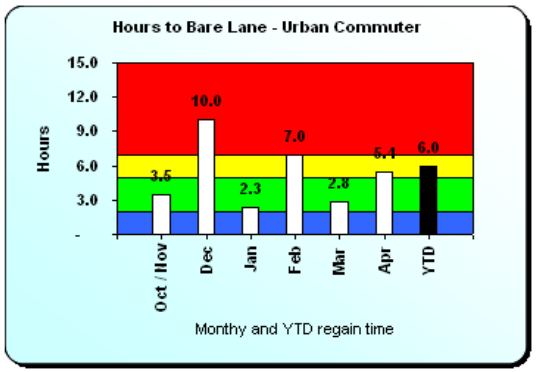
Data Period 10/15/2007 to 4/15/2008

Significantly Under Expectation
Under Expectation
Meets Expectation
Over Expectation

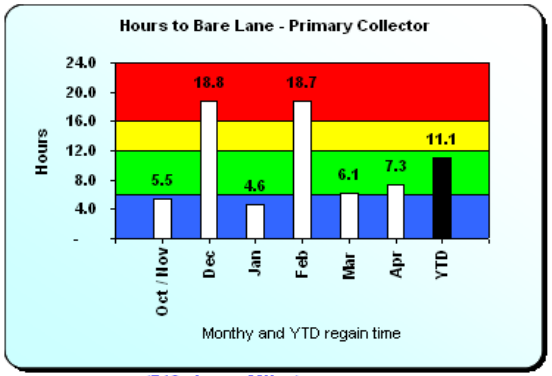
Notes: Jeff Hall



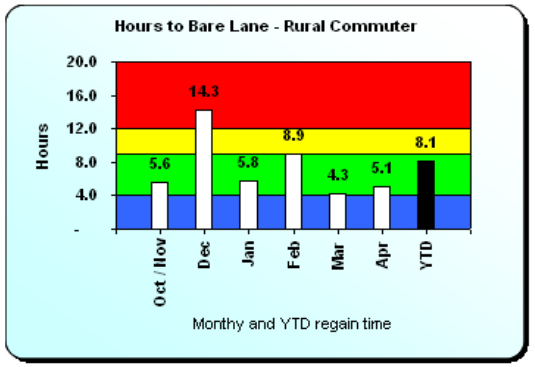
(96 Lane Miles)



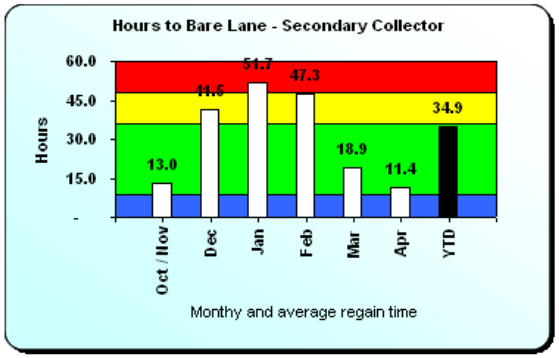
(632 Lane Miles)



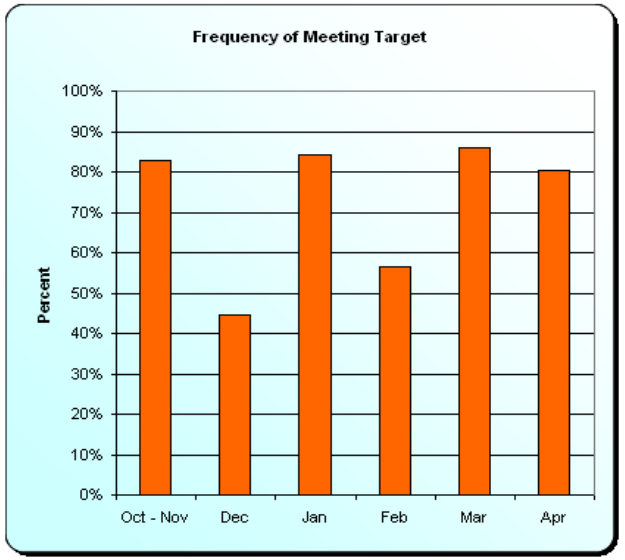
(518 Lane Miles)

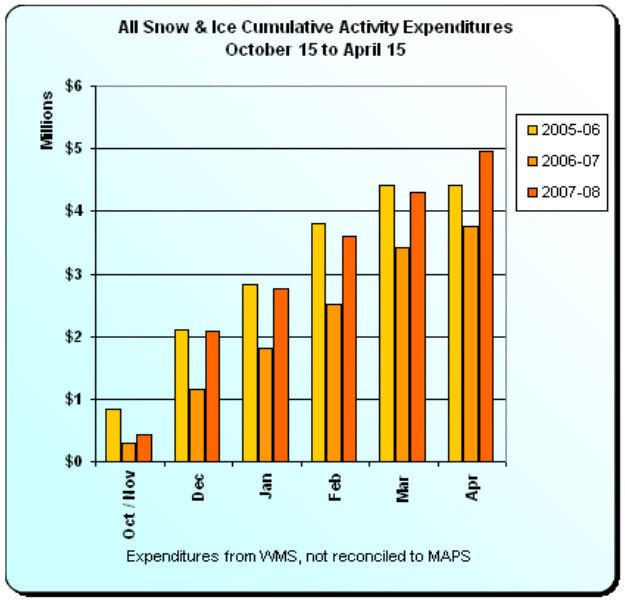


(1,671 Lane Miles)



(831 Lane Miles)





(3,748 Lane Miles)

Maintenance: Snow & Ice Removal

District 1

Snow Accumulation Reporting	Duluth International Airport	Cook County Airport	International Falls	Floodwood	Hinckley	Average Accumulation
Month Accumulation	14.6	18.1	23.5	17	13.2	17.3
Season to date Accumulation	78	92.5	94.6	51.8	48	73.0

	Apr-07	Apr-08	Average # of Events to date for 07-08 Season
Snow Events:	1	3	38
Freezing Rain Events:	0	0	6

Material Usage:	Apr-07	Apr-08	Total to date for 07-08 Season
Salt (tons)	3,719	4,826	34,443
Sand (tons)	814	1,365	16,668
Brine (gal)	9,105	12,551	278,503
Other Materials:			
Mag Chl	4,535	7,548	87,213

Comments

District 1 had 2 Major events in April. The event on the 6th came thru from the SW to NE and dumped up to 33 inches of wet heavy Snow in the Virginia - Hibbing areas. The event of the 10th -11th & 12 again followed the same track but stayed further south in the District and left another 4-15" of wet heavy snow with winds in excess of 55mph. D1 had 2 late April weekend events on the 19th & 26. A very busy April for District 1.

Back Next

District 1 Labor, Equipment and Material Costs per Service Level, 07-08 S&I Season

Data source is WMS using PPMS Reports

	Regular Hours	Regular Hours Cost	Overtime Hours	Overtime Hours Cost	Total Labor Cost	Equipment Cost	Material Cost	Total Cost
Super Commuter	1,397	$28,159	640	$19,841	$48,783	$92,263	$66,487	$207,533
Urban Commuter	6,605	$136,834	3,025	$93,042	$233,383	$458,792	$389,830	$1,082,005
Rural Commuter	12,729	$257,407	5,143	$155,889	$419,415	$878,559	$753,862	$2,051,835
Primary	3,363	$68,046	1,388	$42,269	$111,846	$244,817	$255,028	$611,691
Secondary	2,790	$54,814	791	$23,744	$79,508	$165,516	$160,704	$405,727
All Classes Total	26,884	$545,260	10,987	$334,785	$892,935	$1,839,947	$1,625,911	$4,358,791

Note: The data above is costs for activity 2406, Plowing and Sanding, only.

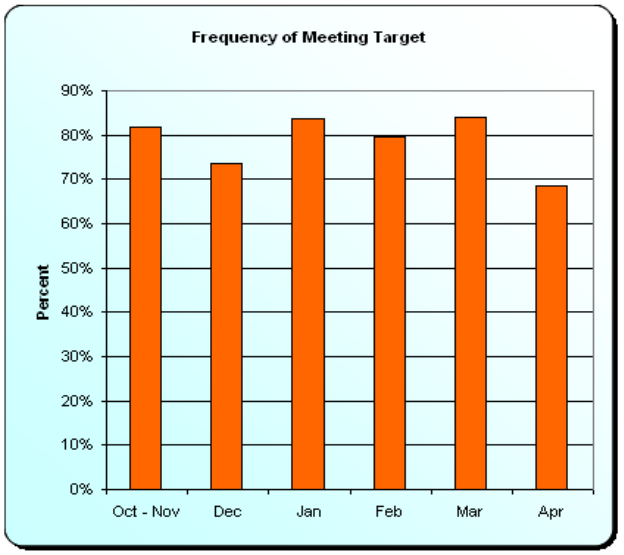
Back Next

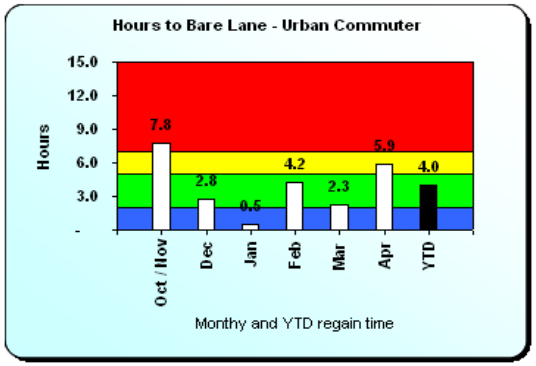
Maintenance: Snow & Ice Removal
Hours to Bare Lane - **District 2**
Winter 2007 - 2008

Data Period 10/15/2007 to 4/15/2008

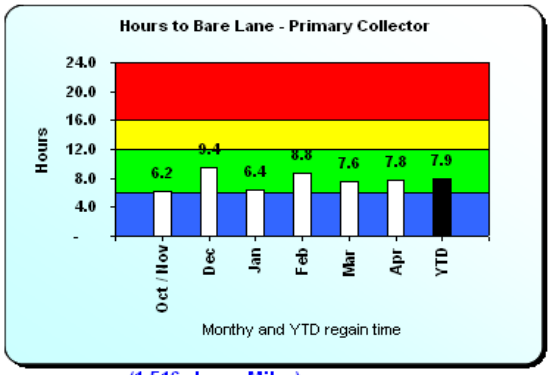
- Significantly Under Expectation
- Under Expectation
- Meets Expectation
- Over Expectation

Notes: Mary Swenson

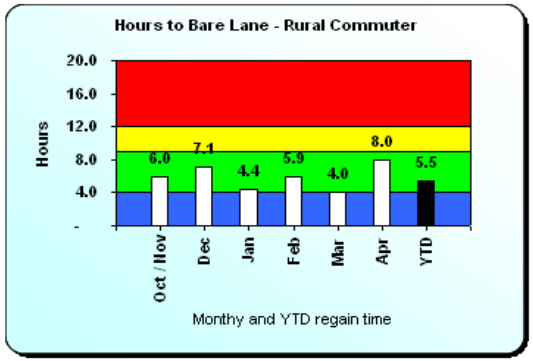




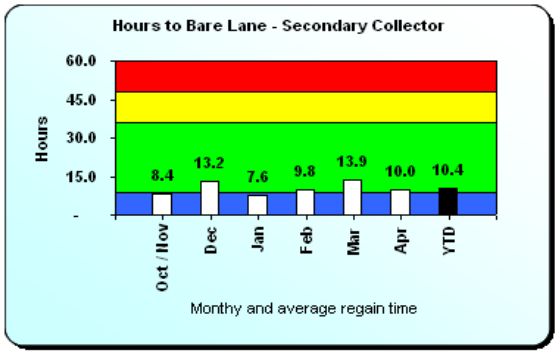
(63 Lane Miles)



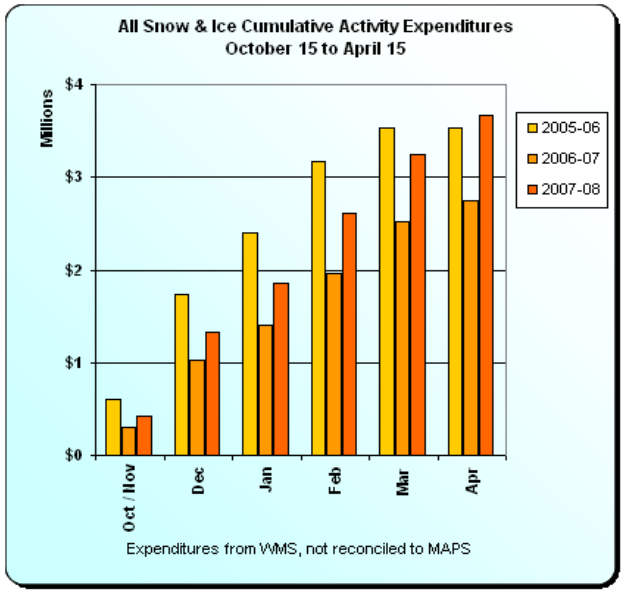
(1,516 Lane Miles)



(1,714 Lane Miles)



(624 Lane Miles)



(3,917 Lane Miles)

Maintenance: Snow & Ice Removal

District 2

Snow Accumulation	Bemidji	Baudette	Crookston	Park Rapids	Average Accumulation
Reporting Month Accumulation	40	26	24	44	33.5
Season to date Accumulation	89.0	67.5	65.5	71.5	73.4

	Apr-07	Apr-08	Average # of Events to date for 07-08
Snow Events:	1	1	15
Freezing Rain Events:	1	1	14

Material Usage:

	Apr-07	Apr-08	Total to date for 07-08 Season
Salt (tons)	1,067	1,563	11,200
Sand (tons)	630	770	8,769
Brine (gal)	7,013	7,810	112,710
Other Materials:			
Clear Lane	2	0	44

Comments

April temps ranged from 19 as our low and 62 as our high. Wind speeds were from 12 mph gusting to 39 mph. The east side of our district was hit hard with snow accumulations from 12 to 27 inches or more each storm. Wet heavy snow with compaction was our fight. The crews did an excellent job!

Back Next

2
0
Hours

District 2 Labor, Equipment and Material Costs per Service Level, 07-08 S&I Season

Data source is WMS using PPMS Reports

	Regular Hours	Regular Hours Cost	Overtime Hours	Overtime Hours Cost	Total Labor Cost	Equipment Cost	Material Cost	Total Cost
Super Commuter	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Urban Commuter	359	$7,600	268	$8,508	$16,285	$28,475	$12,574	$57,334
Rural Commuter	8,757	$178,366	4,058	$123,998	$305,322	$675,743	$367,412	$1,348,477
Primary	6,167	$123,932	2,325	$70,214	$195,809	$456,530	$223,006	$874,435
Secondary	2,824	$55,867	845	$25,583	$81,969	$191,756	$95,861	$369,586
All Classes Total	18,107	$365,765	7,496	$228,303	$599,385	$1,352,504	$698,853	$2,649,832

Note: The data above is costs for activity 2406, Plowing and Sanding, only.

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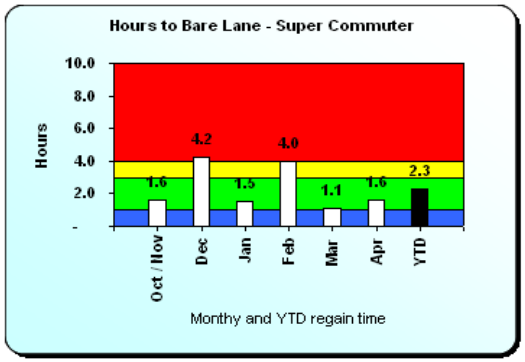
Maintenance: Snow & Ice Removal
Hours to Bare Lane - **District 3**
Winter 2007 - 2008

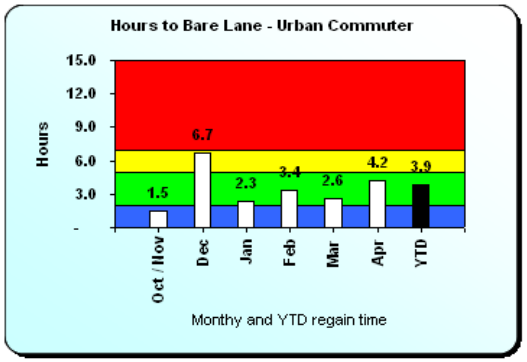
Data Period 10/15/2007 to 4/15/2008

Significantly Under Expectation
Under Expectation
Meets Expectation
Over Expectation

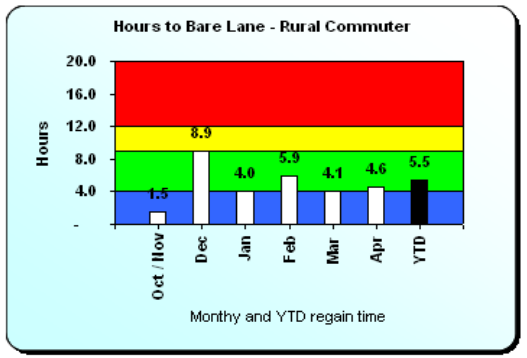
Notes: Randy Reznicek



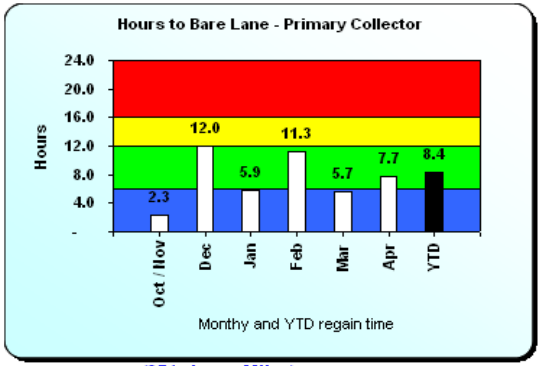
(368 Lane Miles)



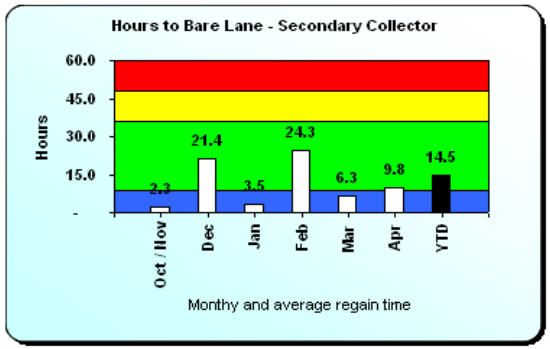
(1,246 Lane Miles)



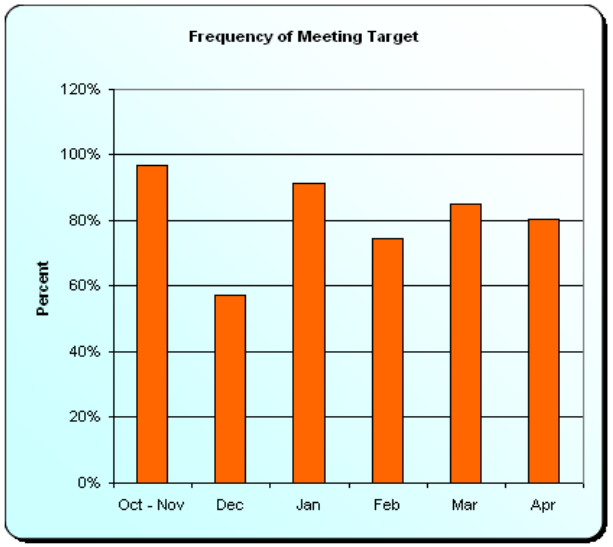
(1,560 Lane Miles)

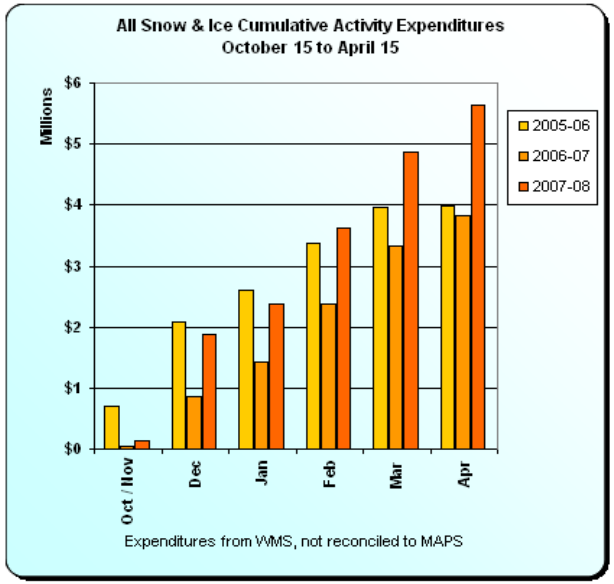


(851 Lane Miles)



(24 Lane Miles)





(4,050 Lane Miles)

District 3

Snow Accumulation	St. Cloud Airport	Cambridge	Crow Wing County Airport	Remer Airport	Average Accumulation
Reporting Month Accumulation	10.9	5	23	17	14
Season to date Accumulation	52.1	47.1	55.4	59.8	53.6

	Apr-07	Apr-08	Average # of Events to date for 07-08 Season
Snow Events:	0	3.2	26.8
Freezing Rain Events:		0	0

Material Usage:			Total to date for 07-08 Season
Salt (tons)		4,539.35	28,977
Sand (tons)		26	1,022
Brine (gal)		35,233	379,771
Other Materials:			
		LCS 650	77,267

Comments

District 3 had three different storms of heavy wet snow accumulations of varying degrees.
Paynesville, Sauk Centre and the 3A Baxter area received double digit accumulations in the last event of April. St. Cloud 3B received a portion of all 3 of the April storms with

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District 3 Labor, Equipment and Material Costs per Service Level, 07-08 S&I Season

Data source is WMS using PPMS Reports

	Regular Hours	Regular Hours Cost	Overtime Hours	Overtime Hours Cost	Total Labor Cost	Equipment Cost	Material Cost	Total Cost
Super Commuter	3,190	65,485	1,395	42,057	109,064	254,646	198,669	562,379
Urban Commuter	9,805	$196,515	3,825	$116,912	$317,935	$738,129	$513,557	$1,569,623
Rural Commuter	8,866	$177,023	3,777	$115,709	$296,525	$699,352	$524,079	$1,519,956
Primary	4,209	$84,076	1,506	$46,224	$131,923	$306,638	$202,458	$641,019
Secondary	91	$1,896	21	$683	$2,607	$6,578	$8,275	$17,461
All Classes Total	26,161	$524,995	10,524	$321,585	$858,054	$2,005,343	$1,447,038	$4,310,438

Note: The data above is costs for activity 2406, Plowing and Sanding, only.

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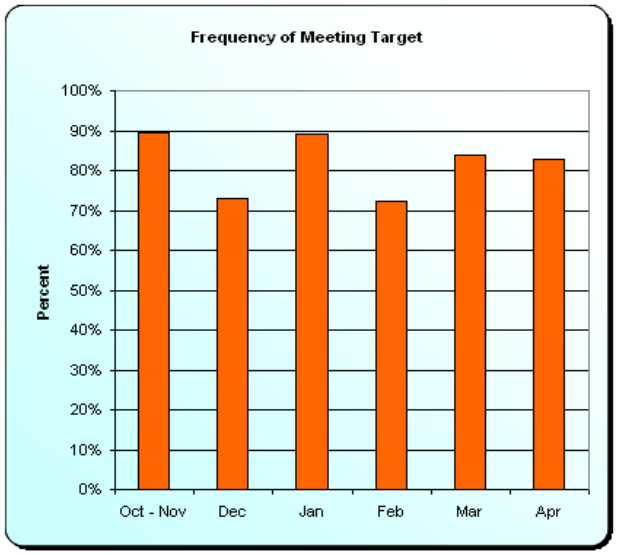
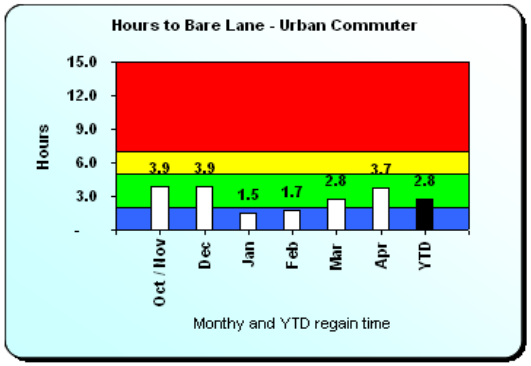
Maintenance: Snow & Ice Removal
Hours to Bare Lane - **District 4**
Winter 2007 - 2008

Data Period 10/15/2007 to 4/15/2008

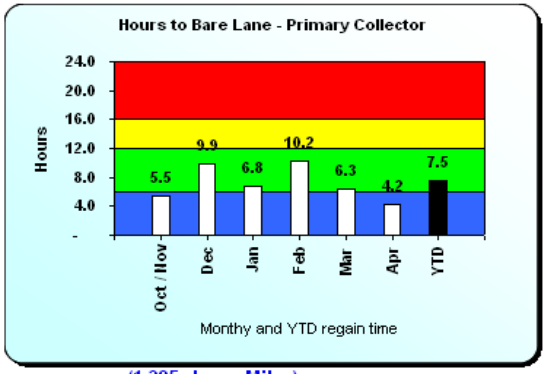
- Significantly Under Expectation
- Under Expectation
- Meets Expectation
- Over Expectation

Notes: Dennis Redig

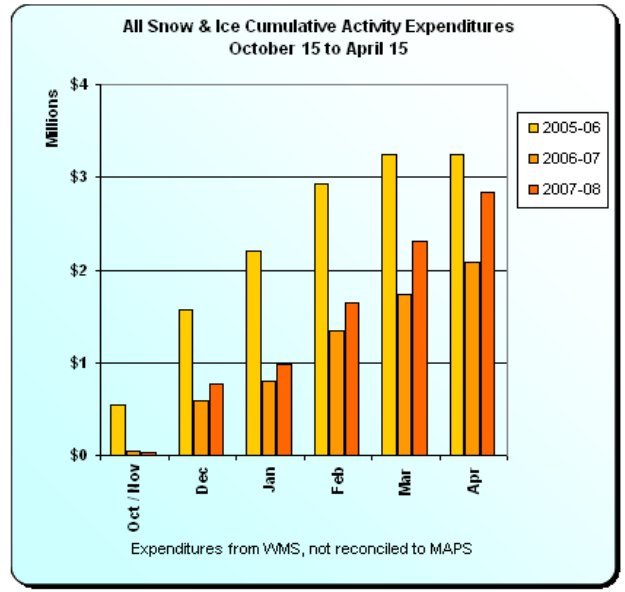




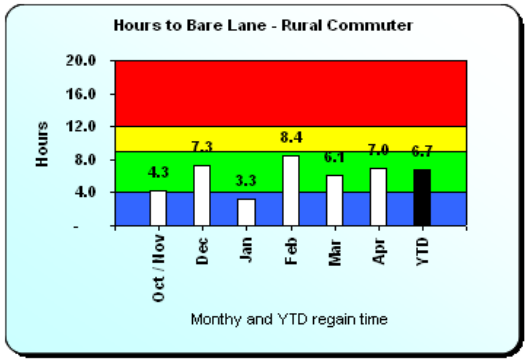
(656 Lane Miles)



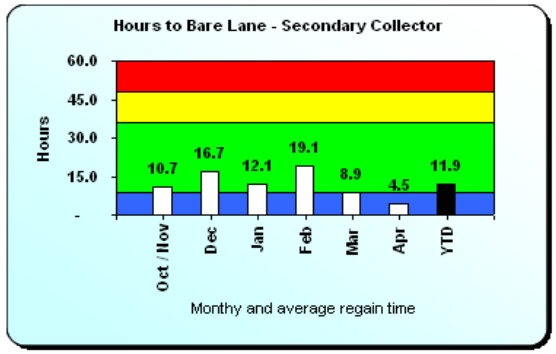
(1,385 Lane Miles)



(3,665 Lane Miles)



(1,124 Lane Miles)



(501 Lane Miles)

District 4

Snow Accumulation	Morris	Detroit Lakes	Breckenridge	Alexandria	Average Accumulation
Reporting Month Accumulation	21	34	16	15.4	21.6
Season to date accumulation	56.3	64.3	51.5	51.6	55.9

	Apr-07	Apr-08	Average # of Events to date for 07-08 Season
Snow Events:	3	4	24
Freezing Rain Events:	0	0	1

Material Usage:	Apr-07	Apr-08	Total to date for 07-08 Season
Salt (tons)	1,750	2,555	9,606
Sand (tons)	1,482	1,342	8,450
Brine (gal)	12,784	10,566	132,793
Other Materials:			
CF 7		500	8,600
Mag Cl			2,700
clear lane			168 ton

Comments

SNOW - SNOW - AND MORE SNOW

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District 4 Labor, Equipment and Material Costs per Service Level, 07-08 S&I Season

Data source is WMS using PPMS Reports

	Regular Hours	Regular Hours Cost	Overtime Hours	Overtime Hours Cost	Total Labor Cost	Equipment Cost	Material Cost	Total Cost
Super Commuter	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Urban Commuter	4,490	$92,455	2,292	$70,327	$165,057	$351,166	$245,301	$761,524
Rural Commuter	5,513	$113,238	2,439	$74,117	$189,865	$413,000	$220,700	$823,565
Primary	5,805	$113,236	2,086	$61,837	$177,563	$436,587	$182,072	$796,222
Secondary	1,514	$29,791	547	$16,378	$46,691	$116,099	$60,812	$223,602
All Classes Total	17,322	$348,720	7,364	$222,659	$579,176	$1,316,852	$708,885	$2,604,913

Note: The data above is costs for activity 2406, Plowing and Sanding, only.

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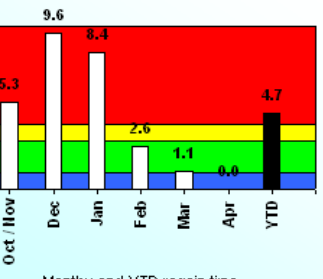
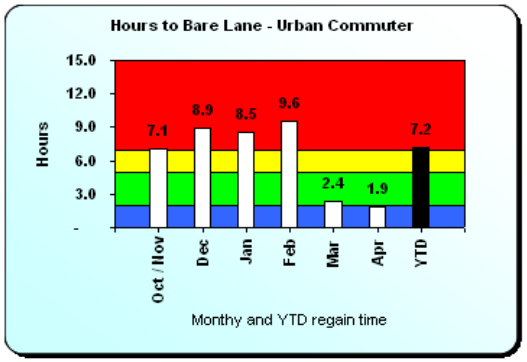
Maintenance: Snow & Ice Removal
Hours to Bare Lane - **District 6**
Winter 2007 - 2008

Data Period 10/15/2007 to 4/15/2008

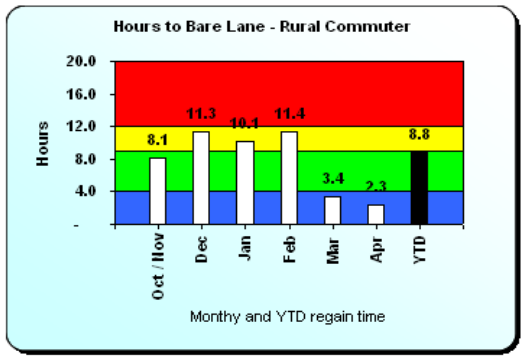


Notes: Brian Wolfgram

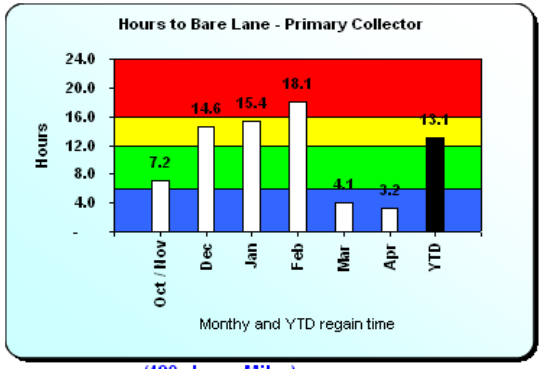
(323 Lane Miles)



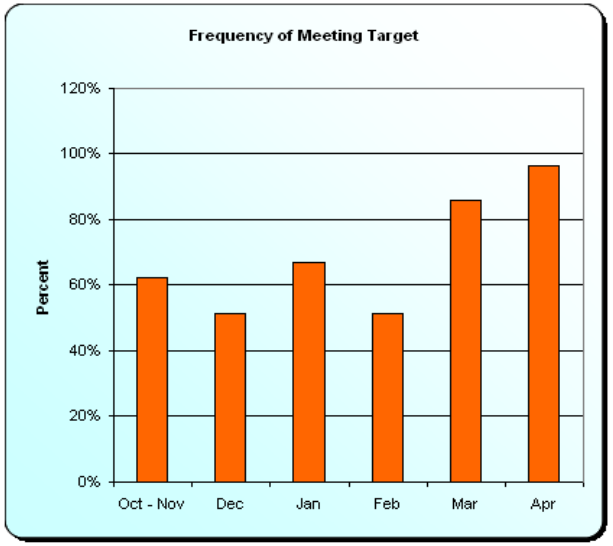
(1,196 Lane Miles)

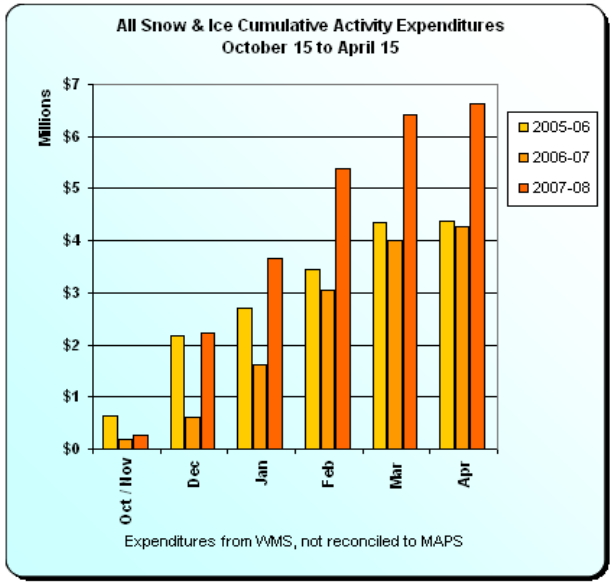


(1,799 Lane Miles)



(480 Lane Miles)





(3,798 Lane Miles)

Maintenance: Snow & Ice Removal

District 6

Snow Accumulation	Albert Lea	Faribault	Red Wing	LaCrosse	Rochester	Average Accumulation
Reporting Month Accumulation	1			0.8	0.8	0.9
Season to date Accumulation	32.8	24.8		67.9	44.1	42.4

	Apr-07	Apr-08	Average # of Events to date for 07-08 Season
Snow Events:	1	2	39
Freezing Rain Events:			1

Material Usage:	Apr-07	Apr-08	Total to date for 07-08 Season
Salt (tons)	2,620	2,378	39,857
Sand (tons)	230	145	13,965
Brine (gal)	4,855	12,613	903,255
Other Materials:			
LCS			9,065

Comments

The winter season proved to be a strong one for the southeast. Plenty of snow, wind and cold temperatures came at us starting November 21st and ending April 12th. There were 25 A shift splits and 32 B shift splits, along with working 12 weekends and 3 Holidays. The biggest challenges were the very high winds along with sub-zero temperatures.

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District 6 Labor, Equipment and Material Costs per Service Level, 06-07 S&I Season

Data source is WMS using PPMS Reports

	Regular Hours	Regular Hours Cost	Overtime Hours	Overtime Hours Cost	Total Labor Cost	Equipment Cost	Material Cost	Total Cost
Super Commuter	2,354	$47,529	929	$28,626	$77,319	$154,658	$138,885	$370,862
Urban Commuter	14,446	$285,623	6,316	$191,922	$484,410	$945,808	$757,335	$2,187,553
Rural Commuter	14,713	$292,069	6,896	$208,984	$507,708	$1,059,551	$756,069	$2,323,328
Primary	3,432	$568,901	1,573	$48,293	$118,690	$251,722	$199,371	$569,784
Secondary	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
All Classes Total	34,945	$1,194,122	15,714	$477,825	$1,188,127	$2,411,739	$1,851,660	$5,451,527

Note: The data above is costs for activity 2406, Plowing and Sanding, only.

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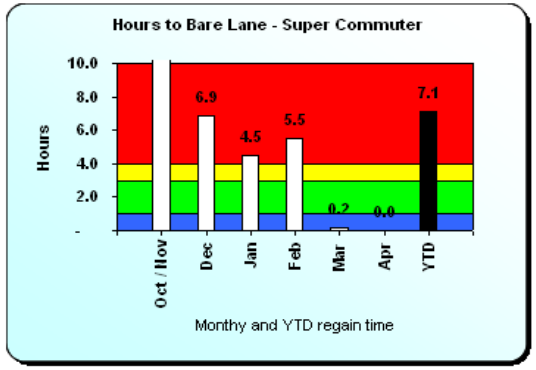
Maintenance: Snow & Ice Removal
Hours to Bare Lane - **District 7**
Winter 2007 - 2008

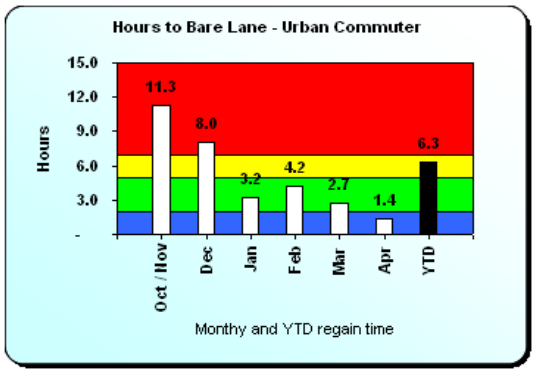
Data Period 10/15/2007 to 4/15/2008

Significantly Under Expectation
Under Expectation
Meets Expectation
Over Expectation

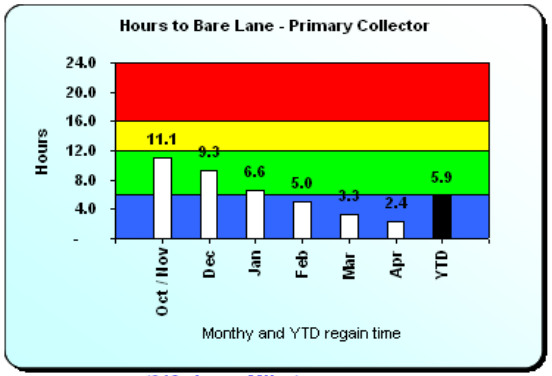
Notes: Thomas Zimmerman



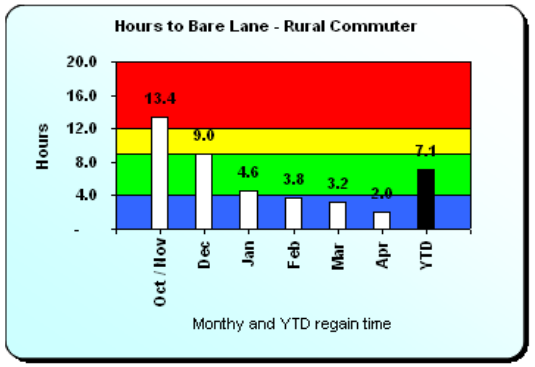
(30 Lane Miles)



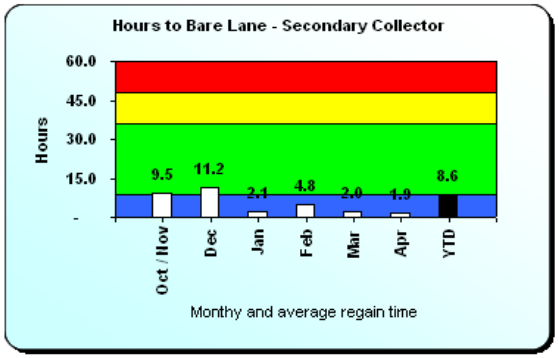
(993 Lane Miles)



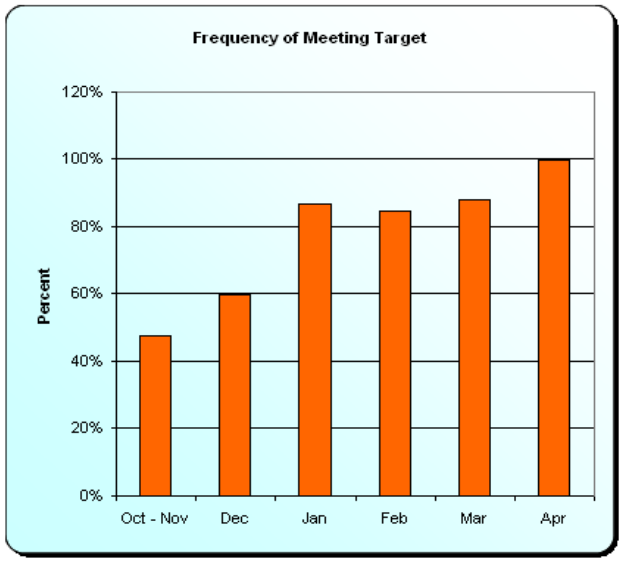
(643 Lane Miles)

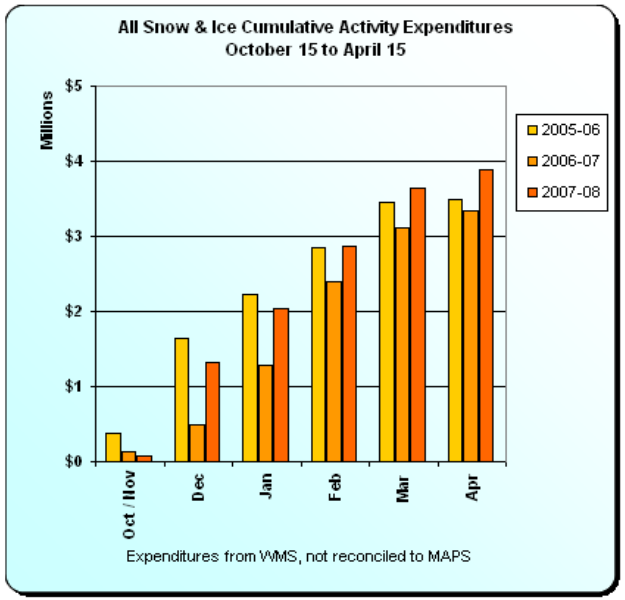


(1,546 Lane Miles)



(109 Lane Miles)





(3,321 Lane Miles)

District 7

Snow Accumulation Reporting Month	Worthington	St. James	Gaylord	Amboy	Average Accumulation
Accumulation	10.0	7.0	10.5	3.5	7.8
Season to date Accumulation	48.5	42.5	38.3	43.5	43.2

	Apr-07	Apr-08	Average # of Events to date for 07-08 Season
Snow Events:	1	2.1	23.7
Freezing Rain Events:	5	0	2.3

Material Usage:

	Apr-07	Apr-08	Total to date for 07-08 Season
Salt (tons)	1,474	1,292	19,968
Sand (tons)	81	237	2,077
Brine (gal)	7,497	9,536	482,367
Other Materials:			
LCS			13,411

Comments

This past winter was a bit colder than the past few winters. Snowfall generally was accompanied with strong winds and falling temperatures which affected the regain times and chemical usage. Overall, this winter was a little worse than our historical average with slightly higher chemical usage. Late, heavy snowfalls toward the end of March and in April pushed us past our averages.

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District 7 Labor, Equipment and Material Costs per Service Level, 07-08 S&I Season

Data source is WMS using PPMS Reports

	Regular Hours	Regular Hours Cost	Overtime Hours	Overtime Hours Cost	Total Labor Cost	Equipment Cost	Material Cost	Total Cost
Super Commuter	244	$4,903	135	$4,053	$9,076	$20,870	$25,580	$55,526
Urban Commuter	6,604	$132,449	2,187	$65,849	$200,968	$406,844	$387,562	$995,374
Rural Commuter	9,862	$199,142	2,824	$86,625	$289,731	$572,255	$514,017	$1,376,003
Primary	3,024	$61,261	724	$22,422	$84,714	$173,637	$138,784	$397,134
Secondary	536	$11,098	129	$3,970	$15,289	$34,141	$24,647	$74,077
All Classes Total	20,270	$408,853	5,999	$182,919	$599,778	$1,207,747	$1,090,590	$2,898,114

Note: The data above is costs for activity 2406, Plowing and Sanding, only.

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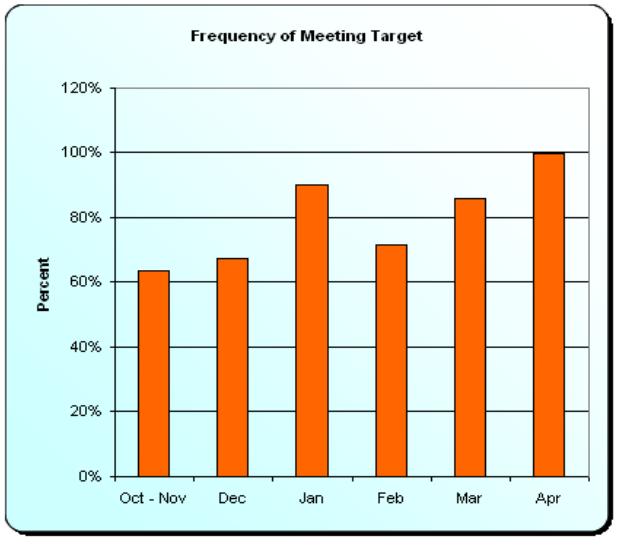
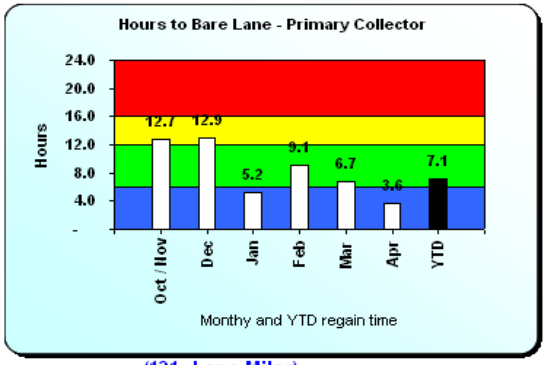
Maintenance: Snow & Ice Removal
Hours to Bare Lane - **District 8**
Winter 2007 - 2008

Data Period 10/15/2007 to 4/15/2008

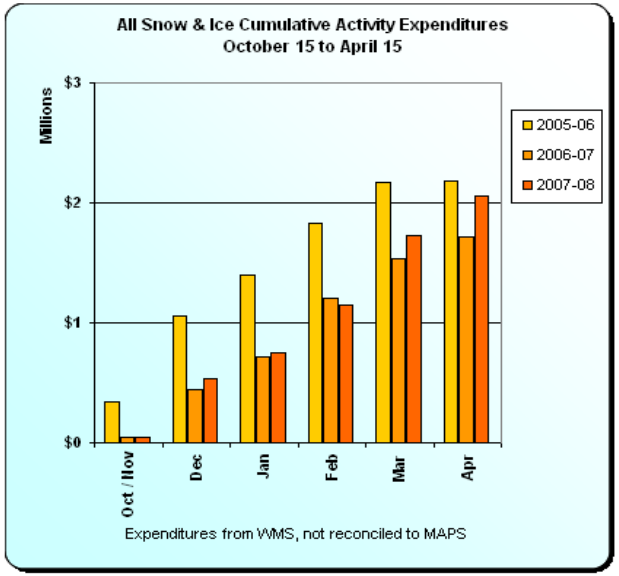
- Significantly Under Expectation
- Under Expectation
- Meets Expectation
- Over Expectation

Notes: Jeff Butson

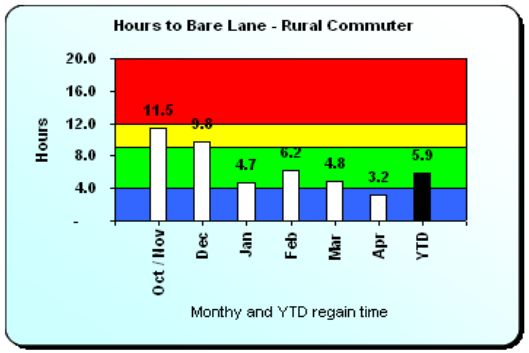




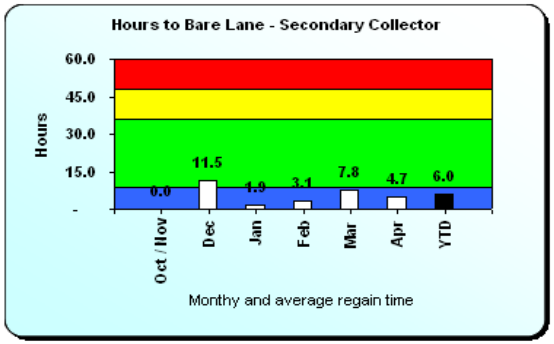
(121 Lane Miles)



(2,893 Lane Miles)



(1,527 Lane Miles)



(1,245 Lane Miles)

Maintenance: Snow & Ice Removal

12.1

District 8

Snow Accumulation	Pipestone	Milan	Marshall	Litchfield	Average Accumulation
Reporting Month Accumulation	7.0	26.5	7.2	13.8	13.6
Season to date Accumulation	37.4	73.8	28.7	49.5	47.4

	Apr-07	Apr-08	Average # of Events to date for 07-08 Season
Snow Events:	2	3	21
Freezing Rain Events:	0	0	1

Material Usage:

	Apr-07	Apr-08	Total to date for 07-08 Season
Salt (tons)	1,048	1,654	9,429
Sand (tons)	467	694	4,518
Brine (gal)	5,136	19,912	183,455
Other Materials:			
MgCL	354	0	3,313

Comments

D8 had three wet & windey snow events for April. The West part of the district in Milan had 15" on April 11th & 15" on March 21.

Back Next

District 8 Labor, Equipment and Material Costs per Service Level, 07-08 S&I Season

Data source is WMS using PPMS Reports

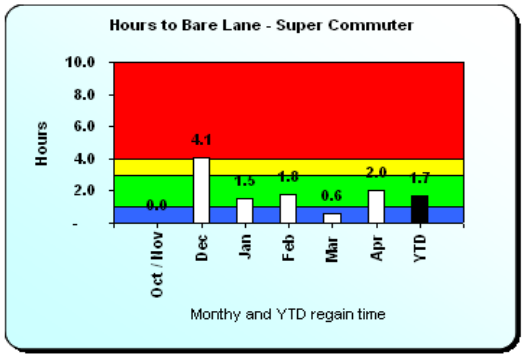
	Regular Hours	Regular Hours Cost	Overtime Hours	Overtime Hours Cost	Total Labor Cost	Equipment Cost	Material Cost	Total Cost
Super Commuter	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Urban Commuter	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Rural Commuter	8,525	$174,695	1,561	$47,895	$226,600	$498,721	$364,459	$1,089,780
Primary	4,825	$97,773	873	$26,887	$126,728	$296,044	$179,509	$602,281
Secondary	351	$7,344	57	$1,752	$9,262	$22,358	$15,151	$46,771
All Classes Total	13,701	$279,812	2,491	$76,534	$362,590	$817,123	$559,119	$1,738,832

Note: The data above is costs for activity 2406, Plowing and Sanding, only.

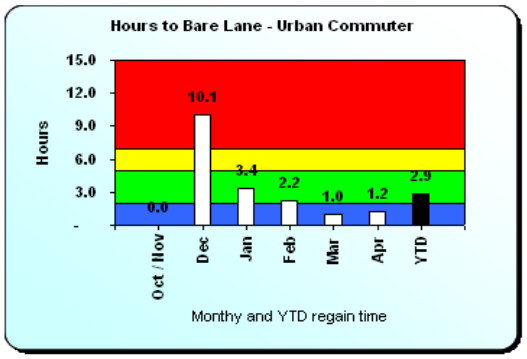
Back Next

Maintenance: Snow & Ice Removal
Hours to Bare Lane - **Metro**
Winter 2007 - 2008

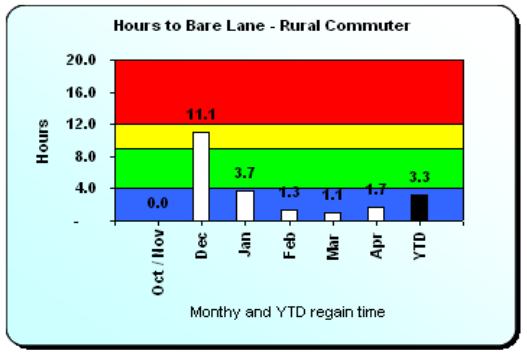
Data Period 10/15/2007 to 4/15/2008



(3,665 Lane Miles)

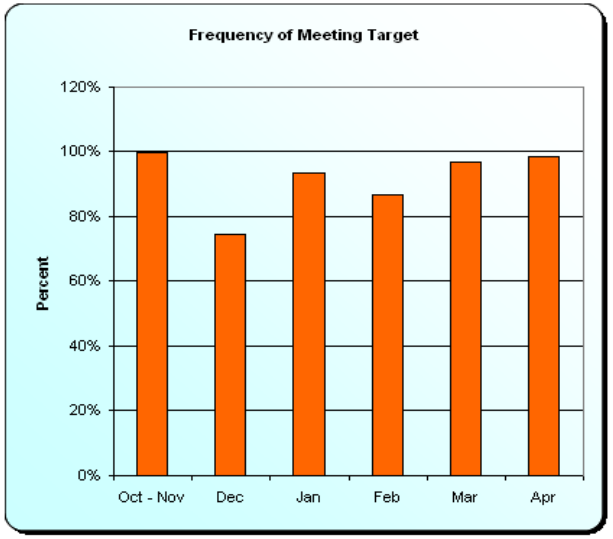


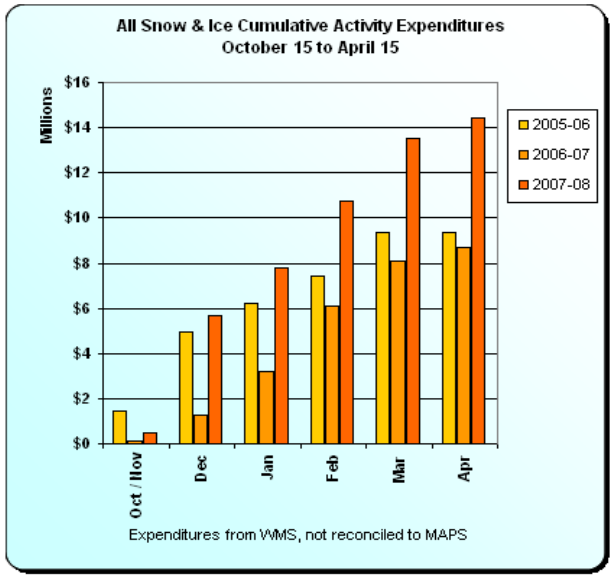
(804 Lane Miles)



(456 Lane Miles)

Notes: Norm Ashfeld





(4,925 Lane Miles)

Maintenance: Snow & Ice Removal

District Metro

Snow Accumulation	SE-MSP Airport	SW-Chanhassen	NE-Harris (I35W)	NW-Maple Grove (I94)	Average Accumulation
Reporting Monthly Accumulation	1.6	3.8	3.4	0.4	2.3
Season to date accumulation	44.9	60.5	43.2	38.5	46.8

	Apr-07	Apr-08	Average # of Events to date for 07-08 Season
Snow Events:	3	3	33
Freezing Rain Events:	0	0	1

Material Usage:	Apr-07	Apr-08	Total to date for 07-08 Season
Salt (tons)	3,963	4,942	80,055
Sand (tons)	11	0	480
Brine (gal)	5,010	3,255	186,998
Other Materials:			
	LCS	2,920	111,596
	MAG	82	6,723

Comments

The first couple of weeks in April was cold with lite snow. Metro had a couple of inches of snow from the 10th to the 12th, but missed the worst of the storm that west and north of the cities received.

Back Next

Metro District Labor, Equipment and Material Costs per Service Level, 07-08 S&I Season

Data source is WMS using PPMS Reports

	Regular Hours	Regular Hours Cost	Overtime Hours	Overtime Hours Cost	Total Labor Cost	Equipment Cost	Material Cost	Total Cost
Super Commuter	53,681	$1,075,299	41,139	$1,221,811	2,329,817	$3,667,972	$3,120,471	$9,118,260
Urban Commuter	8,919	$184,465	7,092	$218,421	$408,978	$616,603	$545,381	$1,570,961
Rural Commuter	3,610	$74,190	2,894	$89,695	$166,406	$244,124	$233,453	$643,982
Primary	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Secondary	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
All Classes Total	66,210	$1,333,954	51,125	$1,529,927	$2,905,201	$4,528,699	$3,899,305	$11,333,203

Note: The data above is costs for activity 2406, Plowing and Sanding, only.

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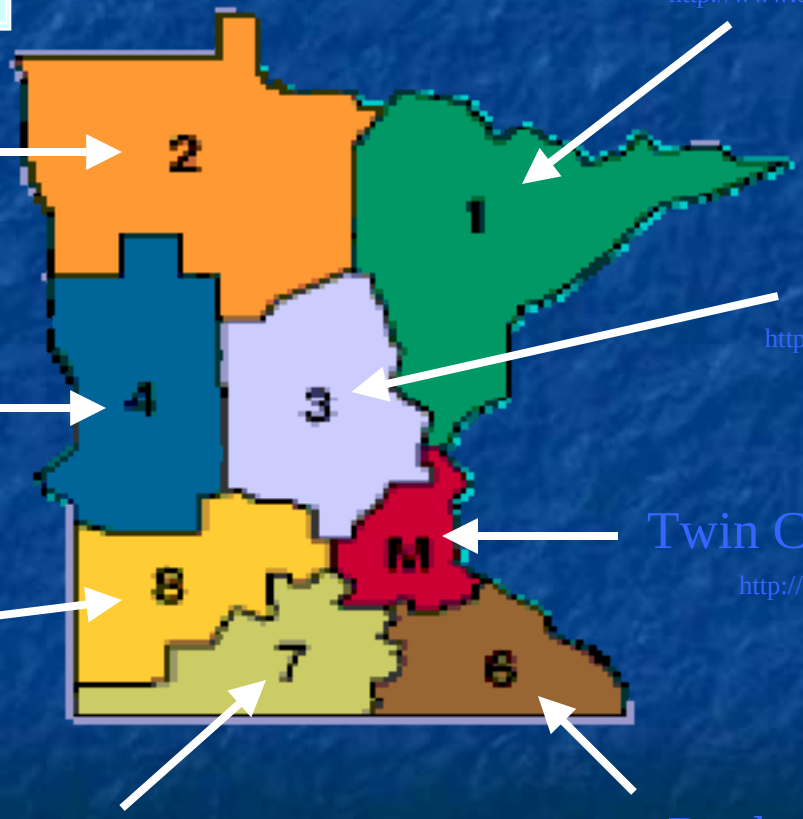
Statewide:

By District

By Service Level

Executive Summary

Minnesota



Duluth 1
http://www.dot.state.mn.us/d1/

Bemidji 2
http://www.dot.state.mn.us/d2/

Brainerd 3
http://www.dot.state.mn.us/d3/

Detroit Lakes 4
http://www.dot.state.mn.us/d4/

Twin Cities – Metro Area
http://www.dot.state.mn.us/metro/

Willmar 8
http://www.dot.state.mn.us/d8/

Mankato 7
http://www.dot.state.mn.us/d7/

Rochester 6
http://www.dot.state.mn.us/d6/


Have a Safe Winter Season

2008-2009 Snow and Ice Season Final Report

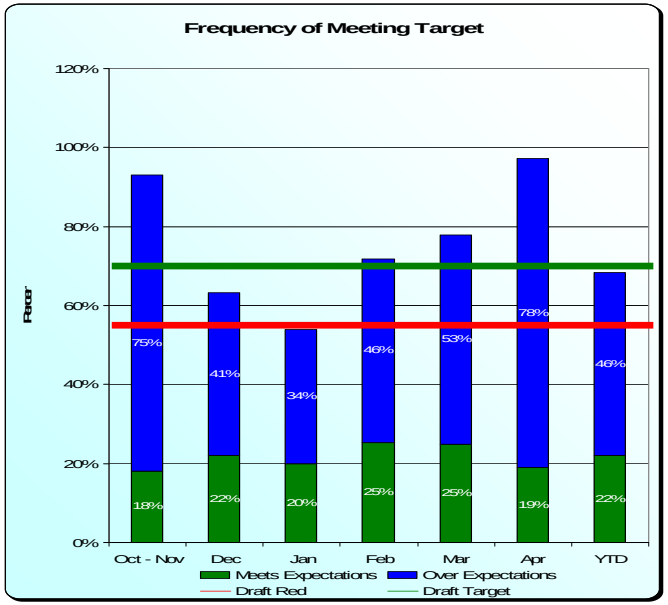
Minnesota Department of Transportation, Office of Maintenance

2008-2009 End of Year Snow and Ice Report
Executive Summary

Safety of the traveling public is the primary goal of Mn/DOT's snow and ice removal operations. With Mn/DOT's dedicated crews and leaders in the districts, we are able to deliver snow and ice services to 30,000 lanes miles of state highways. Training and technology has allowed us to increase efficiency and help counteract rising fuel and material costs.

The 2008-2009 Snow and Ice Season marked the first year that a staffing document for snow and ice control services was developed. This document articulated a plan for snow and ice staffing and identified areas where we operate consistently statewide and areas where we do not. In any organization, it is important to document that staffing and decision making variations occur.

Mn/DOT has a system wide bare lane target regain time that was established using customer market research. Minnesotans need to have transportation facilities that safely accommodate travel shortly after an event has passed. It was determined that drivers felt comfortable driving at posted speeds when the driving lanes were clear, even though the center line and edge lines were covered with small amounts of snow, thus defining "bare lane". The system wide bare lane target regain times for the five maintenance roadway classes are: Super Commuter 0 to 3 hours, Urban Commuter 2 to 5 hours, Rural Commuter 4 to 9 hours, Primary 6 to 12 hours and Secondary 9 to 36 hours. These times are measured from the end of a storm event to the time "bare lanes" are regained. Mn/DOT's most recent measure of our performance is the frequency at which we meet these targets. Recent market research, not specific to snow and ice, indicates that Mn/DOT should meet our maintenance targets 70 percent of the time.



5 Year SPOT Celebration

Last September/October marked the fifth year of the Statewide Snowplow Operator Training (SPOT) at Camp Ripley. Five years ago, we put into action a statewide plan to better train our snow plow operators. Prior to this time, training was being done but not consistently around the state. Working from existing curriculum, partnering with Camp Ripley, and utilizing the knowledgeable central office and district maintenance staff, a successful SPOT program has been developed.

The program has received recognition from various areas including the National Transportation Training Directors Association (NTTDA) and the American Public Works Association (APWA). Visitors from around the world have come to the training to watch and learn.

This 5 Year milestone provides Mn/DOT with an opportunity to recognize this accomplishment and acknowledge the district staff that has significantly contributed to SPOT over the years. A district led statewide appreciation of those responsible for making SPOT a Mn/DOT success is underway.

Snowplow Simulator

Mn/DOT has made a significant investment in a snowplow training simulator which supports and supplements our existing Maintenance and Safety training program. Snowplow operators often work long shifts, and manipulate their vehicle in heavy traffic, on slippery roads with very limited visibility. Operators must maneuver the controls for the plow, the sander, the different communication devices, and maintain control of the vehicle. Employees are trained on defensive and evasive driving to help minimize the frequency and severity of accidents. This training better prepares our operators by raising their awareness of hazardous situations involving weather, traffic and road conditions. As a result, operators are able to handle potentially dangerous situations. Operators develop better driving habits (acceleration, braking, driving speed and space management) that will result in improved fuel efficiency and increased safety.

This initiative aligns with the Strategic Vision's core values: maintain safety as a priority and commitment to employee's well-being, development and success.

The training simulator has received great media exposure and coverage at the Fall Maintenance Expo, Employee Meetings, District Expos, SPOT, local TV and newspapers, and from employees and managers. The simulator uses state-of-the-art technologies to train operators that will help reduce winter related accidents with snowplows. Additional benefits associated with simulator include: reduced insurance costs, fuel costs, fleet management, liability exposure, vehicle damage, training cost and workers compensation claims.

2008-2009 Snow and Ice Season at a glance.

	07- 08 Season	08- 09 Season
Snowfall for season (inches) Chanhassen	44.9	56.8
Snowfall for season (inches) Statewide Average	54.5	61.2
Number of lane miles	30,317	30,227
Statewide salt usage (Tons)	226,783	228,866
Statewide sand usage (Tons)	57,190	76,373
Statewide brine usage (Gallons)	2,565,641	2,136,393
Total Material Costs - 2406	$11,882,303	$13,017,127
Labor Costs (Regular and Overtime) - 2406	$7,990,538	$9,417,059
Equipment Costs - 2406	$15,485,359	$17,899,585
Statewide Average for Labor, Equipment and Material Costs Per Lane Mile	$1,166	$1,334

SUMMARY OF STATEWIDE SAND AND CHEMICAL USAGE

Winter of	Snowfall* (inches)	Sand (Tons)	TotalChemical (Salt Tons**)	Winter of	Snowfall* (inches)	Sand (Tons)	TotalChemical (Salt Tons**)
1970-71	54.7	-	148,712	1989-90	35.5	396,062	150,019
1971-72	64.2	283,552	116,664	1990-91	43.3	301,408	178,491
1972-73	41.7	269,614	92,343	1991-92	81.5	334,453	185,216
1973-74	51.2	273,525	112,115	1992-93	47.4	371,904	191,303
1974-75	64.2	337,064	148,210	1993-94	39.7	397,798	160,805
1975-76	54.5	298,607	135,249	1994-95	58.0	277,484	166,499
1976-77	43.6	228,876	91,971	1995-96	75.0	339,931	231,206
1977-78	50.7	261,346	107,834	1996-97	73.0	369,289	251,159
1978-79	68.4	240,289	126,394	1997-98	45.0	262,018	229,723
1979-80	53.0	254,882	93,935	1998-99	56.5	229,263	212,263
1980-81	21.1	168,339	56,295	1999-00	36.2	153,271	171,087
1981-82	94.0	295,518	116,929	2000-01	75.8	301,583	222,894
1982-83	74.0	284,761	126,055	2001-02	65.5	121,798	240,428
1983-84	99.0	303,133	126,665	2002-03	35.0	106,478	180,561
1984-85	72.4	255,862	116,939	2003-04	66.3	111,210	230,918
1985-86	69.5	320,014	152,543	2004-05	26.5	100,105	233,434
1986-87	17.3	258,638	115,593	2005-06	44.4	90,780	273,261
1987-88	68.7	300,270	150,043	2006-07	35.5	51,716	182,386
1988-89	70.1	355,456	201,170	2007-08	44.9	57,190	226,783
				2008-09	56.8	76,373	228,866

*Snowfall recorded at Twin Cities International Airport
**Includes salt used in winter-treated sand and brine.

Average Service Level Regain Times, 2008-2009

	(0-3 hours)	(2-5 hours)	(4-9 hours)	(6-12 hours)	(9-36 hours)	
District	**Super Commuter**	**Urban Commuter**	**Rural Commuter**	**Primary**	**Secondary**	**All Service Levels Average**
1	6.3	8.6	13.4	17.8	37.9	15.1
2		2.5	4.5	6.7	9.9	6.3
3	3.3	6.6	9.7	13.4	17.1	9.4
4		6.3	13	18.5	18.6	15.2
Metro	2.3	3.7	4.2			2.9
6	4.5	7.2	10.4	14.1		9.9
7		6.3	7.8	8.2	9.6	7.6
8			10.2	12.0	13.6	11.1
Statewide	3.2	6.6	9.6	12.7	16.2	10.0

Average Labor, Equipment and Material Costs Per Lane Mile By Service Level, 2008-2009

District	Super Commuter	Urban Commuter	Rural Commuter	Primary	Secondary	All Service Levels Average
1	$3,631	$3,085	$1,445	$1,112	$1,016	$1,778
2		$1,691	$951	$558	$603	$753
3	$1,579	$1,542	$1,067	$974	$820	$1,211
4		$1,772	$960	$690	$620	$920
Metro	$3,078	$2,624	$2,148			$2,886
6	$1,253	$2,147	$1,405	$1,110		$1,545
7		$1,402	$1,175	$891	$918	$1,159
8			$825	$682	$603	$756
Statewide	$2,781	$1,992	$1,165	$799	$701	$1,339

*Road classifications not included in districts are left blank. Data is from the WMS program. Activity 2406 only.

Adjusted Winter Maintenance Material Usage Report, 2008-2009 Season

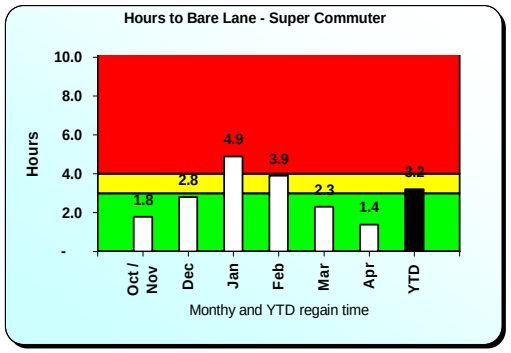
	Salt Usage (Tons)	Sand Usage (Tons)	Salt Brine (Gallons)	Mag Chloride (Gallons)	Mag Chloride (Pounds)	Treated Salt (Tons)	Calcium Chloride (Gallons)	Calcium Chloride Pellets (Ton)	Potassium Acetate (Gallons)	Liquid Corn Salt (Gallons)
District 1	38,294	22,706	272,826	108,154						
District 2	10,912	8,815	81,963	650		19				
District 3	27,461	3,089	348,456	1,800			20,135	1.4		
District 4	10,461	8,947	82,073	2,400					9,000	
Metro	77,662	3,033	167,516	12,708					41,527	52,316
District 6	35,408	18,811	578,955	3,300	4,000		1,650			4,400
District 7	20,587	3,831	450,809				8,650			
District 8	8,081	7,141	153,795							
Statewide	**228,866**	**76,373**	**2,136,393**	**129,012**	**4,000**	**19**	**30,435**	**1.4**	**50,527**	**56,716**

*Includes all Snow and Ice Activities

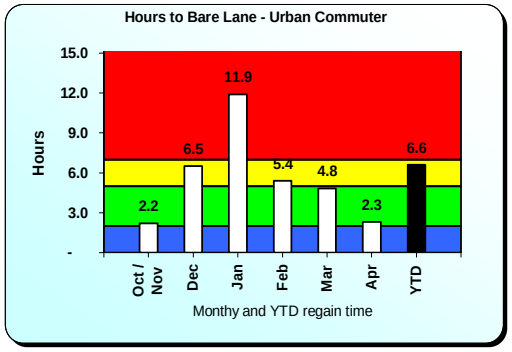
Maintenance: Snow & Ice Removal
Hours to Bare Lane - **Statewide**
Winter 2008 - 2009

Data Period 10/01/2008 to 4/30/2009

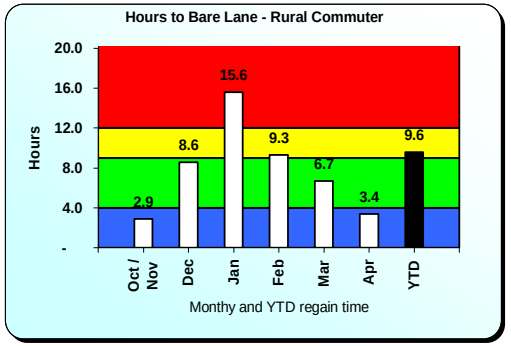
Significantly Under Expectation
Under Expectation
Meets Expectation
Over Expectation



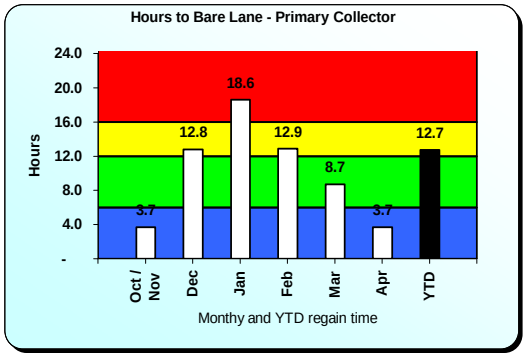
(4,464 Lane Miles)



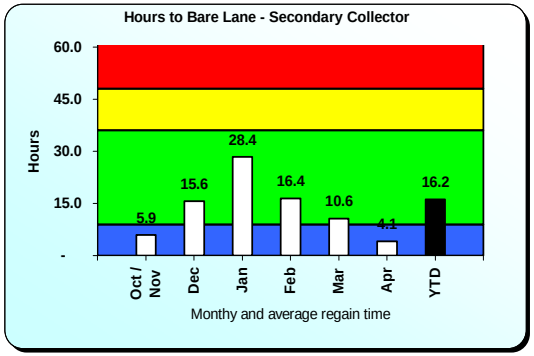
(5,699 Lane Miles)



(11,542 Lane Miles)



(6,393 Lane Miles)



(2,107 Lane Miles)

Program & Project Management System (PPMS)

Snow & Ice Report - Labor, Equipment, and Material Summary Ordered by Service Level

Report ID: 22553
Rate Type: Actual Costs/Usage
Dates: Oct. 1, 2008 to Apr. 30, 2009

Work Order:
Org: 0000 and reporting ORGs; ORG TYPE: Time Sheet
Activity: '2406'
Job Number: ALL

Report Subtitle: Statewide

V.20080708

	RT Hours	RT Cost	OT Hours	OT Cost	Labor Cost	Equipment Usage	Equipment Cost	Material Cost	Total Cost
Super Commuter	75,235.25	$1,529,348.40	51,319.85	$1,567,253.59	$3,144,019.55	131,975.18	$5,014,801.34	$3,788,315.33	$11,947,136.22
Urban Commuter	58,261.10	$1,202,447.29	29,356.50	$908,264.36	$2,142,704.70	83,987.29	$4,120,874.77	$3,134,410.18	$9,397,989.65
Rural Commuter	82,256.90	$1,697,094.08	34,077.35	$1,059,894.14	$2,795,961.82	109,566.17	$5,757,989.79	$4,160,988.54	$12,714,940.15
Primary	34,676.00	$707,763.21	11,427.10	$354,379.51	$1,076,691.97	45,564.92	$2,418,043.81	$1,461,444.85	$4,956,180.63
Secondary	8,933.50	$180,557.97	2,420.30	$74,143.86	$257,680.98	10,619.95	$587,875.34	$471,968.59	$1,317,524.91
Total:	259,362.75	$5,317,210.95	128,601.10	$3,963,935.46	$9,417,059.02	381,713.51	$17,899,585.05	$13,017,127.49	$40,333,771.56

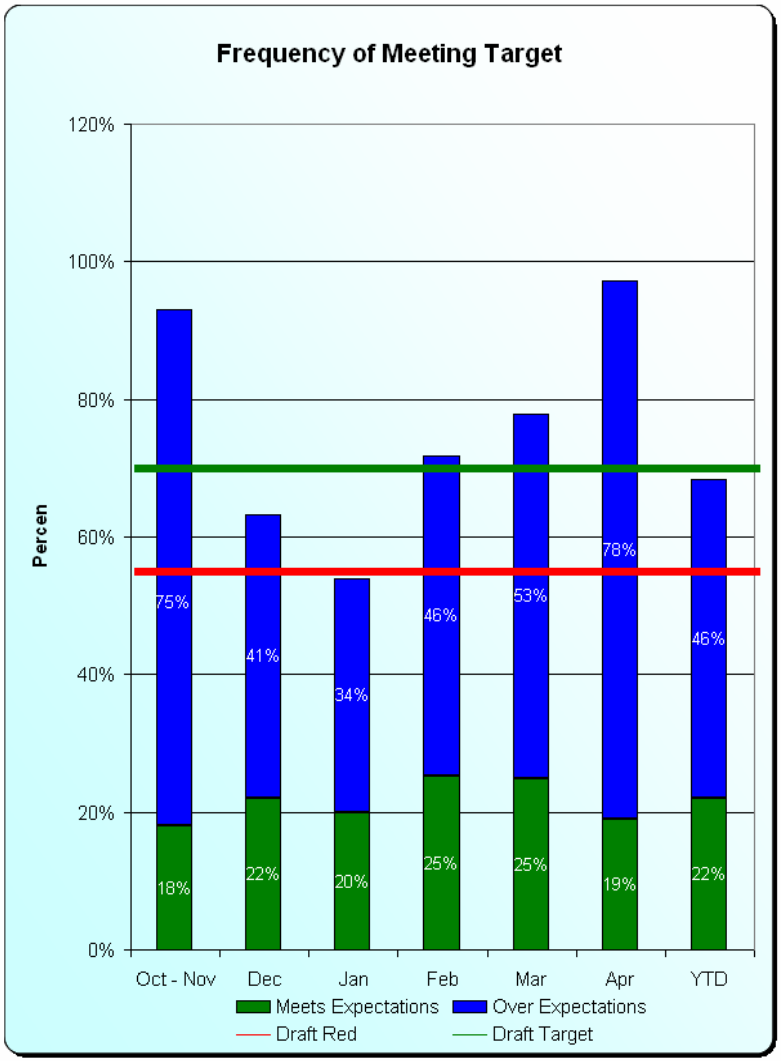
Data from WMS. Activity 2406

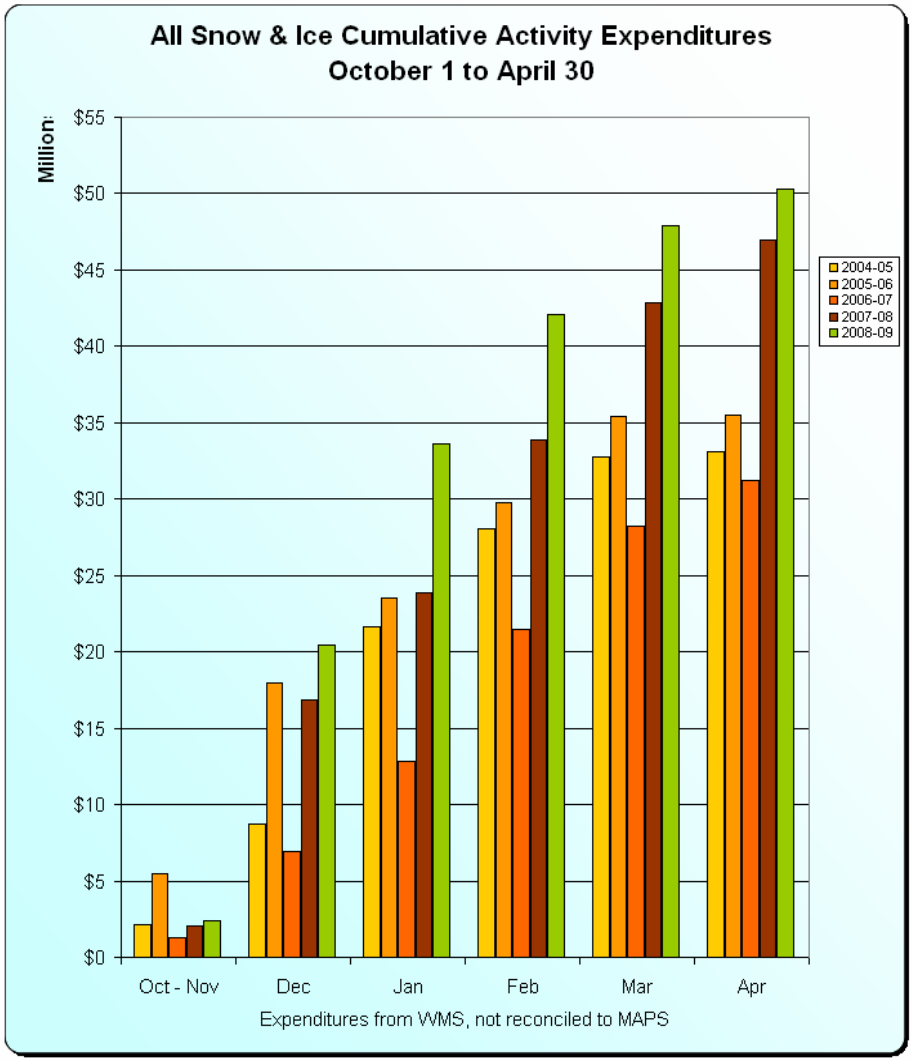
Maintenance: Snow & Ice Removal

Statewide

Winter 2008 - 2009

Data Period 10/01/2008 to 4/30/2009

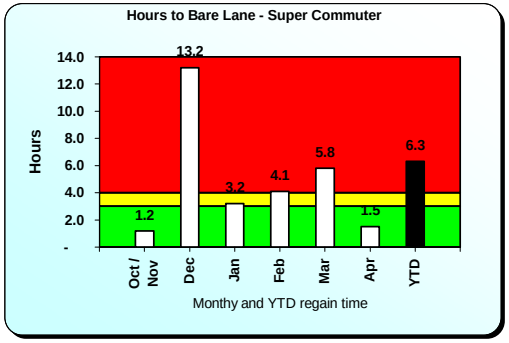




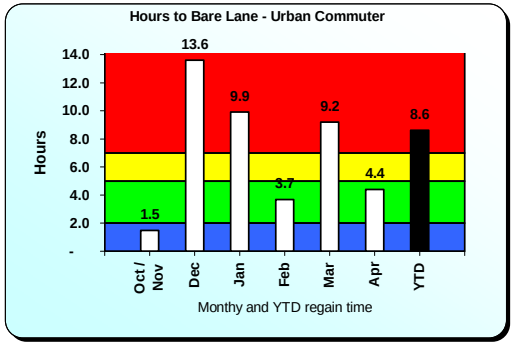
Maintenance: Snow & Ice Removal
Hours to Bare Lane - **District 1**
Winter 2008 - 2009

Data Period 10/01/2008 to 4/30/2009

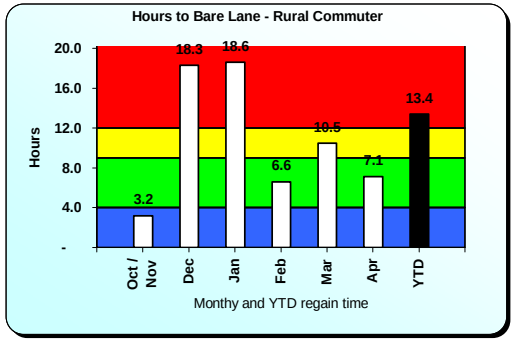
Significantly Under Expectation
Under Expectation
Meets Expectation
Over Expectation



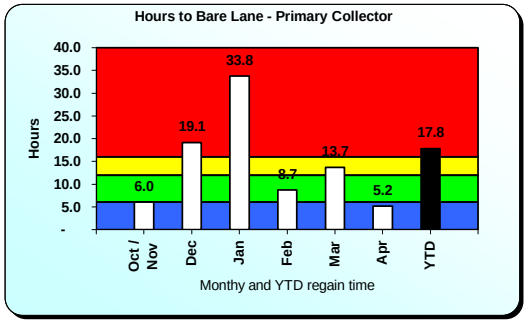
(96 Lane Miles)



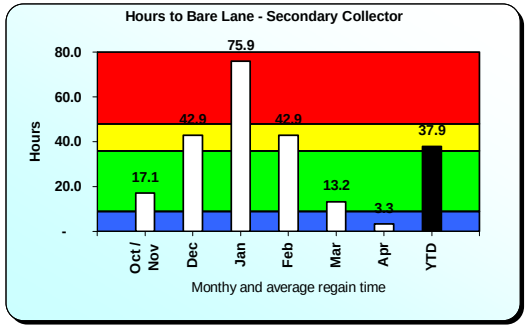
(632 Lane Miles)



(1,671 Lane Miles)



(518 Lane Miles)



(831 Lane Miles)

Program & Project Management System (PPMS)

Snow & Ice Report - Labor, Equipment, and Material Summary Ordered by Service Level

Report ID: 22545
Rate Type: Actual Costs/Usage
Dates: Oct. 1, 2008 to Apr. 30, 2009

Work Order:
Org: 9100 and reporting ORGs; ORG TYPE: Time Sheet
Activity: '2406'
Job Number: ALL

Report Subtitle: District 1

V.20080708

	RT Hours	RT Cost	OT Hours	OT Cost	Labor Cost	Equipment Usage	Equipment Cost	Material Cost	Total Cost
Super Commuter	1,789.00	$35,254.98	1,096.00	$33,178.24	$69,388.12	2,437.25	$134,568.99	$87,375.71	$291,332.82
Urban Commuter	6,726.50	$143,235.70	3,562.25	$112,845.80	$259,681.35	8,732.62	$493,566.65	$428,872.10	$1,182,120.10
Rural Commuter	14,035.25	$286,789.45	6,317.95	$193,778.77	$487,036.22	18,504.82	$1,041,939.53	$1,004,390.06	$2,533,365.81
Primary	3,645.25	$75,181.65	1,678.25	$51,695.28	$128,552.43	5,236.61	$279,322.72	$287,635.58	$695,510.73
Secondary	3,039.00	$62,274.45	734.00	$22,554.99	$85,775.34	3,358.05	$181,209.14	$231,877.98	$498,862.46
Total:	29,235.00	$602,736.23	13,388.45	$414,053.08	$1,030,433.46	38,269.35	$2,130,607.03	$2,040,151.43	$5,201,191.92

Data from WMS. Activity 2406

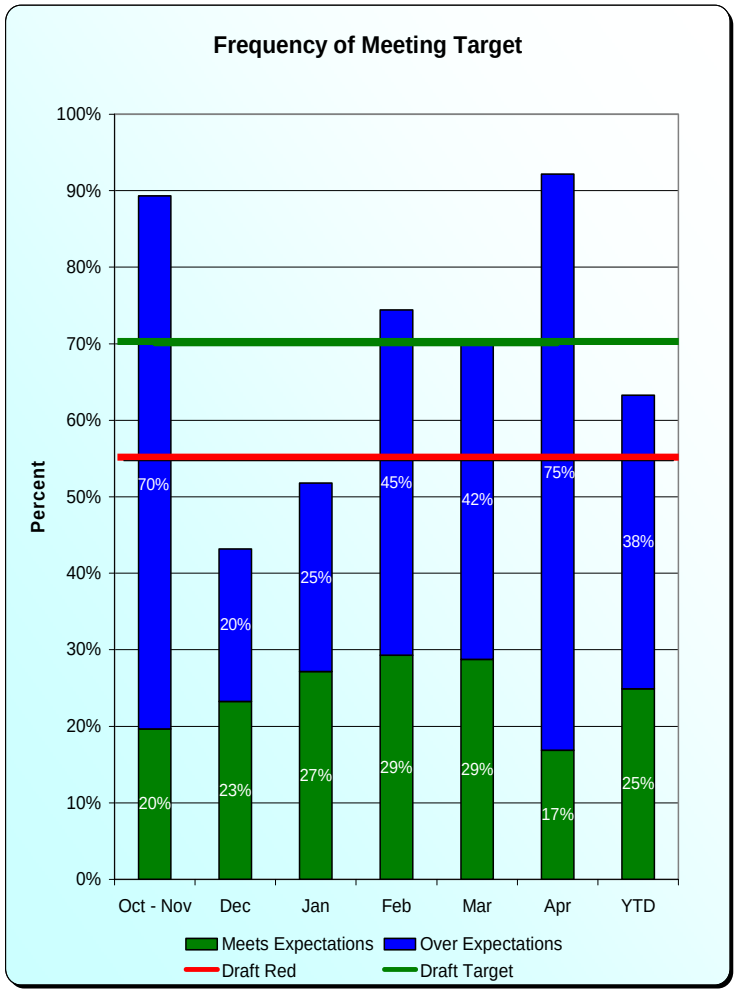
Maintenance: Snow & Ice Removal

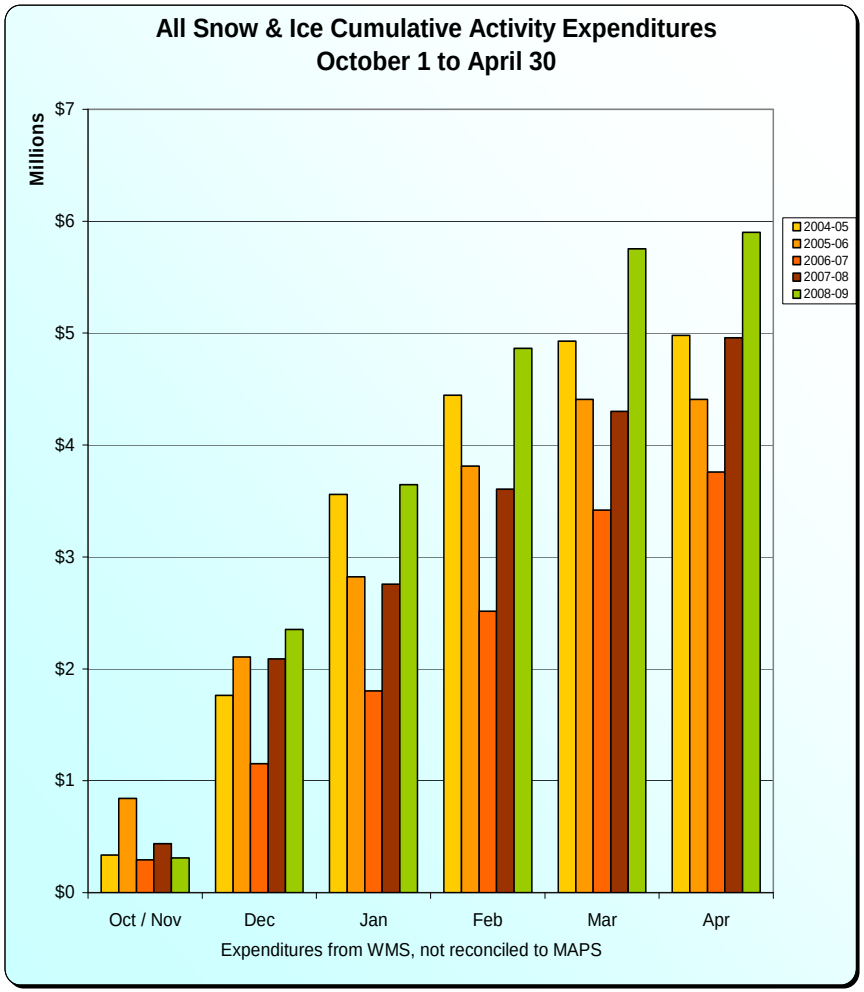
District 1

Winter 2008 - 2009

Data Period 10/01/2008 to 4/30/2009

Notes:
Jeff Hall





April 1, 2009 through April 30, 2009

District 1

Snow Accumilation:	Duluth International Airport	Cook County Airport	International Falls	Hibbing	Hinckley	Average
Reporting Month Accumulation	1.2	4.3	1.9	1.2	0	2.1
Season to date Accumulation	72	76.4	123.4	57.2	38.9	73.2

	Apr-08	Apr-09	Average to date for 08-09 Season
Snow Events:	3	1	31
Freezing Rain Events:	0	0	6

Material Usage:			Total to date for 08-09 Season
Salt (tons)	4,826	952	38,294
Sand (tons)	1,365	910	22,706
Brine (gal)	12,551	4,068	272,826
Other Materials:			
Mag (gals)	7,548	1,465	108,154

Comments, 50 words or less:

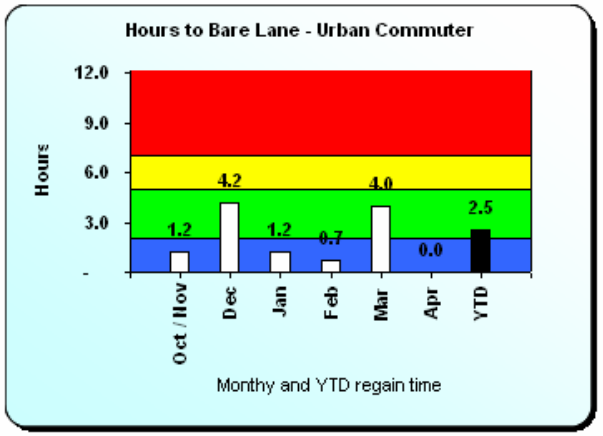
D1 had a fairly nice April with only 1 major snow event recorded which shows significantly in our material usage.
All in all an average winter and comparable material usages with last season.

Close

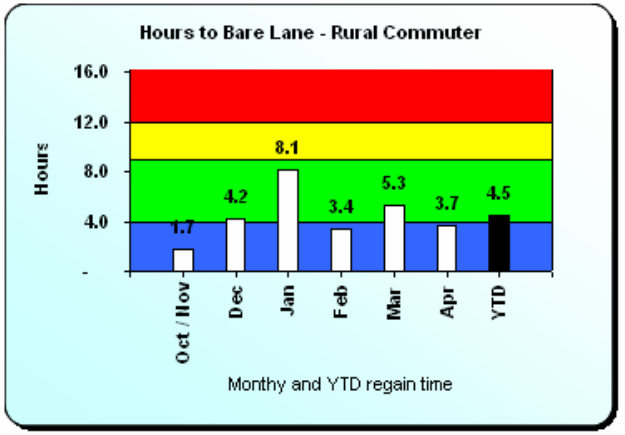
Maintenance: Snow & Ice Removal
Hours to Bare Lane - **District 2**
Winter 2008 - 2009

Data Period 10/01/2008 to 4/30/2009

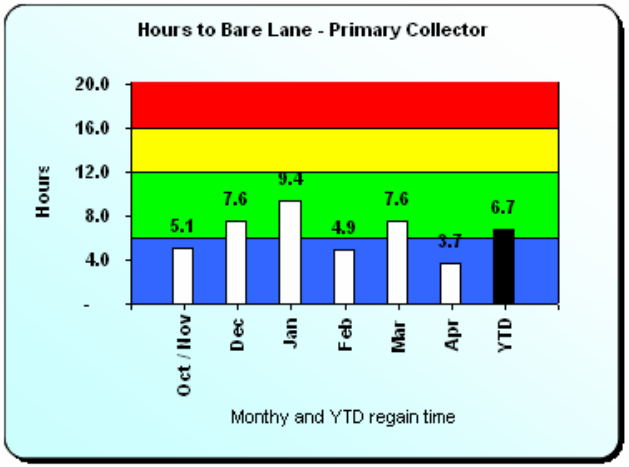
Significantly Under Expectation
Under Expectation
Meets Expectation
Over Expectation



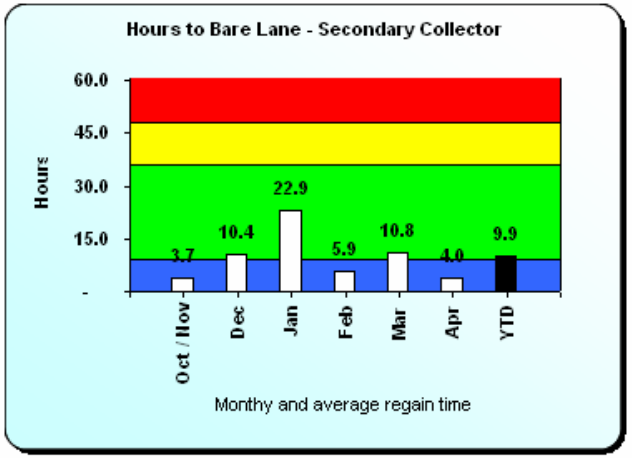
(79 Lane Miles)



(1,698 Lane Miles)



(1,516 Lane Miles)



(624 Lane Miles)

Program & Project Management System (PPMS)

Snow & Ice Report - Labor, Equipment, and Material Summary Ordered by Service Level

Report ID: 22546
Rate Type: Actual Costs/Usage
Dates: Oct. 1, 2008 to Apr. 30, 2009

Work Order:
Org: 9200 and reporting ORGs; ORG TYPE: Time Sheet
Activity: '2406'
Job Number: ALL

Report Subtitle: District 2

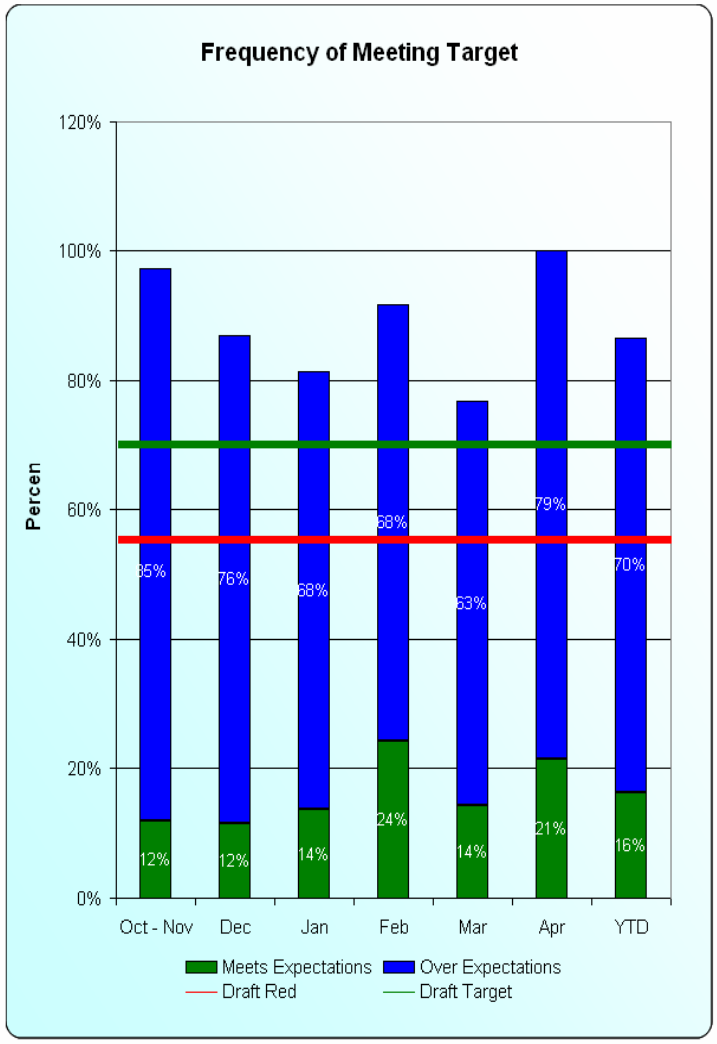
V.20080708

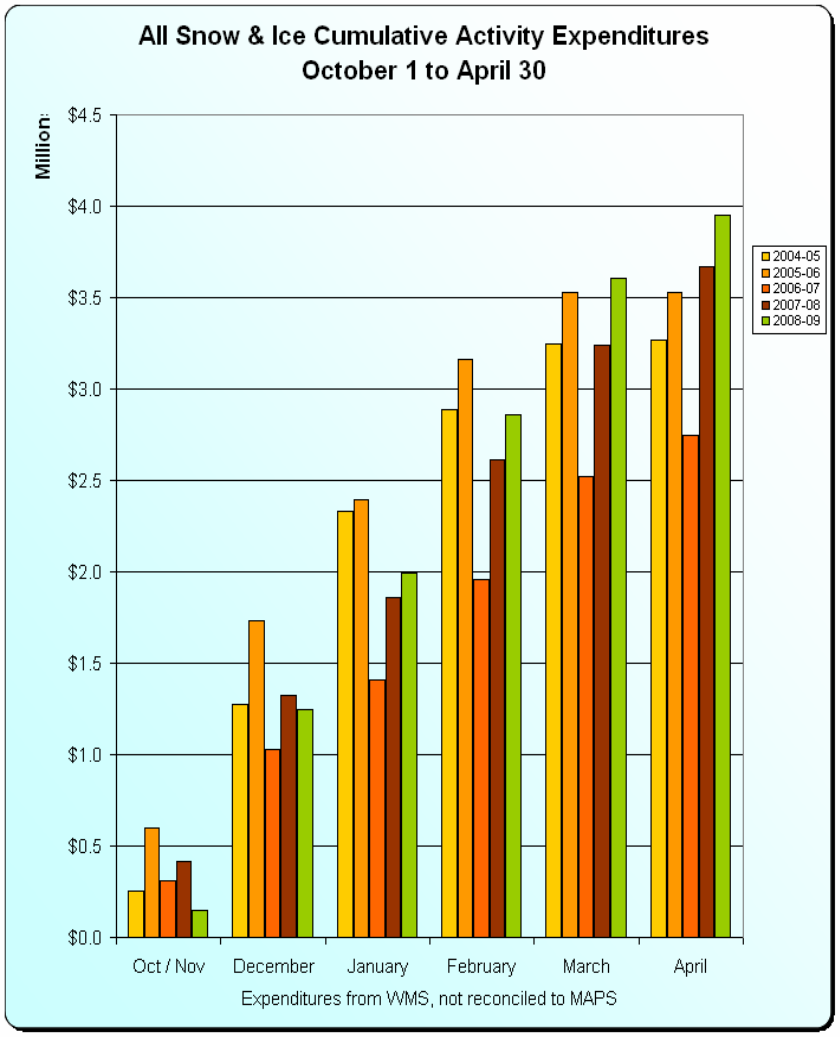
	RT Hours	RT Cost	OT Hours	OT Cost	Labor Cost	Equipment Usage	Equipment Cost	Material Cost	Total Cost
Urban Commuter	769.00	$16,906.98	309.00	$10,071.88	$27,393.16	967.00	$54,108.93	$24,344.77	$105,846.86
Rural Commuter	9,523.50	$198,936.14	3,972.80	$124,094.02	$326,823.21	12,824.55	$728,732.22	$459,290.06	$1,514,845.49
Primary	5,492.50	$113,258.57	1,752.00	$54,797.26	$169,689.93	7,453.60	$379,064.06	$207,201.01	$755,955.00
Secondary	2,657.50	$52,682.42	838.00	$25,226.32	$78,616.29	3,336.50	$180,180.14	$109,409.24	$368,205.67
Total:	18,442.50	$381,784.11	6,871.80	$214,189.48	$602,522.59	24,581.65	$1,342,085.35	$800,245.08	$2,744,853.02

Data from WMS. Activity 2406

Maintenance: Snow & Ice Removal
District 2
Winter 2008 - 2009
Data Period 10/01/2008 to 4/30/2009

Notes:
Mary
Swenson





April 1, 2009 through April 30, 2009

District 2

Snow Accumulation	Bemidji	Baudette	Crookston	Park Rapids	Average Accumulation
Reporting Month Accumulation	2	0	0	8	2.5
Season to date Accumulation	85.5	81.6	60	115	85.5

	Apr-08	Apr-09	Average # of Events to date for 08-09
Snow Events:	1	1	16
Freezing Rain Events:	1	0	11

Material Usage:

			Total to date for 08-09 Season
Salt (tons)	1,563	456 adj. bal.	10,912
Sand (tons)	770	310 adj. bal.	8,815
Brine (gal)	7,810	2,750 adj. bal.	81,963
Other Materials:			
Clear Lane		10	19
Mag Chlor		650	650

Comments

April showers brought us snow along with our flood fighting. Daytime temps were mild with cooler evening/early mornings than normal. We continue to have border crossings up north closed due to high water still on TH 1- open to local traffic only, TH 11, TH 175. The crews are very busy repairing the damage done by the flood waters.

Close

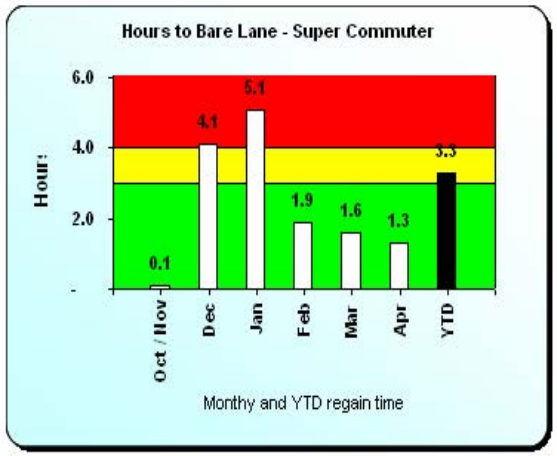
Maintenance: Snow & Ice Removal

Hours to Bare Lane - District 3

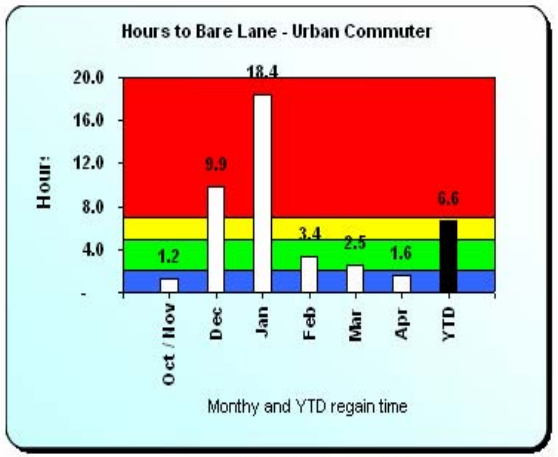
Winter 2008 - 2009

Data Period 10/01/2008 to 4/30/2009

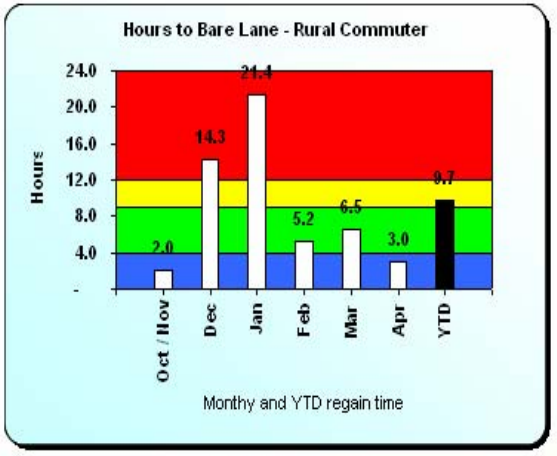
- Significantly Under Expectation
- Under Expectation
- Meets Expectation
- Over Expectation



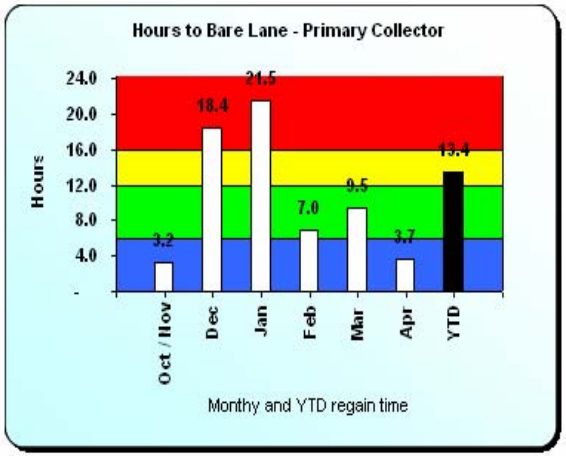
(368 Lane Miles)



(1,283 Lane Miles)



(1,628 Lane Miles)



(772 Lane Miles)

Program & Project Management System (PPMS)

Snow & Ice Report - Labor, Equipment, and Material Summary Ordered by Service Level

Report ID: 22547
Rate Type: Actual Costs/Usage
Dates: Oct. 1, 2008 to Apr. 30, 2009

Work Order:
Org: 9300 and reporting ORGs; ORG TYPE: Time Sheet
Activity: '2406'
Job Number: ALL

Report Subtitle: District 3

V.20080708

	RT Hours	RT Cost	OT Hours	OT Cost	Labor Cost	Equipment Usage	Equipment Cost	Material Cost	Total Cost
Super Commuter	3,885.25	$78,325.21	1,524.50	$46,425.54	$126,684.70	5,095.25	$296,234.91	$154,623.80	$577,543.41
Urban Commuter	11,189.75	$228,248.69	4,914.50	$152,640.58	$386,479.92	15,115.95	$863,958.02	$488,836.68	$1,739,274.62
Rural Commuter	10,943.25	$220,965.74	4,144.75	$129,099.81	$354,911.75	14,619.30	$815,468.57	$467,591.44	$1,637,971.76
Primary	5,229.75	$104,744.63	1,630.75	$51,086.60	$157,926.73	7,148.75	$364,157.51	$221,406.39	$743,490.63
Secondary	119.50	$2,559.33	18.00	$608.08	$3,207.91	130.00	$7,964.60	$8,878.33	$20,050.84
Total:	31,367.50	$634,843.60	12,232.50	$379,860.61	$1,029,211.01	42,109.25	$2,347,783.61	$1,341,336.64	$4,718,331.26

Data from WMS. Activity 2406

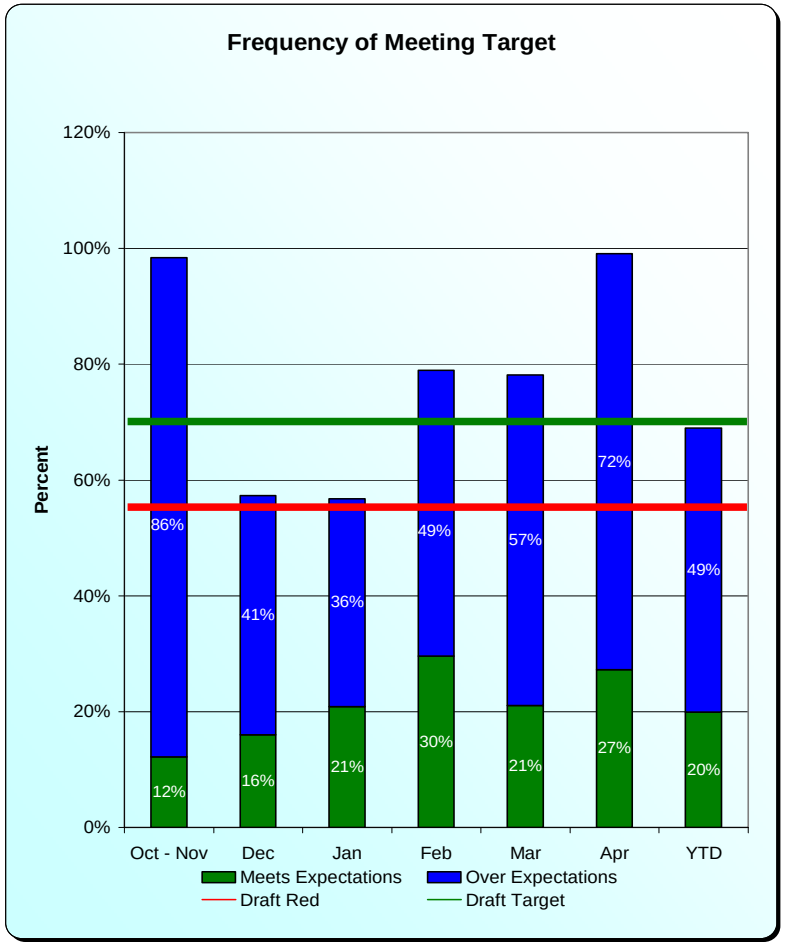
Maintenance: Snow & Ice Removal

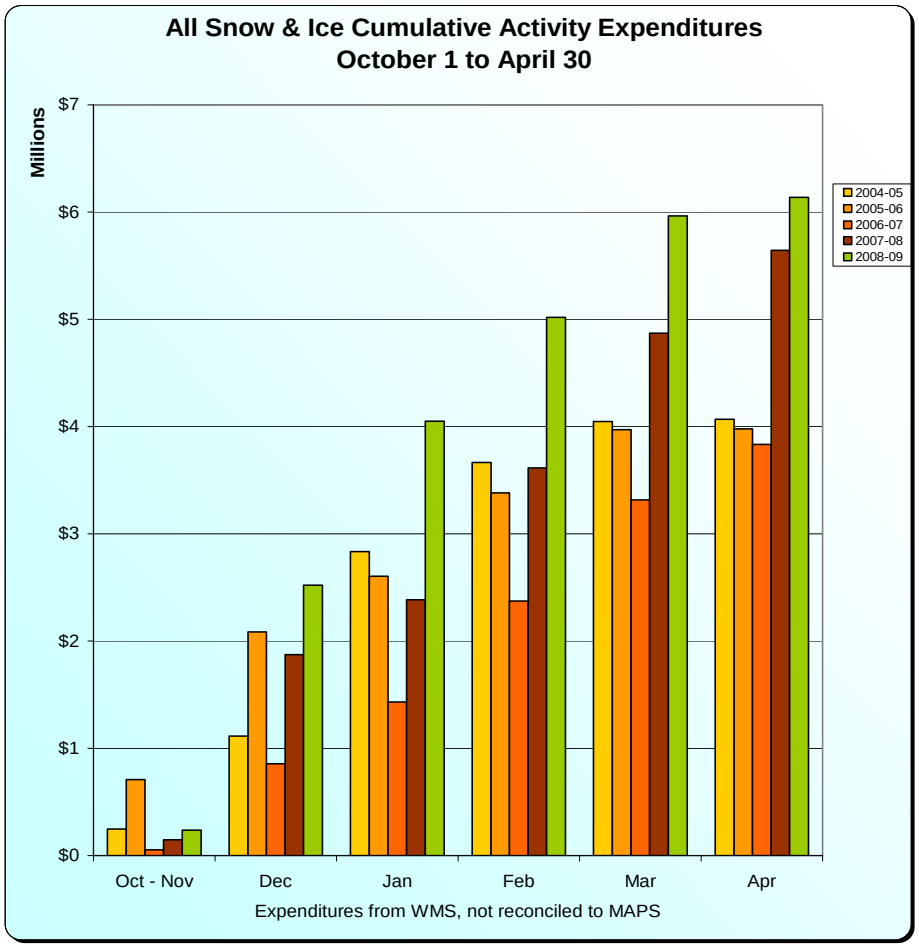
District 3

Winter 2008 - 2009

Data Period 10/01/2008 to 4/30/2009

Notes:
Randy
Reznicek





April 1, 2009 through April 30, 2009

District	**3**

Snow Accumulation	St. Cloud Airport	Cambridge	Crow Wing County Airport	Remer Airport	**Average Accumulation**
Reporting Month Accumulation	**3.6**	**3**	**6.3**	**6**	**4.7**
Season to date Accumulation	**53.6**	**61.3**	**49.2**	**64**	**57.0**

	Apr-08	**Apr-09**	**Average # of Events to date for 08-09 Season**
Snow Events:	**3.2**	**0.89**	**27.7**
Freezing Rain Events:		**1**	**11**

Material Usage:	**Apr-08**	**Apr-09**	**Total to date for 08-09 Season**
Salt (tons)	**4539.35**	**753.00**	**27,461.00**
Sand (tons)	**25.68**		**3089.03**
Brine (gal)	**35,232.64**	**10,176.00**	**348,455.51**
Other Materials:			
CACL		**20,135**	**20,135**
MgCl2		**1,800**	**1,800**
CACL Pellets		**1.4 Tons**	**1.4 Tons**

Comments

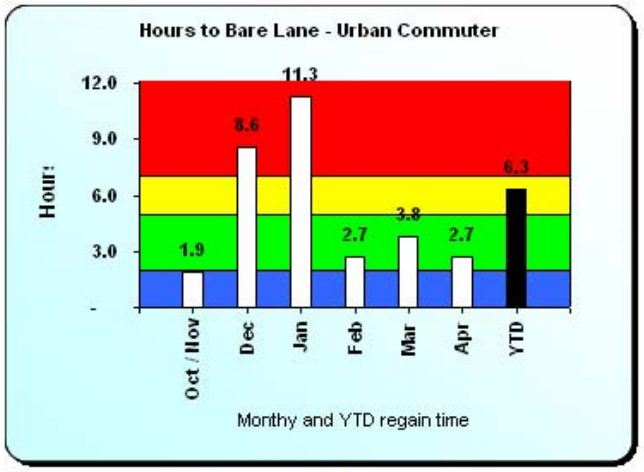
Had some snow early in month with a little freezing drizzle mixed in the southern portion of District. Nothing significant after that. Mild April as far as snow, moisture goes.

Close

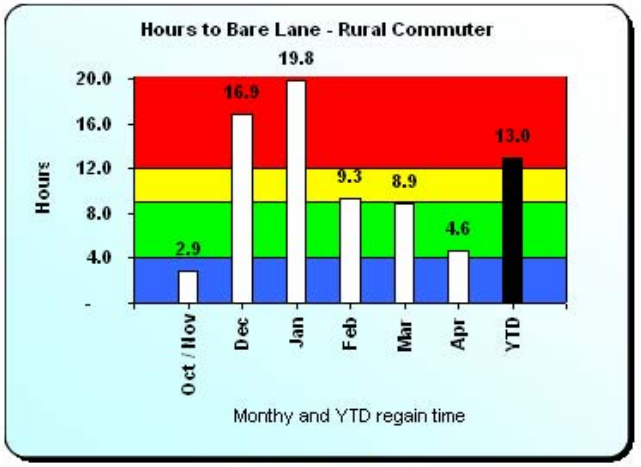
Maintenance: Snow & Ice Removal
Hours to Bare Lane - **District 4**
Winter 2008 - 2009

Data Period 10/01/2008 to 4/30/2009

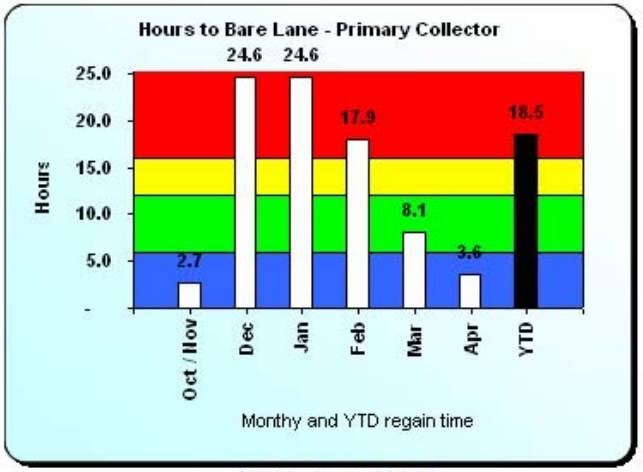
Significantly Under Expectation
Under Expectation
Meets Expectation
Over Expectation



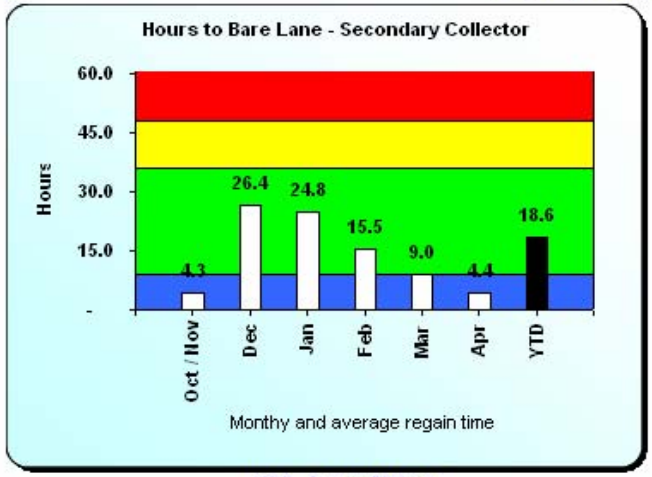
(653 Lane Miles)



(1,247 Lane Miles)



(1,290 Lane Miles)



(422 Lane Miles)

Program & Project Management System (PPMS)

Snow & Ice Report - Labor, Equipment, and Material Summary Ordered by Service Level

Report ID: 22548
Rate Type: Actual Costs/Usage
Dates: Oct. 1, 2008 to Apr. 30, 2009

Work Order:
Org: 9400 and reporting ORGs; ORG TYPE: Time Sheet
Activity: '2406'
Job Number: ALL

Report Subtitle: District 4

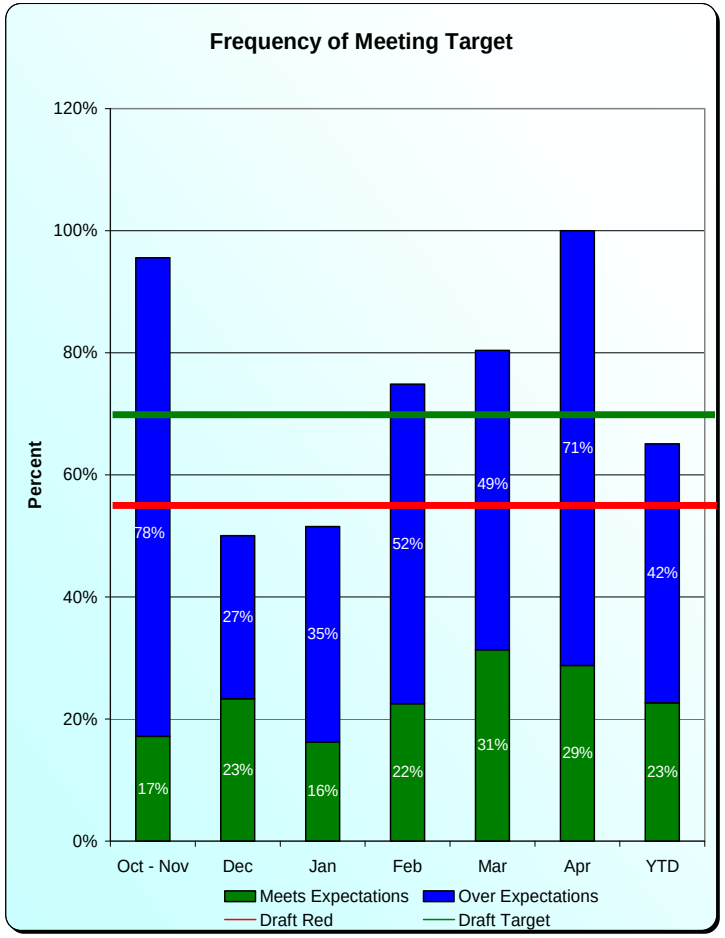
V.20080708

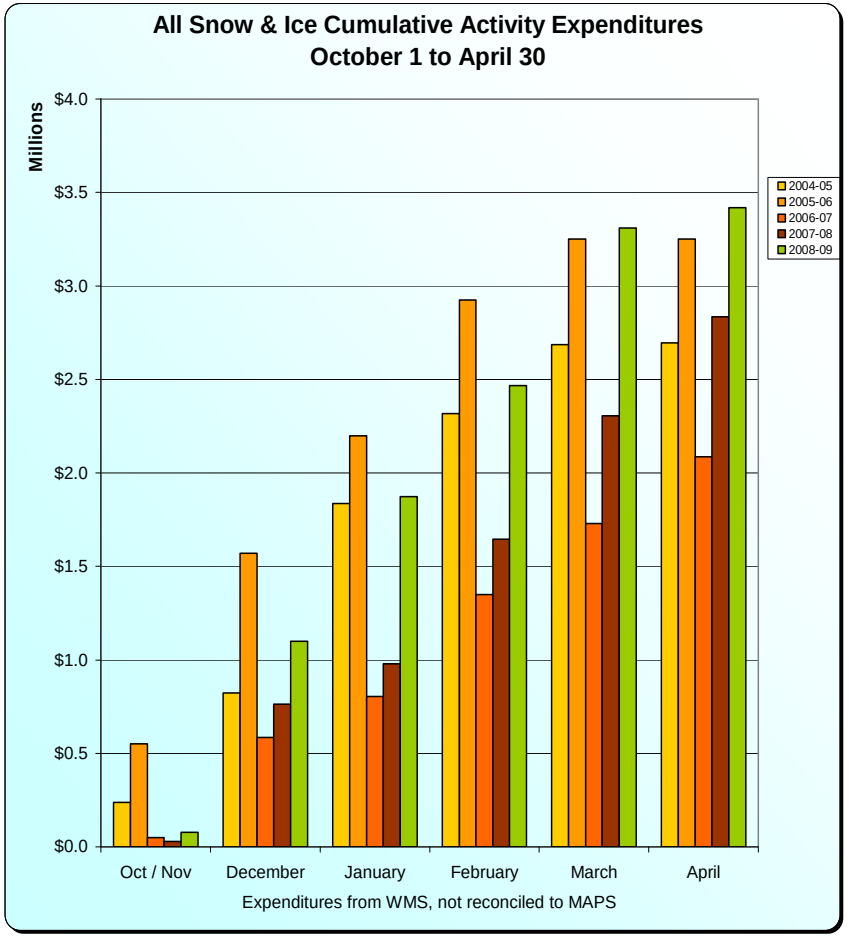
	RT Hours	RT Cost	OT Hours	OT Cost	Labor Cost	Equipment Usage	Equipment Cost	Material Cost	Total Cost
Urban Commuter	6,893.35	$144,215.31	2,341.25	$73,053.00	$221,094.21	8,366.55	$471,949.08	$248,750.64	$941,793.93
Rural Commuter	7,545.15	$161,206.87	2,137.35	$67,414.54	$232,464.56	8,769.30	$491,869.56	$218,913.78	$943,247.90
Primary	7,525.75	$152,634.79	1,906.85	$58,419.10	$214,587.89	8,925.71	$519,419.65	$176,249.15	$910,256.69
Secondary	2,138.25	$42,795.79	435.80	$13,294.42	$56,945.21	2,481.90	$141,816.63	$75,844.91	$274,606.75
Total:	24,102.50	$500,852.76	6,821.25	$212,181.06	$725,091.87	28,543.46	$1,625,054.92	$719,758.48	$3,069,905.27

Data from WMS. Activity 2406

Notes:
Dennis Redig

Maintenance: Snow & Ice Removal
District 4
Winter 2008 - 2009
Data Period 10/01/2008 to 4/30/2009





April 1, 2009 through April 30, 2009

District 4

Snow Accumulation	Morris	Detroit Lakes	Breckenridge	Alexandria	Average Accumulation
Reporting Month Accumulation	0.5	2	3	0.5	1.5
Season to date accumulation	67.5	70.1	92.6	65.5	73.9

	Apr-08	Apr-09	Average # of Events to date for 08-09 Season
Snow Events:	4	1	31
Freezing Rain Events:	0	0	8

Material Usage:	Apr-08	Apr-09	Total to date for 08-09 Season
Salt (tons)	2,555	575	10,461
Sand (tons)	1,342	257	8,947
Brine (gal)	10,565	4,465	82,073
Other Materials:			
Cf7	500	0	9,000
Mag Cl.	0	0	2,400
Treated	0	0	

Comments

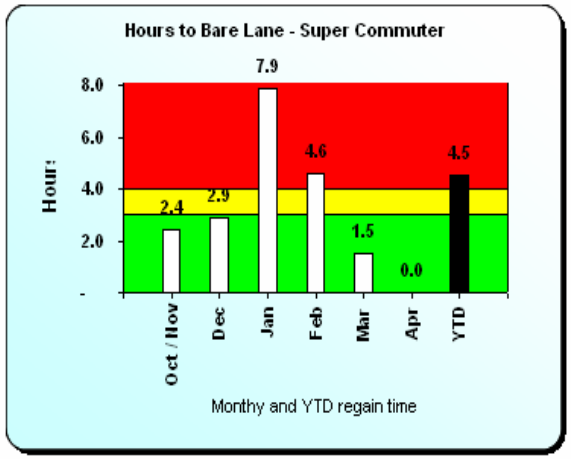
Winter was over with the tails of the March 31 storm with just the remainder April 1. Regains were met as tempertures cooperated..

Close

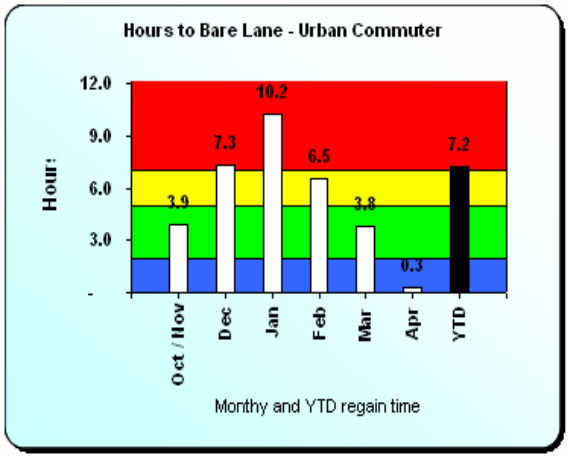
Maintenance: Snow & Ice Removal
Hours to Bare Lane - **District 6**
Winter 2008 - 2009

Data Period 10/01/2008 to 4/30/2009

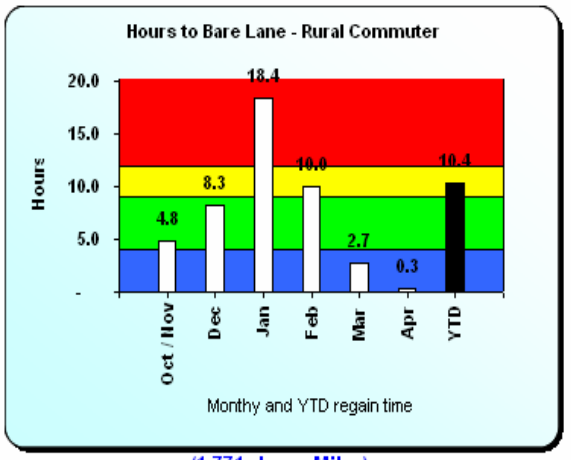
Significantly Under Expectation
Under Expectation
Meets Expectation
Over Expectation



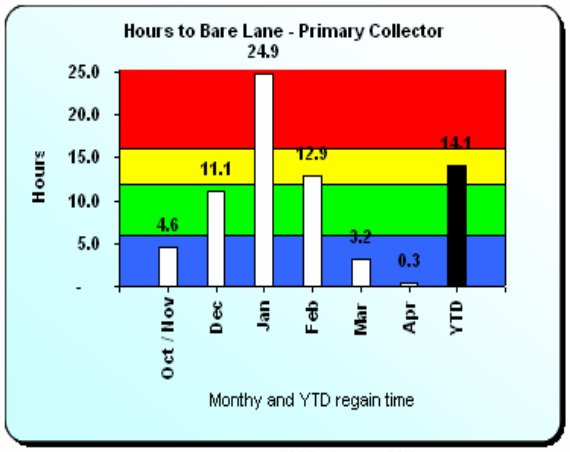
(289 Lane Miles)



(1,253 Lane Miles)



(1,771 Lane Miles)



(409 Lane Miles)

Program & Project Management System (PPMS)

Snow & Ice Report - Labor, Equipment, and Material Summary Ordered by Service Level

Report ID: 22550
Rate Type: Actual Costs/Usage
Dates: Oct. 1, 2008 to Apr. 30, 2009

Work Order:
Org: 9600 and reporting ORGs; ORG TYPE: Time Sheet
Activity: '2406'
Job Number: ALL

Report Subtitle: District 6

V.20080708

	RT Hours	RT Cost	OT Hours	OT Cost	Labor Cost	Equipment Usage	Equipment Cost	Material Cost	Total Cost
Super Commuter	2,693.25	$53,970.66	1,443.00	$43,908.26	$99,442.97	4,182.51	$188,609.10	$141,528.33	$429,580.40
Urban Commuter	12,955.75	$263,785.98	6,584.50	$202,558.37	$472,979.45	21,758.49	$923,332.09	$827,921.60	$2,224,233.14
Rural Commuter	14,199.75	$286,530.74	7,441.00	$229,176.63	$522,944.42	20,359.55	$1,068,366.56	$866,916.25	$2,458,227.23
Primary	3,095.25	$62,646.16	1,533.75	$47,330.42	$111,455.73	4,595.95	$235,242.43	$201,720.69	$548,418.85
Total:	32,944.00	$666,933.54	17,002.25	$522,973.68	$1,206,822.57	50,896.50	$2,415,550.18	$2,038,086.87	$5,660,459.62

Data from WMS. Activity 2406

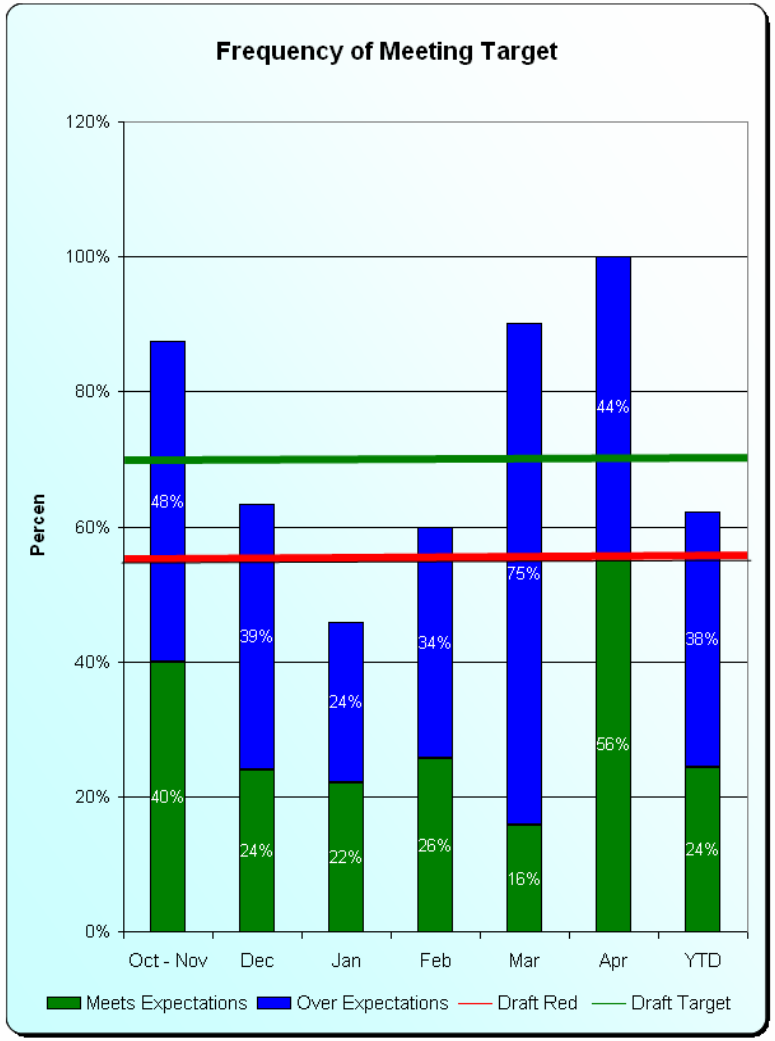
Maintenance: Snow & Ice Removal

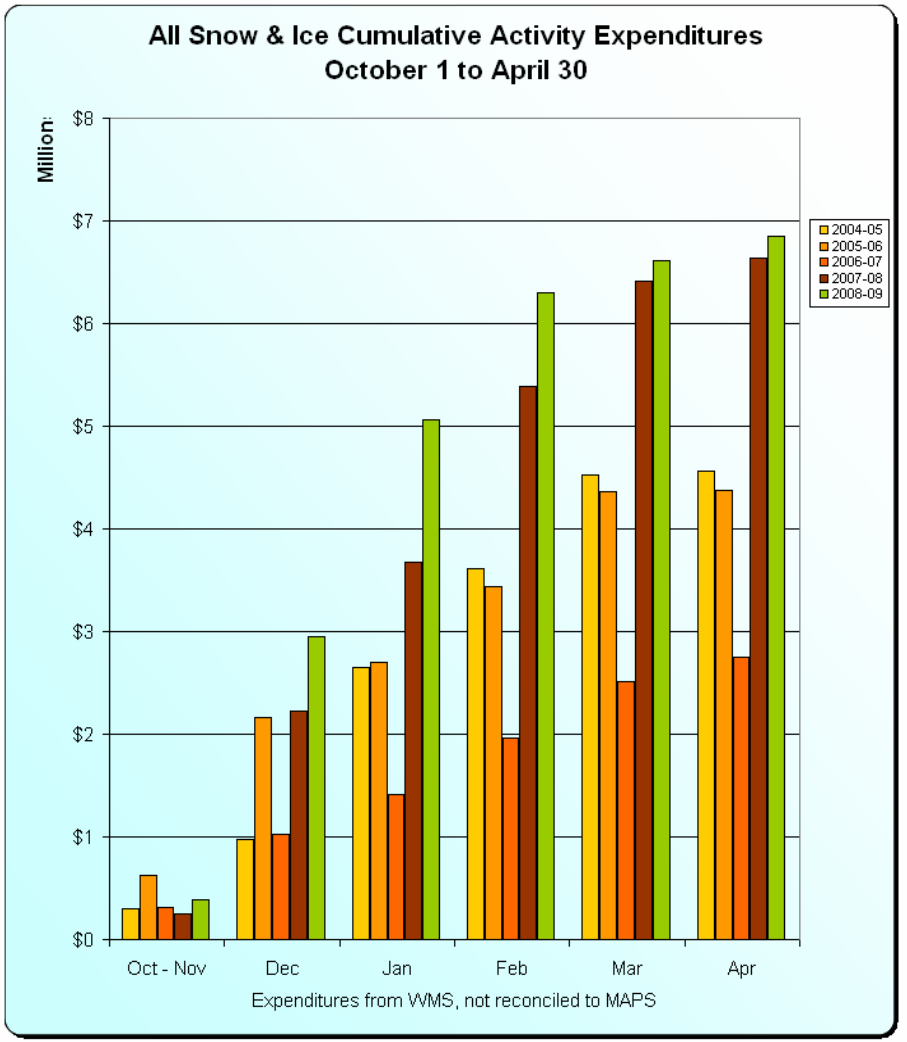
District 6

Winter 2008 - 2009

Data Period 10/01/2008 to 4/30/2009

Notes: Dave Redig





April 1, 2009 through April 30, 2009

District 6

Snow Accumulation	Albert Lea	Faribault	Red Wing	LaCrosse	Rochester	Average Accumulation
Reporting Month Accumulation	1.5	1.1	0.5	0.0	0.1	0.6
Season to date Accumulation	42.3	52.6	44.9	55.6	52.1	49.5

	Apr-08	Apr-09	Average # of Events to date for 08-09 Season
Snow Events:	3	1	36
Freezing Rain Events:	0	1	13

Material Usage:			Total to date for 08-09 Season
Salt (tons)	2,395	320	35,408
Sand (tons)	144	0	18,811
Brine (gal)	12,613	1,045	578,955
Other Materials:			
LCS		0	4,400
mgCL gal		0	3,300
mgcl lbs		0	4,000
tiger rg8		0	1,650

Comments

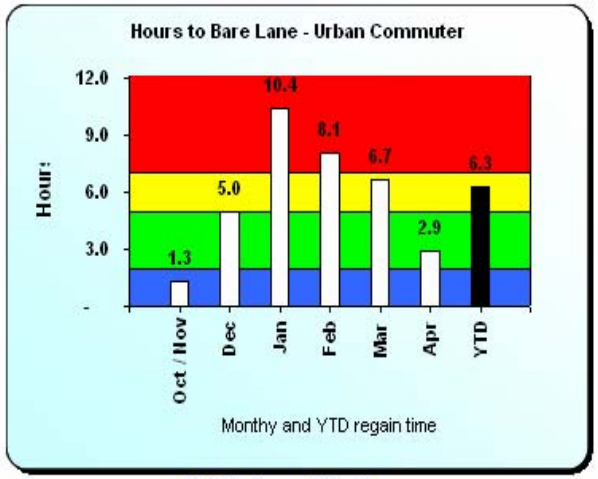
April started with snow and rain the first week. Then went to normal temps with no snow for the rest of the month.

Close

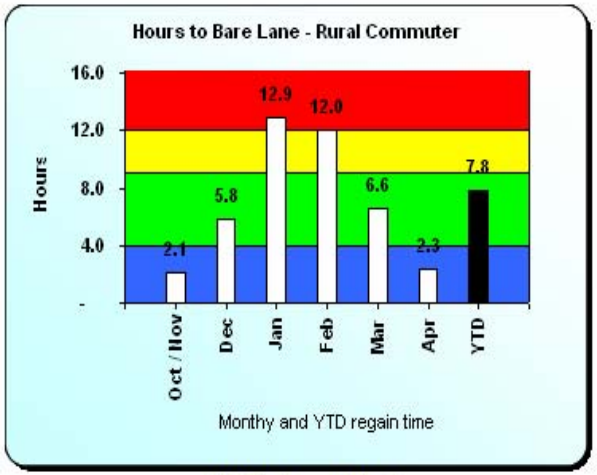
Maintenance: Snow & Ice Removal
Hours to Bare Lane - **District 7**
Winter 2008 - 2009

Data Period 10/01/2008 to 4/30/2009

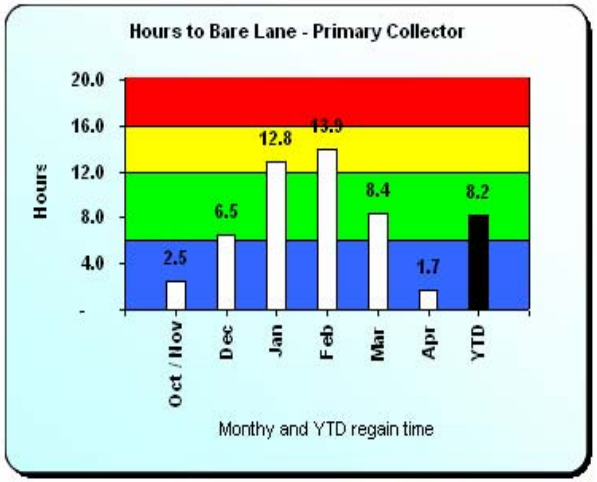
Significantly Under Expectation
Under Expectation
Meets Expectation
Over Expectation



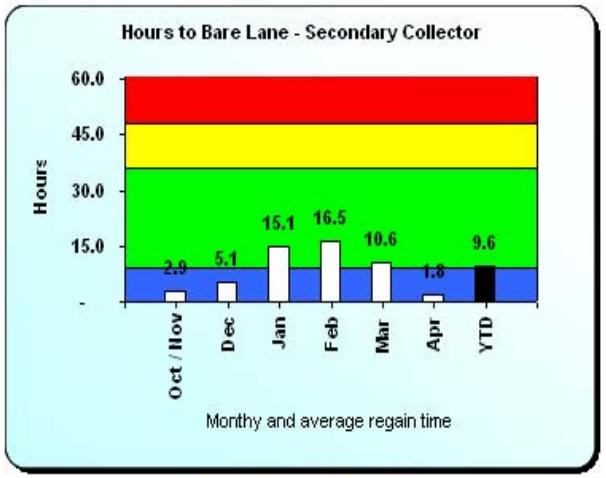
(1,023 Lane Miles)



(1,552 Lane Miles)



(643 Lane Miles)



(109 Lane Miles)

Program & Project Management System (PPMS)

Snow & Ice Report - Labor, Equipment, and Material Summary Ordered by Service Level

Report ID: 22551
Rate Type: Actual Costs/Usage
Dates: Oct. 1, 2008 to Apr. 30, 2009

Work Order:
Org: 9700 and reporting ORGs; ORG TYPE: Time Sheet
Activity: '2406'
Job Number: ALL

Report Subtitle: District 7

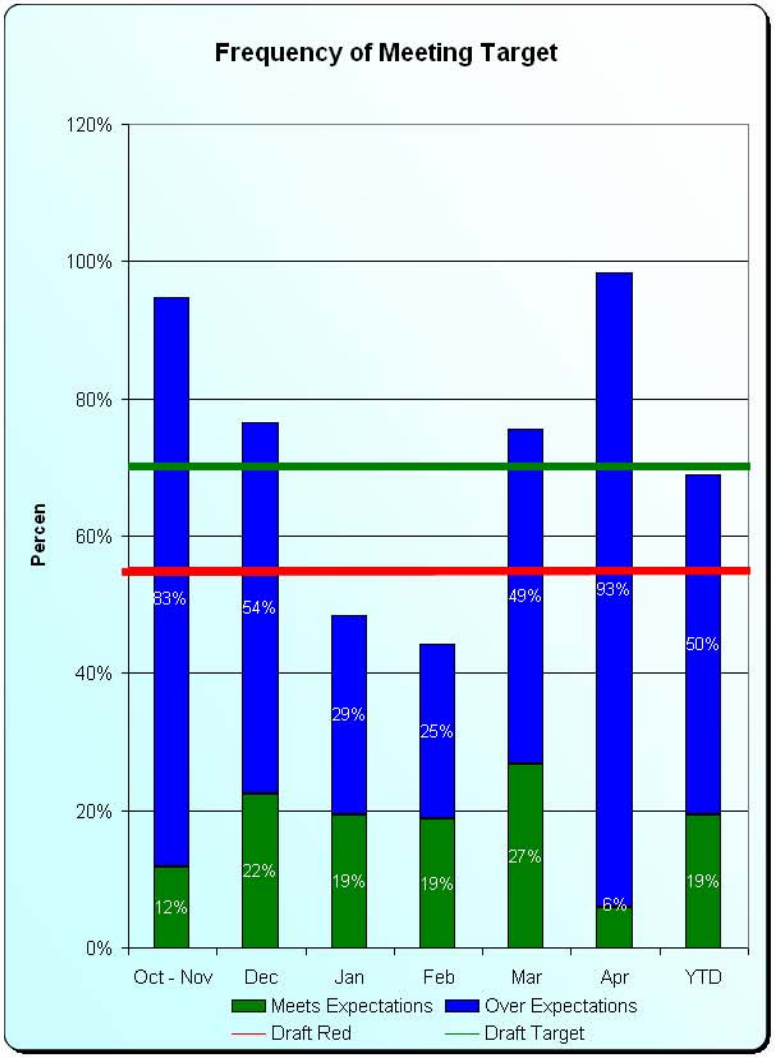
V.20080708

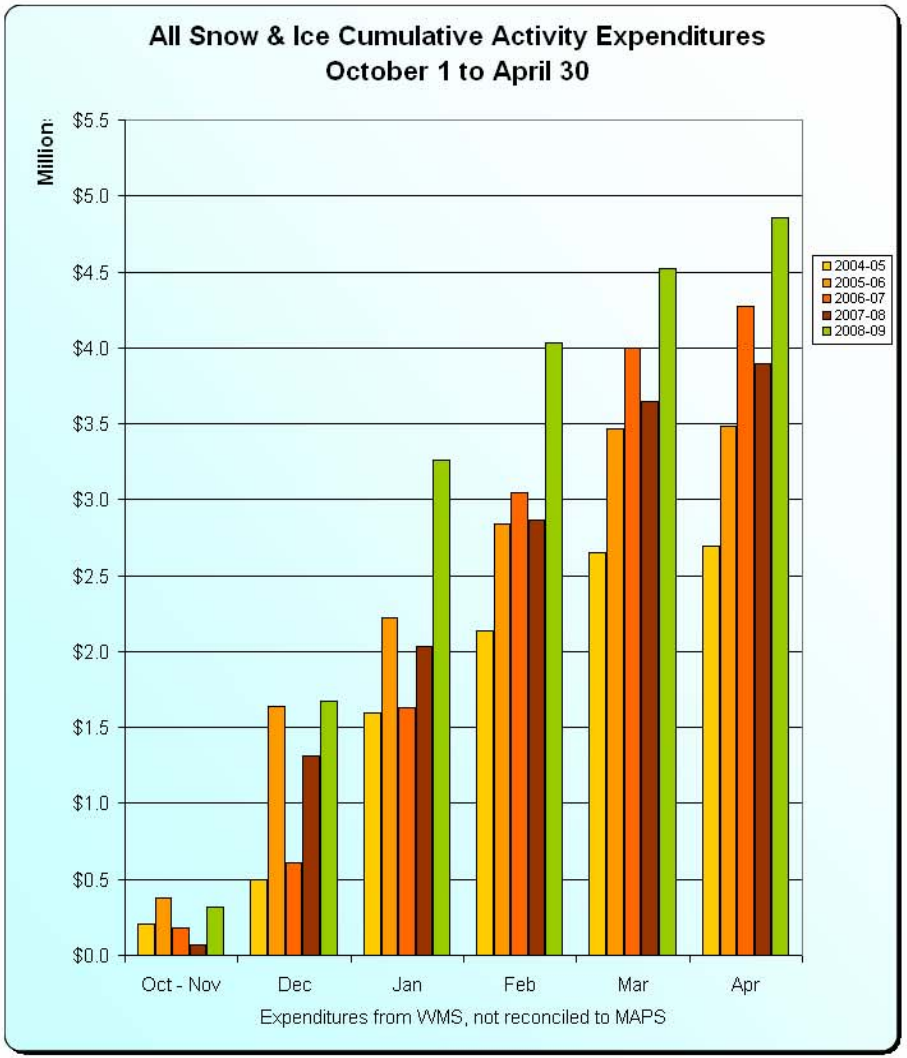
	RT Hours	RT Cost	OT Hours	OT Cost	Labor Cost	Equipment Usage	Equipment Cost	Material Cost	Total Cost
Urban Commuter	7,947.00	$165,392.52	3,516.00	$108,688.91	$277,646.48	11,042.48	$547,690.23	$520,843.00	$1,346,179.71
Rural Commuter	10,606.50	$220,455.20	5,107.50	$159,242.42	$384,097.27	15,378.05	$722,448.89	$621,296.64	$1,727,842.80
Primary	3,310.50	$69,534.02	1,543.00	$48,696.21	$119,514.53	4,883.00	$235,532.47	$184,903.45	$539,950.45
Secondary	479.25	$10,112.23	274.00	$8,723.52	$19,039.45	712.00	$41,051.13	$28,778.45	$88,869.03
Total:	22,343.25	$465,493.97	10,440.50	$325,351.06	$800,297.73	32,015.53	$1,546,722.72	$1,355,821.54	$3,702,841.99

Data from WMS. Activity 2406

Maintenance: Snow & Ice Removal
District 7
Winter 2008 - 2009
Data Period 10/01/2008 to 4/30/2009

Notes:
Thomas Zimmerman





April 1, 2009 through April 30, 2009

District 7

Snow Accumulation	Worthington	St. James	Gaylord	Amboy	Average Accumulation
Reporting Month Accumulation	10	3	2	1.5	4.2
Season to date Accumulation	47.5	55	50.5	50.5	50.9

	Apr-08	Apr-09	Events to date for 08-09 Season
Snow Events:	2.1	1.1	25.5
Freezing Rain Events:	0	0	5

Material Usage:	Apr-08	Apr-09	Total to date for 08-09 Season
Salt (tons)	1,292	1,228	20,587
Sand (tons)	237	44	3,831
Brine (gal)	9,536	12,335	450,809
Other Materials:			
Calcium Chloride (gal)			8,650

Comments

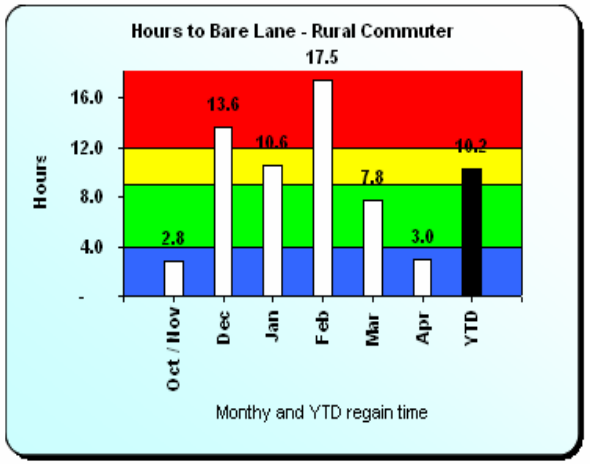
This winter's usage summary is very close to last winter's. It was colder with a few more events and a bit more snow, and our chemical usage was just a little higher than last year. Both winters were longer and tougher than what we would consider a "normal" winter. The highlight of this winter was the impressive performance of the calcium chloride liquid, especially in the colder temperatures.

Close

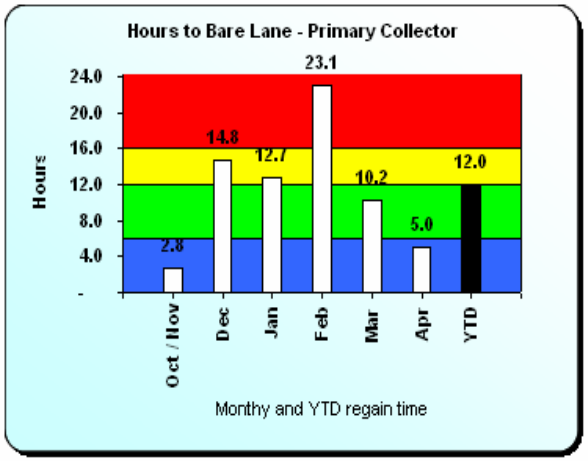
Maintenance: Snow & Ice Removal
Hours to Bare Lane - **District 8**
Winter 2008 - 2009

Data Period 10/01/2008 to 4/30/2009

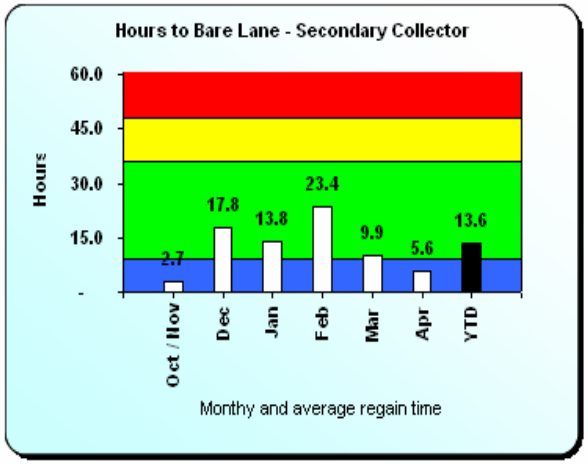
Significantly Under Expectation
Under Expectation
Meets Expectation
Over Expectation



(1,542 Lane Miles)



(1245 Lane Miles)



(121 Lane Miles)

Program & Project Management System (PPMS)

Snow & Ice Report - Labor, Equipment, and Material Summary Ordered by Service Level

Report ID: 22552
Rate Type: Actual Costs/Usage
Dates: Oct. 1, 2008 to Apr. 30, 2009

Work Order:
Org: 9800 and reporting ORGs; ORG TYPE: Time Sheet
Activity: '2406'
Job Number: ALL

Report Subtitle: District 8

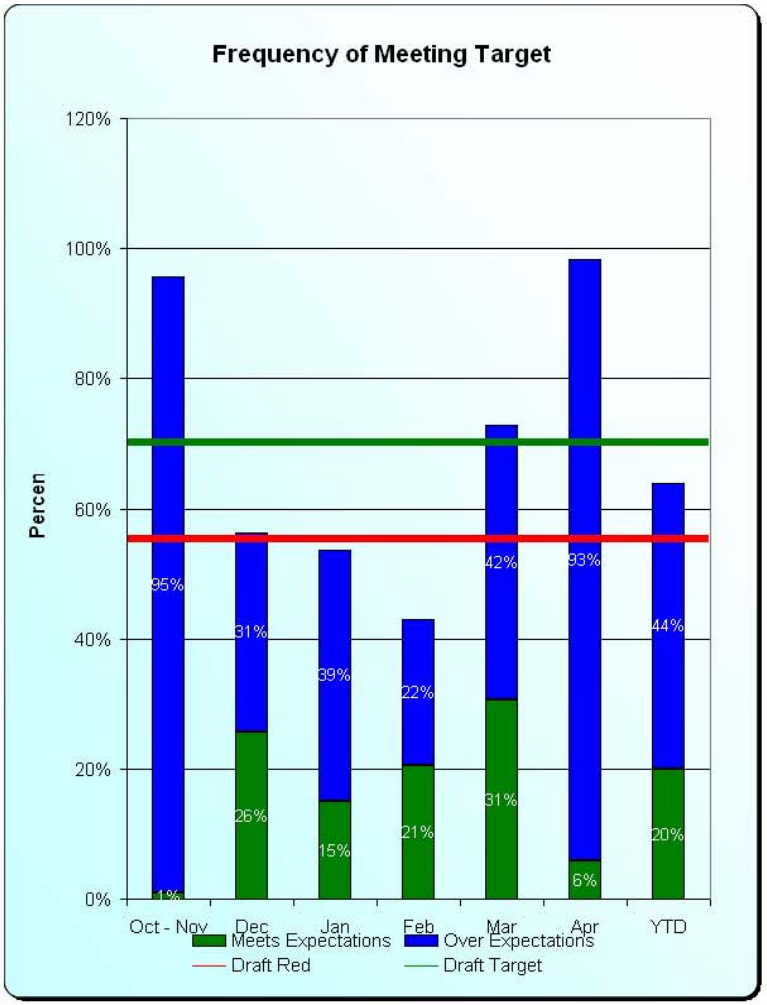
V.20080708

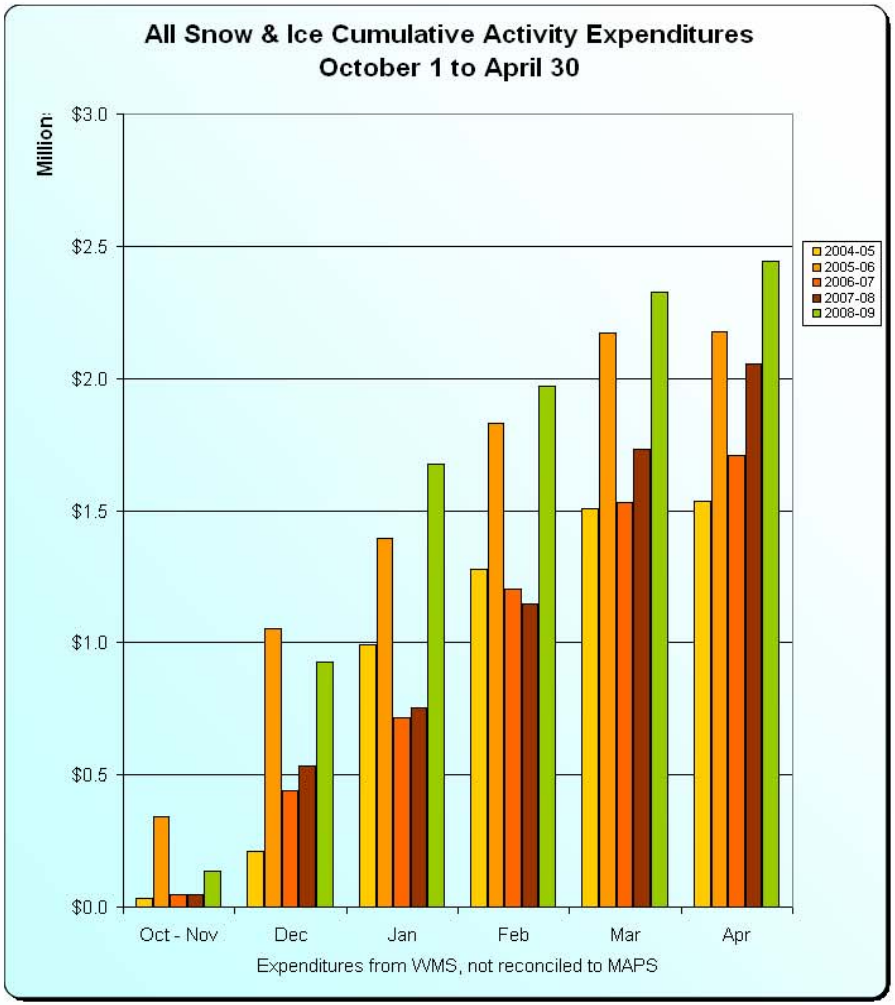
	RT Hours	RT Cost	OT Hours	OT Cost	Labor Cost	Equipment Usage	Equipment Cost	Material Cost	Total Cost
Rural Commuter	11,045.25	$229,160.85	2,139.50	$67,453.63	$301,973.38	11,997.35	$653,579.17	$307,272.11	$1,262,824.66
Primary	6,377.00	$129,763.39	1,382.50	$42,354.64	$174,964.73	7,321.30	$405,304.97	$182,328.58	$762,598.28
Secondary	500.00	$10,133.75	120.50	$3,736.53	$14,096.78	601.50	$35,653.70	$17,179.68	$66,930.16
Total:	17,922.25	$369,057.99	3,642.50	$113,544.80	$491,034.89	19,920.15	$1,094,537.84	$506,780.37	$2,092,353.10

Data from WMS. Activity 2406

Notes:
Jeff
Butson

Maintenance: Snow & Ice Removal
District 8
Winter 2008 - 2009
Data Period 10/01/2008 to 4/30/2009





April 1, 2009 through April 30, 2009

District	**8**

Snow Accumulation	Pipestone	Milan	Marshall	Litchfield	**Average Accumulation**
Reporting Month Accumulation	**10.2**	**T**	**NA**	**3.2**	**6.7**
Season to date Accumulation	**39.4**	**44.8**	**NA**	**44.4**	**42.9**

	Apr-07	**Apr-08**	**Average # of Events to date for 07-08 Season**
Snow Events:	**3**	**2**	**19**
Freezing Rain Events:	**0**	**0**	**6**

Material Usage:			**Total to date for 07-08 Season**
Salt (tons)	**1,654**	**666**	**8,081**
Sand (tons)	**694**	**296**	**7,141**
Brine (gal)	**19,912**	**7,024**	**153,795**
Other Materials:			
Mgcl	**0**	**0**	**2,904**

Comments

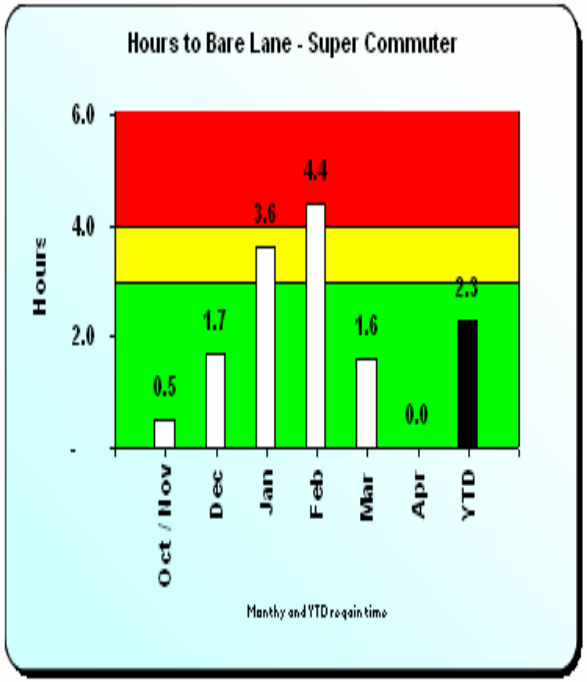
T
This S&I season was near average in snow accumulation and events. Salt usage was below average where sand usage was up due to cold temps in January.

Close

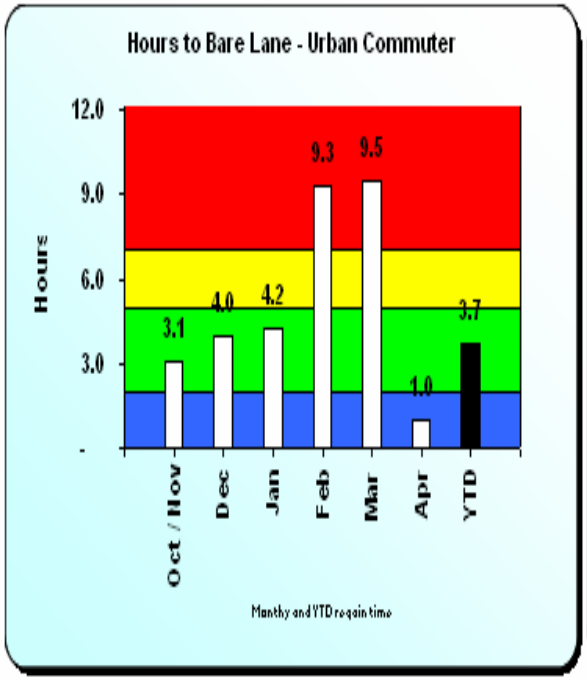
Maintenance: Snow & Ice Removal
Hours to Bare Lane - **Metro**
Winter 2008 - 2009

Data Period 10/01/2008 to 4/30/2009

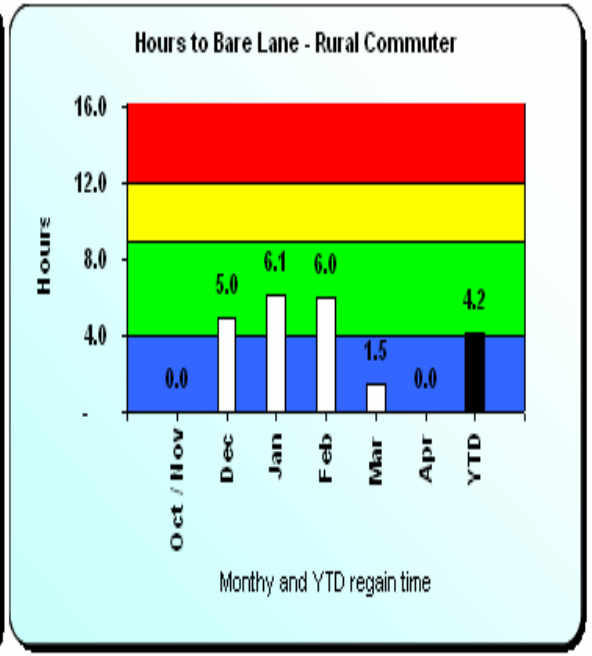
Significantly Under Expectation
Under Expectation
Meets Expectation
Over Expectation



(3,711 Lane Miles)



(776 Lane Miles)



(433 Lane Miles)

Program & Project Management System (PPMS)

Snow & Ice Report - Labor, Equipment, and Material Summary Ordered by Service Level

Report ID: 22549
Rate Type: Actual Costs/Usage
Dates: Oct. 1, 2008 to Apr. 30, 2009

Work Order:
Org: 7300 and reporting ORGs; ORG TYPE: Time Sheet
Activity: '2406'
Job Number: ALL

Report Subtitle: Metro

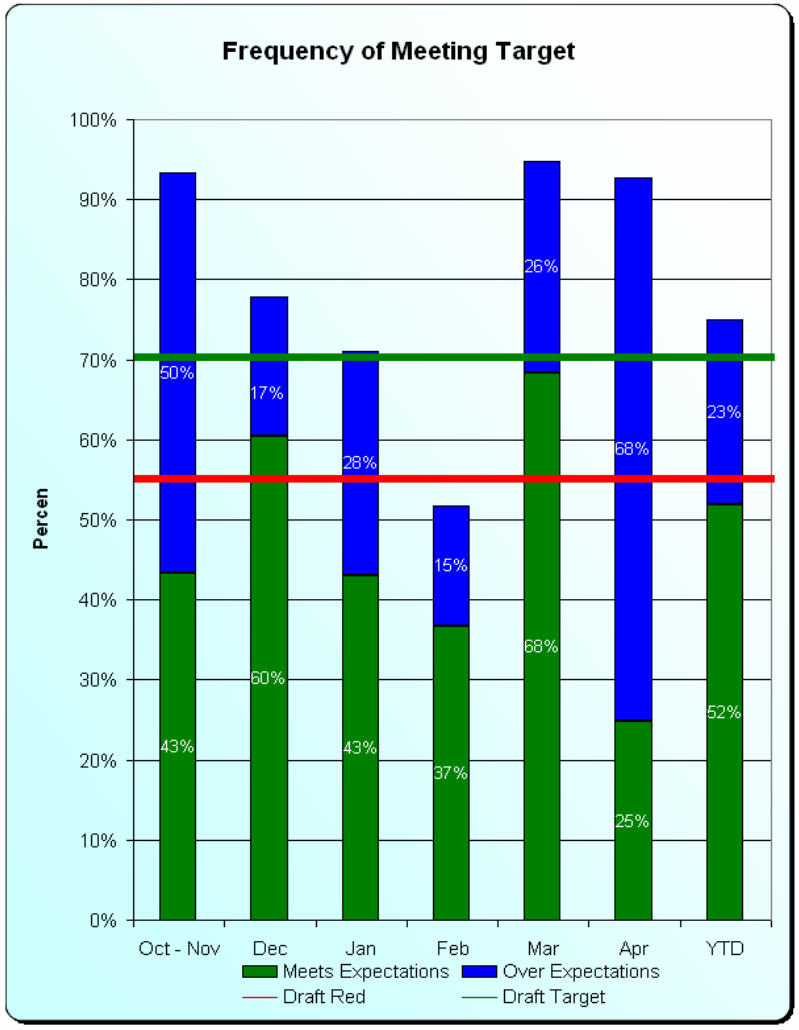
V.20080708

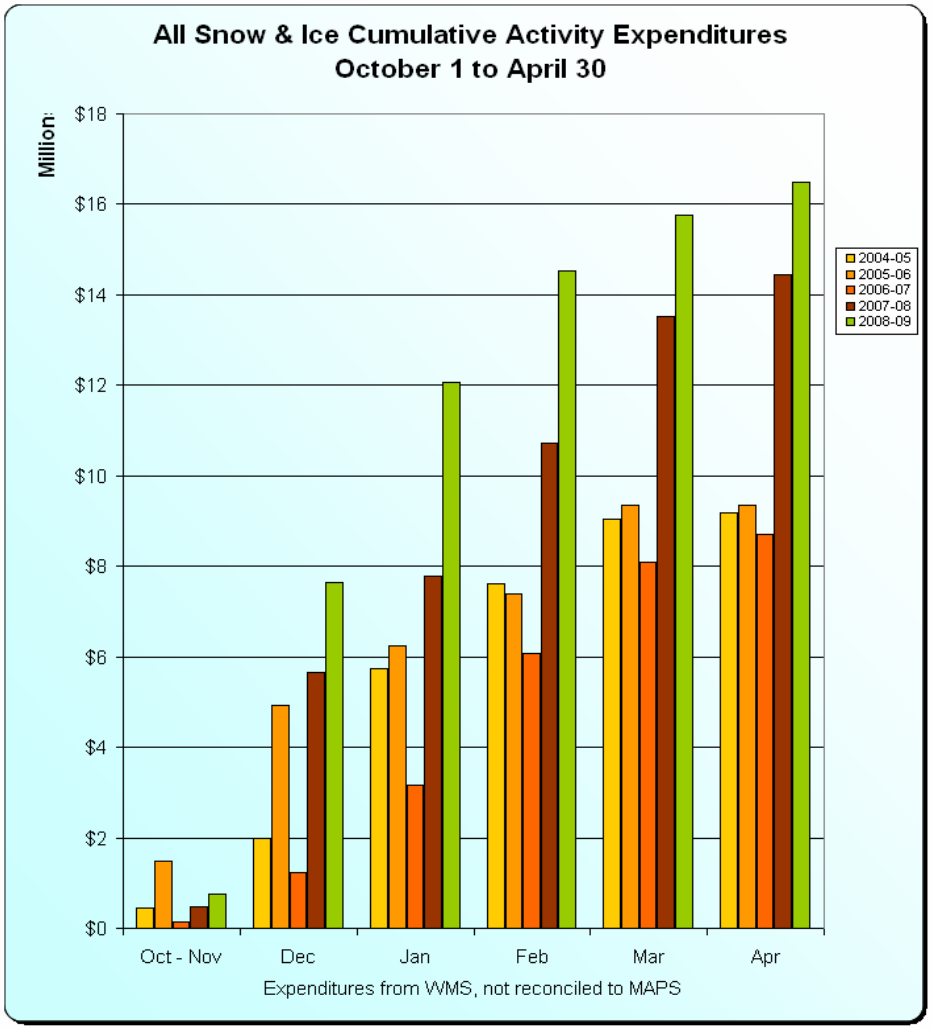
	RT Hours	RT Cost	OT Hours	OT Cost	Labor Cost	Equipment Usage	Equipment Cost	Material Cost	Total Cost
Super Commuter	66,806.25	$1,360,449.01	47,166.85	$1,440,440.70	$2,843,815.97	120,211.17	$4,392,642.53	$3,401,937.32	$10,638,395.82
Urban Commuter	11,763.75	$240,268.35	8,107.00	$247,635.64	$496,266.19	17,784.70	$765,098.33	$593,928.81	$1,855,293.33
Rural Commuter	4,358.25	$93,049.09	2,816.50	$89,634.32	$185,711.01	7,113.25	$235,585.29	$215,318.20	$636,614.50
Total:	82,928.25	$1,693,766.45	58,090.35	$1,777,710.66	$3,525,793.17	145,109.12	$5,393,326.15	$4,211,184.33	$13,130,303.65

Data from WMS. Activity 2406

Maintenance: Snow & Ice Removal
Metro
Winter 2008 - 2009
Data Period 10/01/2008 to 4/30/2009

Notes:
Mark
Fischbach





April 1, 2009 through April 30, 2009

District | **Metro**

Snow Accumilation:	SE-MSP Airport	SW-Chanhassen	NE-Harris (I35W)	NW-Maple Grove (I94)	**Average**
Reporting Month Accumulation	**2.5**	**4.1**	**0.2**	**0.3**	**1.8**
Season to date Accumulation	**45.0**	**56.8**	**41.5**	**33.2**	**44.1**

	Apr-08	**Apr-09**	**Average # of Events to date for 08-09 Season**
Snow Events:	**3**	**1**	**40**
Freezing Rain Events:	**0**	**1**	**2**

Material Usage:			**Total to date for 08-09 Season**
Salt (tons)	**4,942**	**867**	**77,662**
Sand (tons)	**0**	**0**	**3,033**
Brine (gal)	**3,255**	**1,980**	**167,516**
Other Materials:			
LCS	**2,920**	**160**	**52,316**
MAG CHL	**82**	**0**	**12,708**
CF7			**41,527**

Comments, 50 words or less:

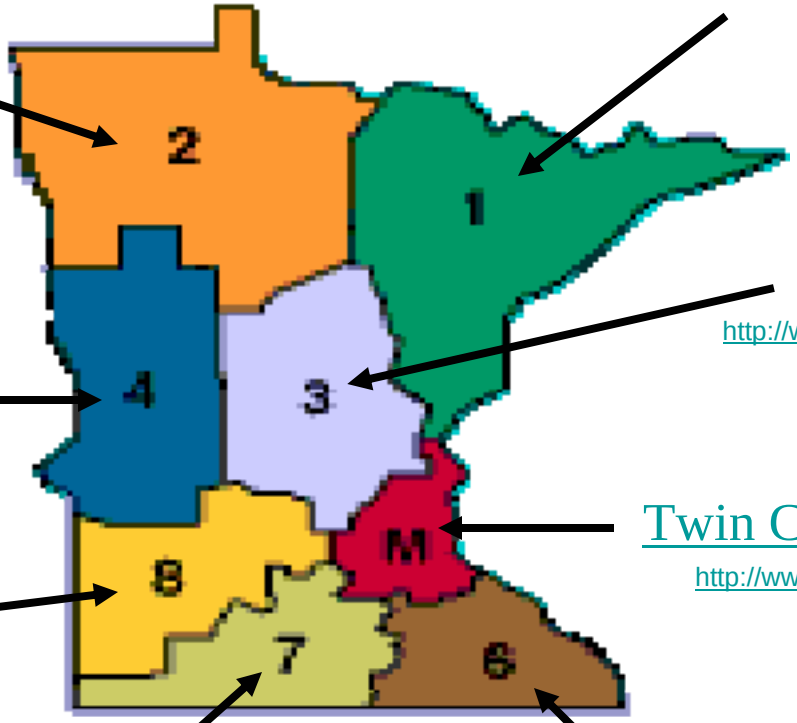
Metro had 2 small events in the beginning of the month otherwise it was a nice spring month of April.

Close

Minnesota

Duluth 1
http://www.dot.state.mn.us/d1.html

Bemidji 2
http://www.dot.state.mn.us/d2.html



Brainerd 3
http://www.dot.state.mn.us/d3.html

Detroit Lakes 4
http://www.dot.state.mn.us/d4.html

Twin Cities – Metro Area
http://www.dot.state.mn.us/metro.html

Willmar 8
http://www.dot.state.mn.us/d8.html

Mankato 7
http://www.dot.state.mn.us/d7.html

Rochester 6
http://www.dot.state.mn.us/d6.html

133.4.1 Priority Route Classifications

Continuous treatment routes are given top priority. Continuous treatment is the application (and re-application as needed) of snow and ice control treatments on the full length of a specified route, throughout the storm until all lanes are restored to a wet or dry condition. A district continuous treatment system shall include all major highways, minor highways with high traffic volumes (at the district engineer's discretion) and other urban and community routes designated by the district (regardless of AADT). Continuity of route treatments as well as coordination with adjoining districts (regardless of AADT) shall be addressed between the districts. Snow and ice control shall follow these guidelines and objectives for determining route priorities.

First Priority Routes (Continuous Treatment Routes): All major highways and those designated minor, urban and community routes. This also includes all designated incident bypass routes.

The objective is to have all lanes on these routes restored to a clear condition as soon as possible after the end of the storm. To achieve this objective, continuous application of snow and ice control treatments (and re-application as needed), on the full length of these routes, 24 hours per day throughout the storm, will be necessary. Interstates and other higher AADT routes will be plowed and treated first. The use of anti-icing methods is appropriate for first priority routes.

Second Priority Routes: All other minor highways not included in the first priority routes.

The objective is to have these routes open to two-way traffic and treated with salt and/or abrasives on hills, curves, intersections and other areas as needed as soon as possible after the end of the storm. 24-hour per day coverage is appropriate until the objective has been met. These routes should be prioritized by traffic volume.

Paved Shoulders: The objective is to have paved shoulders plowed during, or shortly after, the storm. Do not treat paved shoulders directly with anti-icing or

de-icing chemicals. Removing snow and ice from paved shoulders should be in conjunction with plowing of the traveled lanes in each priority classification, especially the high sides of super-elevated curves, if drifting is occurring, if weather predictions are unfavorable, or to reduce ramping situations. It is not necessary to return paved shoulders to a wet or dry condition as soon as possible after the end of the storm. Obtaining bare pavement on paved shoulders should be accomplished during normal working hours. Paved shoulders next to extended or continuous traffic barriers, bridge parapets, impact attenuators, guardrails, curbs, narrow medians and gore areas should be given special consideration where snow accumulates and has the potential to form ramps. Sight distance locations such as at intersections and interchanges should be cleared of any obstructions caused by snow piles or accumulations. Snow and ice removal operations shall remain in effect on a 24-hour per day basis until the above-mentioned objectives are met and sustained for both first and second priorities.

Post storm clean up during normal working hours includes continued plowing and treating of second priority routes, bridge flushing and sweeping, equipment cleaning and maintenance, and salt storage housekeeping.

Refer to Intent.

Reasons for policy: To ensure the routes with the most traffic are cleared first and provide uniform statewide snow removal practices.
Effective Date: 6/1/99
Revision Dates: 6/17/03, 10/14/05, 12/01/06, 8/16/07

Township of Hamilton
Snow and Ice Control Information

When do you apply salt to the roadways?

- Prior to the onset of frozen precipitation, all township roads will be anti-iced with liquid salt (brine) unless pavement temperatures are not favorable for this action.
- Anti-icing is a policy which involves spreading salt as early as possible to prevent snow and ice from bonding to the pavement surface and keeping it in a plowable condition.
- Anti-icing significantly reduces the amount of salt needed to maintain our roadways in a passable condition.
- Chemicals used for anti-icing in Hamilton are currently liquid salt (brine) and solid salt, prewetted with magnesium or calcium chloride.
- The neighborhood roads will be treated both prior to the onset of frozen precipitation (providing pavement temperatures are in an acceptable range) and after an event has ended if snow pack has occurred on those roads.

How long does it take to spread salt on the Township roads?

- If all spreading equipment is running, the primary roads can be spread with anti-deicing chemicals in 1 ½ hours.
- If all spreading equipment is running, we can apply anti-icing/deicing chemicals to the secondary (neighborhood) roads in about 6 hours.

Are you investigating any alternatives to your current anti/deicing materials?

- Yes. We are always looking for ways to do things better and more cost effectively.
- Anti-icing with Liquid salt (brine) is an example of this.
- We are investigating the use of chemical blends using different chlorides and in some cases other products like agricultural byproducts (sugars).
- We are currently investigating the use of different types of plow blades such as rubber, polyethylene, composites, etc. We are also investigating the use of wingplows for some of our trucks which will allow a truck to plow wider road widths. In some cases, one truck will do the work of two.

How much snow must fall before you begin snow plowing operations and what roads get plowed first?

- Usually 1 inch or more must accumulate on the pavements before plowing begins.
- On the primary roads, every attempt is made to keep the roadway clear of snow “curb to curb”.
- Primary roads are maintained in a passable condition throughout the entire storm.
- Once the primary roads have been deemed passable, and that condition can be sustained with fewer resources, a decision to deploy plows into the neighborhoods (secondary roads) is considered.
- We generally will not enter the secondary roads (neighborhoods) to plow snow unless the accumulated snow is going to be problematic.
- Driveways will not be cleared.
- Population density dictates what portions of the township are plowed first.
- We will apply anti-icing chemical on streets prior to the onset of frozen precipitation.
- We will apply deicing chemicals on snow pack and ice to improve conditions on the neighborhood streets.

I have seen dump trucks, with large tanks in their truck bodies, spraying some type of liquid on the roadway prior to a storm arriving. What is that?

- They are anti-icing the pavements using liquid salt (brine).
- This is a proactive approach to preventing snow and ice from bonding to the pavement.
- It reduces the amount of salt needed during winter operations and provides for safer roadways.

How many vehicles do you use for plowing?

- 20 dump trucks and 6 loaders are used for plowing operations.
- During heavier snow accumulations, up to 25 contractor trucks may be utilized to supplement the plowing operation.

Who is responsible for clearing sidewalks?

- The adjacent property owner is responsible for clearing the sidewalks.
- Sidewalks must be cleared within 12 daylight hours following the end of accumulating snowfall.
- When clearing sidewalks, snow should not be shoveled or blown into the streets.

Tips for dealing with a winter snowstorm

1) Whenever possible, remove your vehicle from the street whenever plowable snows are forecast. Vehicles parked along the curbs make it difficult for plow operators to clear the roads.

2) Whenever possible, please avoid driving or parking on the roads during or immediately after a heavy snowstorm. The less traffic our plow operators encounter, the more efficiently they can get the roads cleared.

3) Do not shovel or blow snow into public streets. This not only defeats the purpose of our snow plowing but creates unsafe conditions for all drivers. All shoveled or blown snow should be piled in your yard or in the area between the curb and sidewalk.

4) We will not clear driveway openings. During the course of plowing snow off of the roads, driveways may get plowed in (snow deposited in front of the driveway opening by plow trucks). This is unavoidable. To minimize this inconvenience, residents are encouraged to clear the area of the roadway (adjacent to the curb) to the left of their driveway (when looking at the street from their property). Most of the snow, being carried by the plow, will drop off in that area before reaching the driveway. Unfortunately, it is often necessary to plow some roads more than once (especially those roads that were plowed early in the event); consequently, you may have to open up your driveway more than once.

NEW YORK STATE
DEPARTMENT OF TRANSPORTATION

OFFICE OF OPERATIONS MANAGEMENT

HIGHWAY MAINTENANCE GUIDELINES

SNOW AND ICE CONTROL

April, 2006

NEW YORK STATE DEPARTMENT OF TRANSPORTATION

HIGHWAY MAINTENANCE GUIDELINES

SNOW AND ICE CONTROL

5.0000 Snow and Ice Control on State Highways

5.1000 Preparation for Snow and Ice Control

5.2000 Storm Watch

5.3000 Snow Control

5.4000 Ice Control

5.5000 Stockpiling and Storing Chemical and Abrasives

5.6000 Snow Stake Installation

5.7000 Maintaining the Capability of Drainage Features

5.8000 Passive Snow Control

5.9000 Municipal Snow and Ice Contracts

Appendix A - Operational Plan Outline

Appendix B - Definitions, Handling Chemicals & Equipment Checklist

Appendix C - Application Rates

Appendix D - Abrasives – Snow and Ice Control Specifications

Appendix E - Reference Material

April, 2006

5.0000 SNOW AND ICE CONROL ON STATE HIGHWAYS

5.0100 General Principles

Our State's society and economy depend upon the all-weather use of our streets and highways. When the State system is closed or the capacity reduced, the traveling public, industry and commerce are all affected. Also, accidents due to snow and ice on our pavements can be very costly in terms of property damaged, personal injuries and human life.

5.0200 Definition of Terms

The terms "shall, must, should, recommended and may" used in Section 5 have the following meaning:

Shall and Must	-	A required course of action
Should and Recommended	-	A suggested course of action
May	-	An optional course of action

5.0300 Goal

The Department's goal is to provide highways that are passable and reasonably safe for vehicular traffic as much of the time as possible within the limitations imposed by weather conditions and the availability of equipment, material and personnel. It is recognized that due to resource limitations and weather conditions, pavement surfaces will be snow covered and/or slippery some of the time. The traveling public must exercise caution and drive appropriately in those situations.

5.1000 PREPARATION FOR SNOW AND ICE CONTROL

5.1100 Objective

The objective of planning for snow and ice control operations is to have sufficient resources and knowledge to effectively combat snow and ice conditions that routinely affect the State highway system, within budgetary and available resource constraints.

5.1200 Goal

The goal of the preparation effort is to provide for a reasonable and timely response to snow and ice events which affect the State highway system.

5.1300 Methodology

5.1301 Rationale for a Traffic Based Level of Response

Traffic volume has been selected as the basis for level of response primarily because it reflects (1) the degree of difficulty in snow and ice control, (2) the speed of vehicles using the facilities, (3) the relative skill and familiarity of the highway users generally traveling on the highways, and, (4) the number of people that are inconvenienced if our efforts are delayed.

5.1302 Highway Classification for the Purpose of Snow and Ice Control

Class A1 – Expressways with low average running speeds. Examples: Long Island Expressway, Interurban, and Intercity State Routes with traffic volumes approaching or exceeding capacity. These highways are at, near, or over the practical capacity of the highway at certain times during the day. Any interruptions delay some vehicles, thereby raising the volume in a given section to or above the possible capacity. The speed then drops to near zero and complete congestion results. In cases like this, the speed of the Snow and Ice Control vehicle is not governed by the operator or by the efficiency of the operation, but by forces completely beyond control. However, traffic must be kept moving before that complete congestion point is reached. This signifies that, so far as practical, priority attention should be given to these highways.

Class A2 – Expressways with high average running speeds. Typically, these are Interstate type highways with a one-way design hourly volume of 500 or more vehicles per hour. The slowing of a few vehicles does not mean complete congestion of the highway. These highways give Snow and Ice Control vehicles some freedom to maneuver, and plow speed can be controlled by the operator.

Class B – Major State highways with a one-way design hourly volume from 200 to 500 vehicles per hour. As with A2 highways, the immediate need for snow and ice control is not as critical as A1, since vehicles can normally travel without congestion at reduced speeds.

Class C – Minor State highways with a one-way design hourly volume less than 200 vehicles per hour. On these highways traffic volumes are low, motorists are more apt to be familiar with the highway, and congestion point is rarely reached. Plowing speeds can, generally, be controlled by the plow operator.

5.1303 Locations That Require Special Consideration

Locations such as steep grades, intersections, sharp curves, bridges, and railroad crossings should receive special consideration in planning snow and ice control operations, regardless of the highway classification. Section 5.3307 has more information on these types of locations. Areas subject to Great Lakes squalls, or sections susceptible to sudden icing, or subjected to abnormal drifting are also special conditions that warrant individual consideration. There are special snow and ice areas that may require snow removal. These include: ditches and culverts (to provide for proper drainage), bridges, intersections, signs, safety appurtenances, facility driveways and loading areas, and certain commercial areas that could otherwise possibly impair traffic flow and sight distance.

5.1304 Design Rate of Snowfall

A snowfall rate of 1.1 inches per hour has been determined as being exceeded on a few times each year in all areas of the State. It is considered the maximum rate of fall for which staffing is economically possible.

5.1305 Average Truck Speeds (for planning purposes)

Through research, it has been determined that the average plow truck speed (including deadheading and reloading) is 16.5 MPH for highway classes A2, B, C, and D and 14.5 MPH for class A1 highways. These figures help in determining plow beats.

5.1306 Assignment of Snow & Ice Trucks for Various Classes of Highway

The distribution of snow and ice trucks to the Regions shall be:

Highway Class	Lanes Miles/ Truck
A1	20
A2	30
B	30
C	30

5.1307 Plowing Capability of Snow and Ice Trucks

The GVWR (Gross Vehicle Weight Rating) helps determine the plowing capacity of the truck. Trucks with a minimum GVWR of 36,000 pounds will handle the rate and frequency of storms anticipated, spread sufficient material per trip, and minimize the possibility of complete impassability of State highways during less frequent but more severe storms.

5.1308 Spreading Capacity of Snow and Ice Trucks

The spreading capacity of the large dump trucks used for snow and ice control on State highways should be at least 6 C.Y. This will minimize the labor and equipment cost per yard of material spread and provide sufficient material coverage for normal beats. Time lost during reloading is not productive and necessitates increased use of equipment and personnel resources.

5.1309 Other Types of Snow and Ice Equipment That Must Be Considered During Planning

A. Loading Equipment

Sufficient loading capability must be provided to load trucks without unreasonable delays. Additionally, plowed snow must be removed from certain areas on and around the highways. Front end loaders having sufficient capacity of about 2 C.Y. are generally suitable for this purpose. However, in some of our small work locations (1 – 3 trucks) a medium size loader with a 1 C.Y. bucket has proven to be adequate for the loading requirements. Conversely, at some of our larger work locations (greater than 8 trucks) loaders with a 3 C.Y. capacity may be necessary.

B. Graders

Occasionally, despite reasonable effort, snow pack will form on the highway. Graders are suitable for mechanically removing this pack. However, in most cases they are too slow for efficient removal of ordinary snow from the highway. If equipped with a wing plow, they are suitable for benching and some post storm cleanup.

C. Snowblowers

There are some drifting areas where accumulating snow exceeds our capacity to remove it with plow trucks. For this situation, snowblowers having sufficient size and capacity are the only efficient way to open and/or keep the highway open. They are also useful in loading and hauling operations.

D. Light Weight Equipment

There may be some bridges on the highway system that can not accommodate the weight of heavy plow trucks. Additionally, the inside raised shoulder in a roundabout needs a smaller vehicle for snow removal. A variety of lighter plow-equipped trucks, including 4x4 pickups, should be available to maintain these bridges and roundabouts.

E. Large Capacity Loaders

Where traffic volume is extremely high, and there is an occasional heavy snowfall, highways can be closed due to large numbers of stranded vehicles. In such situations availability of front end loaders having bucket capacities of 5 C.Y. or more is desirable. These loaders are capable of removing stranded vehicles from the highway as well as efficient snow removal.

5.1310 Equipment Readiness

Major repairs and overhauls of Snow and Ice equipment should be performed well in advance of the anticipated time of need. Adequate resources are needed to be available to perform this work. Our goal is to have the Snow and Ice fleet ready by November 1. For traditional early snow locations this date should be moved up to October 1. Stored equipment (plows, spreaders, snowblowers, etc.) should be given proper lubrication, protection and painting prior to storage. The flight chains on spreaders should be checked for lubrication during storage to prevent seizure. Whenever possible, spreaders should be stored under cover. Snowblowers should be started periodically during the off season to ensure proper operation later. Proper preventive maintenance and daily maintenance of multi-seasonal equipment is a good way to ensure readiness and proper performance.

5.1311 Personnel Readiness

The training of Snow and Ice personnel to safely and efficiently perform their duties should be a continuing effort. Basic Snow and Ice Training for all new employees is essential. Training for both new and experienced employees should be performed in accordance with Transportation Maintenance Instruction 00-02 and Equipment Operator Snow and Ice Manual dated October 2005. Snow Schools, Seminars, and preparation for snowplow competitions are available training forums.

5.1312 Facilities and Stockpiles

Facilities and stockpiles should be located so as to keep deadheading minimized. Salt shall always be stored under cover. The preferred method is in a building. Whenever salt is piled outside, care must be given in its location to mitigate any negative environmental impacts. Salt piles outside shall always be covered. Information on good housekeeping can be found in the Snow Fighters Handbook, published by the Salt Institute, and the Environmental Handbook for Transportation Operations, by the NYSDOT Environmental Analysis Bureau.

5.1313 Weather Information

Accurate weather information is essential to effective Snow and Ice management. Possible sources of this information should be known to all well in advance of the Snow and Ice season. Possible sources are:

A. The NOAA WEATHER RADIO NETWORK

NOAA Weather Radio is a service of the National Oceanic & Atmospheric Administration (NOAA) of the U. S. Department of Commerce. It provides continuous broadcasts of the latest weather information directly from the National Weather Service offices. Most of the stations operate 24 hours daily. Residency radio scanners equipped to pick up the appropriate frequency can monitor NOAA Weather Radio broadcasts from the following stations:

NOAA STATION	FREQUENCY (M Hz)
Albany	162.550
Binghamton	162.475
Buffalo	162.550
Elmira	162.559
Kingston	162.475

Rochester	162.400
Syracuse	162.550
New York City	162.550
Burlington (Vermont)	162.400

B. Private Weather Forecasting Services

There are a number of private weather forecasting companies that offer a variety of services. NYSDOT has an agreement with a forecasting firm that provides for Regional notification of anticipated Snow and Ice events and other severe weather conditions thru a variety of ways.

C. In-House Weather Information

All Residency Headquarters and Sub-Headquarters have near real-time weather information from sites that cover their area, via the internet. Each Region has a few sites that get satellite feed weather information as a backup. These systems provide excellent data on storm location and timing.

D. Road Weather Information Systems (RWIS)

Recent years have seen an increase in the use of RWIS systems at both the national and state level. These systems provide site specific weather and pavement condition data for both real time and forecast purposes. This tool can provide the manager with valuable information on when personnel will be needed, chemicals to be applied and after storm conditions.

E. Knowledge, Experience, and Communication with Locations in the Storm Path

Over time, people develop a sense of local weather patterns. Certain bridges and sections of highways tend to be possible problem spots. This information should be communicated to all employees that are likely to have snow and ice responsibilities for those areas. When general storms are approaching, communication with Residencies closer to the storm will yield valuable information on the timing and character of the storm as well as information on the cessation of the storm.

F. Other Sources of Weather Data

Local radio and television stations provide some weather information. The amount and priority are a matter of local station policy. Cable television provides access to a weather channel that provides forecasts 24 hours every day. With all of our work facilities having computers available to supervisors and being tied into the Internet, a variety of weather information is available. The Office of Operations Management, has set up direct links to several weather providers from its home page.

5.1400 Operational Plan

Each Residency shall have an Operational Plan for Snow and Ice Control. At a minimum this plan should include beat descriptions, which include lengths and typical cycle times, chemical and abrasive application rates and amounts for the beats, equipment calibrations, staffing and equipment distribution, storm manager procedures, radio watch procedures, and any special procedures for after storm cleanup. The Operational Plan should be developed by the Resident Engineer, Assistant Resident Engineer and front line supervisors. Its purpose is to have in one document all of the necessary information related to Snow and Ice Control for a particular Residency. The information in this document should be shared with all of the personnel in the Residency, so that everyone knows what is expected. An outline of an Operational Plan can be found in Appendix A.

5.2000 STORM WATCH

5.2100 Objective

The objective for storm watch is to have a set of communication procedures in place which will enable timely mobilization of sufficient personnel to effectively deal with snow, ice or other possible emergencies and provide the public and other agencies a forum for reporting potentially hazardous highway related conditions.

5.2200 Goal

The goal for storm watch is to effectively use the selected set of communication procedures to provide timely response to snow, ice and other winter emergencies.

5.2300 Methodology

The methodology will vary among Residences and shall be based on such factors as traffic volume, historical rate and frequency of storms, population centers,

working hours of large employers within the Residency, the necessity of maintaining access to vital services such as hospitals, emergency services, and the necessity of maintaining a consistent level of service on major routes of travel. Continuous telephone watch shall be maintained during the snow and ice season in each Residency. Portions of this may be in the form of commercial services or arrangements with other municipal service agencies, or through another Residency, or through DOT Traffic Management Centers.

5.2301 Storm Manager

The key to an effective snow and ice program is to have the necessary resources in place ready to go when the storm begins. In order to have the resources in place, a Residency Storm Manager must be designated. That person's responsibility is to monitor all of the available forecast information and determine the approximate start time for the storm. With an approximate storm start time, type of storm, and anticipated temperatures (pavement and air) a decision can be made when to have the necessary people and equipment ready to begin snow and ice operations. It is recommended that the storm manager be the Resident Engineer, Assistant Resident Engineer or Highway Maintenance Supervisor 2.

5.2302 Supervision and Preparedness

During periods when snow or ice events are anticipated, it is recommended that supervisors, in light vehicles having communications capability, patrol areas likely to be affected by the event for the purpose of directing the appropriate response. The availability of RWIS and other information resources may diminish or negate the need for patrols.

In situations where a snow or ice event has a high probability of occurring, it is recommended that trucks, carrying the appropriate material, be pre-positioned to begin spreading on their beats as soon as the event starts.

5.3000 Snow Control

5.3100 Objective

The objective of snow control is to provide the traveling public with a passable highway as much of the time as possible, given the constraints of operational resources and the character of the snow event.

5.3200 Goals

Snow control goals will vary with traffic volume and other considerations. Furthermore, the level of service provided will vary with the snow control goals determined to be appropriate given existing conditions. Regular Level of Service should be provided on all classes of highway between 4:00 AM and 10:00 PM Monday thru Friday, and at all times on highways having Average Daily Traffic (ADT) of 50,000 vehicles per day or more. Modified Level of Service should be provided on all classes of highway between 10:00 PM and 4:00 AM Monday thru Friday, and all day Saturday and Sunday, except for highways with and ADT of 50,000 vehicles per day.

The Regional Director may determine it to be appropriate, at his or her discretion, to provide certain highway sections with a higher than modified level of service. Such a determination may occur where it might be necessary to maintain a higher level of service because of unique travel or weather demands. These may include, but not limited to, highway sections serving industrial or recreational areas, other highway sections important for economic activities, or highway sections which may historically receive heavy snowfalls such that the Recommended Maximum Allowable Accumulation Goal, may be routinely exceeded. These variations should be approved by the Regional Director as requested by the Resident Engineer and recommended by the Regional Transportation Maintenance Engineer and documented at the beginning of each snow and ice season, and updated as appropriate during the season.

5.3201 Snow Control Goals – Regular Level of Service

Highway Class	Recommended Maximum Allowable Accumulation During a Storm (Inches)	Elapsed Time After Event End That Full Width of Pavement Should be Cleared (Hours)
A1	2.0	1.5
A2, B, C	2.5	2.0

5.3202 Snow Control Goals – Modified Level of Service

Highway Class	Recommended Maximum Allowable Accumulation During a Storm (Inches)	Elapsed Time After Event End That Full Width of Pavement Should be Cleared (Hours)
A1	2.5	2.0
A2, B, C	3.5	3.0

Plowing should begin as soon as there is enough snow on the pavement to plow. Do not wait for the Recommended Maximum Allowable amounts to be reached before the plowing operation commences.

5.3300 Snow Control Methodology

5.3301 Preparation for Snow Control Operations

A few plows and spreaders should be mounted well in advance of the anticipated date for the first snow storm. As more consistent winter weather approaches, additional units should be readied. All plows and spreaders should be mounted by November 1 as mentioned in Section 1.1310. During the winter season, equipment shall be serviced at the end of each storm. The use of a Truck Check List, such as found in Appendix B, assists an operator in ensuring that all of the critical items are looked at on his or her truck. The trucks and spreaders should be cleaned at the end of each storm.

Ballast, usually in the form of salt or abrasives, provides extra weight needed by the truck to obtain maximum traction for removing snow. The ballast must be removed when the truck is not needed for snow removal.

Blades (cutting edges) and shoes must be inspected by each operator on each shift and changed as necessary in order to prevent moldboard damage and wear.

Properly fit tire chains should be available for each snow and ice vehicle. Conditions such as ice storms may require the use of chains.

5.3302 Snowplowing Procedures – Mainline

A. General

There are a variety of acceptable procedures that will facilitate the removal of snow from the highway and allow for reasonably safe traffic flow. They vary with local traffic conditions, the characteristics of the highway surface and available snow storage area. The paramount objective in all of these procedures is to avoid leaving a windrow or berm of plowed snow between adjacent mainline (travel) lanes where reasonably possible. However, there may be circumstances where insufficient equipment or other conditions may exist that preclude plowing without leaving windrows in certain areas. In such circumstances, windrows may be left, but should only remain in such an area for as brief a period of time as reasonably possible. Depending on road and traffic conditions, plowing speeds should be in the range of 15 MPH to 35 MPH.

B. Two Lane – Two Way Traffic

Plowing shall always be done in the direction of traffic. A one-way plow with right wing is typically used when plowing the snow to the right. The traffic lane and as much of the shoulder as is possible should be plowed clear of the snow in this operation. When a plow truck is plowing to the right, without the right wing, as much of the pavement as possible should be cleared. Some reasonably small amount of plowing over the center line is necessary to clear the pavement. However, plow trucks shall yield the right-of-way to oncoming traffic.

C. Two Lane Section – One Way Traffic

1. Plowing shall always be done with trucks moving in the direction of traffic. Snow should not be plowed to the side of the truck on which traffic has an opportunity to pass unless it is done as part of a close echelon plowing operation that minimizes passing opportunities and will have plowed snow quickly removed from the pavement surface.

2. Typically, the entire passing lane will be plowed in one pass, by plowing the snow to the left if the median is of adequate width to store the snow. This

should preferably be accomplished with a large dump truck equipped with a reversible plow throwing left and a left-hand wing. This truck will typically operate along the right-hand edge of the passing lane so that the plow cuts as close to the lane marking as possible.

3. The entire driving lane should be plowed in the second pass by plowing snow to the right. The truck for this pass should be operated approximately one thousand feet (distance between two reference markers) behind the truck of the first pass. The plowing of the driving lane should preferably be accomplished by a large dump truck equipped with a plow and right-hand wing. This truck will typically be operated along the left edge of the driving lane so as to permit removing the remaining snow, on the entire driving lane and any small area of unplowed snow that may remain on the passing lane, in one pass. This type of plowing is known as tandem plowing. However, it is recommended that both trucks plow in close echelon. This minimizes the chance of vehicles passing and losing control in the unplowed lane. If the trucks leave the mainline plowing operation to plow ramps and intersections it is important that they return to the place they left off as quickly as possible in order to minimize the amount of time sections between "off" and "on" ramps remain in an unplowed condition.

4. If the median is too narrow to store snow, all plowing should be in close echelon and to the right as described in 1. above.

5. There may be circumstances where insufficient equipment or other conditions may exist that preclude plowing without leaving windrows in certain areas. In such circumstances, windrows may be left, but should remain in such an area for as brief a period of time as possible.

D .Three Lane Section – One Way Traffic

1. Plowing shall always be done with trucks moving in the direction of traffic. The inside or left lane should be plowed toward the median or left shoulder if sufficient storage area is available.

2. The center and right-hand lane should be plowed with two trucks utilizing right-throwing plows and wings while traveling in echelon as close together as safely possible. The first truck should generally operate as close to the left-hand edge of the center lane as possible.

3. Should the trucks leave the mainline plowing operation to plow ramps and intersections, it is important that they return to the place they left off as quickly as possible in order to minimize the amount of time sections between "off" and "on" ramps remain in an unplowed condition.

4. Alternative sequencing of the plow trucks is acceptable as long as no windrows or berms of plowed snow are created between adjacent travel lanes. It is recommended that all three trucks plow in close echelon. This minimizes the chance of vehicles passing the center and right lane trucks and then losing control in the unplowed left lane. If it is decided to allow room for vehicles to pass the center and right lane trucks then the distance between the close echelon pair of trucks and the single truck should be a minimum of approximately one thousand feet (distance between two reference markers).

5. If the median is too narrow to store plowed snow, all plowing should be in close echelon to the right.

6. There may be circumstances where insufficient equipment or other conditions may exist that preclude plowing without leaving windrows in certain areas. In such circumstances, windrows may be left, but should remain in such an area for as brief a period of time as possible.

5.3303 Plowing of Ramps and Intersections

In general, ramps and intersections should be plowed at about the same time as mainline sections. However, the character of the storm and traffic conditions may dictate that they be plowed earlier or later than the adjacent mainline sections.

5.3304 Plowing of Shoulders

After pavement and ramps are cleared, the full width of the shoulders should be plowed. It is particularly important that snow be cleared beyond the shoulder high point on banked curves in order to minimize possible re-freeze or snow melt on the pavement. Nose plows should not be used for plowing shoulders. Refer to the Equipment Operator's Snow & Ice Manual.

5.3305 Crossovers, Turnarounds and Gore Areas

Crossovers, turnarounds, and gore areas should be plowed after the storm is over and other elements of the highway have been cleared. These should be done when visibility is good and traffic volume is low.

The use of crossovers during mainline plowing operations is discouraged. Interchanges should be used to the extent possible for the operational movement of plow trucks. When it is necessary to use a crossover it should be of sufficient width to allow the plow truck to be completely off both roadways. Crossovers used as a turn around should be identified in the Operational Plan.

5.3306 Plowing Back and Benching

After the storm is over, plowed snow should be plowed back as far as possible to provide snow storage space in anticipation of the next storm. Care should be taken by the Operator to avoid dragging the wing beyond the paved shoulder. Additional snow storage can be provided by plowing high level snow banks with the wing elevated. This is called benching. The wing should be at least three feet off the pavement to avoid hitting guide rail. If the plow with wing elevated is unable to displace the snow, a snow blower should be used to clear the area.

5.3307 Removal of Snow from Special Areas

A. General

After the storm is over, the shoulders, crossovers and gore areas have been plowed and benching and pushing back operations are underway or complete, the removal of snow from special areas should commence. A list of any special areas, along with any special requirements should be included in your Residency Operational Plan. These operations require loading equipment and hauling vehicles. Front end loaders, snow blowers and heavy dump trucks are usually used for this purpose. If necessary, rental equipment may be considered. This may be available under a Municipal contract or through private rental.

B. Bridges

Accumulated snow should be removed from locations that could melt during the day, drain across the deck, and freeze at night. Bridge drainage features should be cleared to facilitate the designed discharge of water. Bridges having features which prevent plowed snow from leaving the bridge should have accumulated snow removed to make room for the next storm. Particular attention should be given to buildup along concrete barriers on high volume, high speed facilities. Overtime or resources from other residencies or regions may be necessary for this operation to minimize the duration or to facilitate the cleanup effort during off peak hours.

Accumulated snow on bridge sidewalks should be removed. In most cases the local municipality has the responsibility to remove the snow. For those locations with State responsibility, the Residency should develop a plan for the removal of the snow. Working with the local municipalities on this issue is recommended.

C. Impact Attenuators

When possible, accumulated snow should be removed from areas that could affect the performance of impact attenuators. This work may require overtime to minimize the duration or facilitate the cleanup effort during off peak hours.

D. Banked Curves

When possible, accumulated snow on the high side of banked curves should be removed to the shoulder break to minimize the risk of melt water freezing on the pavement.

E. Sag Vertical Curves

When possible, drainage channels should be created in the snow banks on both sides of the highway at the low point in sag vertical curves to minimize the risk of melt water accumulating on the pavement.

F. Ditches and Culverts

When possible ditches and culverts having a history of snow melt water runoff problems should be cleared of accumulated snow prior to anticipated thawing weather.

G. Closed Drainage Systems

The inlets to closed (underground) drainage systems should be cleared prior to anticipated thawing weather.

H. Narrow Median

Accumulated snow should be removed from narrow median areas if it poses possible melt water problems that may otherwise interfere with the traffic control function of the median.

I. Guiderail, Median Barrier and Concrete Barriers (Non- Bridge)

Snow should be removed as close to guiderail, median barrier and concrete barrier as reasonably possible with plow equipment. The complete removal of snow from the traffic side of guiderail and median barrier is not possible with available resources.

J. Roundabouts

In general, roundabouts should be plowed and/or treated as part of the regular plow beats which pass through them. As conditions warrant, one or more of the plow trucks assigned to routes passing through the roundabout should plow the entire circular traffic flow area. Larger facilities may require plow trucks to operate in

tandem to optimize snow removal. The truck apron on the central island should be maintained to insure functionality. Consideration should be given to maintaining sight distances, snow storage capacity and drainage patterns. Heavy snowfalls may require snow removal operations after the storm using loaders, rotary snow blowers or other necessary equipment. Operators should familiarize themselves with the roundabout's curbing and drainage features and should install snow stakes, as needed, prior to the onset of winter weather.

5.3308 Snow Removal from Municipal/Commercial Areas

Within municipal and commercial areas, "reasonable passage and movement" may require loading and hauling snow. This work is to be done only to the extent necessary. Need will be determined by the Resident Engineer. State Forces shall be used to the extent necessary and available. Any combination of State, County, Town and Village forces that is most practicable and applicable under current policy and contract agreements should be used. The clearing of Municipal sidewalks, parking areas, pedestrian refuge islands and center and splinter islands built as part of a roundabout is not intended to be performed or paid for by the State. The Resident Engineer should meet with appropriate municipal officials to coordinate snow removal efforts in these areas to minimize the impact to pedestrians.

Prior to disposing of snow removed from municipal/commercial areas, a check of local rules and ordinances relative to snow disposal should be made for any local requirements. Additionally, a check should be made for applicable watershed rules and regulations made or approved by the New York State Department of Health (P.H.L. 1100), or other regulatory agencies, for required compliance purposes. A list of approved sites should be included in the Residency Operational Plan.

5.3309 Snow Control During Blizzard and White-Out Conditions

Some snow and wind events produce snowfall intensity that severely limits the visibility and performance factors of the plow operator(s). Temporarily curtailing operations under these conditions may be prudent to preserve the safety of plow operator(s), other vehicles using or stranded on the highway and pedestrians that may be in the vicinity of the highway. Most of these events are associated with localized squalls of lake effect snow and are usually of relatively short duration. During these conditions, operators should drive their trucks to a safe location, well off the highway, turn exterior lights off and contact a supervisor for further direction.

Some intense low visibility snowfall/wind events (blizzards) are more sustained and can last from several hours to several days. During these events the overall level of service may be limited to that necessary for supporting local emergency situation response. During this pullback phase, operators waiting for further directions should make appropriate preparations and equipment should be made ready for intense operations when the visibility and/or other difficult conditions improve. Generally, this pullback option should only be used in conjunction with declared states of emergency when non-essential highway travel is prohibited.

5.3310 Vehicle Maintenance

After each event and when any special areas for snow removal have been addressed, maintenance of the equipment should commence. Trucks, material spreaders, loaders and other snow and ice equipment should be cleaned and greased.

5.4000 Ice Control

5.4100 General

It is recognized that it is not possible to provide a "bare" or "wet" pavement surface all of the time. The characteristics of weather events and finite available resources preclude this possibility. The interactive effects of pavement temperature, air temperature, event intensity, and timing of initial treatment, operational cycle time, traffic volume, wind velocity, and solar energy have profound influence on the effectiveness of our ice control measures.

During those times when the pavement surface is not "bare" or "wet" it is incumbent on the driving public to perceive those conditions and operate their vehicles accordingly.

5.4200 Objective

The objective of ice control is to provide a reasonably safe pavement surface given the available resources and limitations imposed by weather conditions.

5.4300 Goal

The goal of ice control is to provide the safest possible pavement surface that climatic conditions and available resources will allow.

5.4400 Methodology

5.4401 Ice Control Methods

There are four basic strategies recognized for ice control used by this Department and many other agencies in the field of snow and ice operations. They are anti-icing, deicing, delayed treatment, and temporary friction improvement.

A. Anti-icing

Anti-icing is a strategy that places and maintains a sufficient quantity of ice control chemicals on the pavement surface before or very soon after precipitation or ice formation begins. This is done to prevent bonding of snow and/or ice to the pavement. When anti-icing methods are properly employed, they can achieve high levels of service for sustained periods of time. To achieve this success, air and pavement temperatures, precipitation type, humidity, origin and intensity of the storm and predictions from online and/or contracted weather services must be tracked and monitored.

B. Deicing

Deicing is a strategy for dealing with snow or ice that has already bonded to the pavement surface. Deicing is most effectively accomplished by spreading a coarse graded (rock salt) solid or pre-wet solid ice control chemical on the surface of the bonded snow or ice. The coarse particulars will melt through the snow and ice, break the bond, and then produce a chemical solution that flows across the pavement surface between the packed snow/ice and road surface. Any snow or ice that has not gone into solution should be removed by subsequent plowing. Sufficient time is necessary to allow the salt to work before plowing commences.

C. Delayed Treatment

Delaying or not applying ice control materials is a tactic that may be used in support of the anti-icing strategy. Road and weather conditions must be closely monitored to ensure success with this tactic. This tactic should be considered when pavement temperature is likely to remain above freezing, or during "dry" snow and blowing snow events where pavement surface temperature is below 15^{o} F and there is no residual ice control

chemical on the pavement. Chemicals should not be applied in conjunction with plowing operations at these low temperatures or when plowing blowing and drifting snow at these low temperatures. Usually snow will not bond to the pavement and can be effectively removed by plowing alone. Traffic will whip the rest of the snow away. In this situation chemicals, or the chemicals in abrasives, may make the snow stick to the pavement, causing icy spots.

D. Temporary Friction Improvement

Friction improvement is an immediate and short term improvement in surface friction that is achieved by spreading abrasives or abrasives/chemical mixtures on the snow/ice surface. This method may be used where low traffic volumes and/or low pavement temperatures exist (below 15° F). A major disadvantage of this method is that its effectiveness degrades quickly with varying levels of traffic therefore it is very important to monitor road conditions to determine if a change in treatment is necessary.

5.4402 Preparation for Ice Control Operations

As with Snow Control preparation, it is critical to have all ice control equipment ready for mounting, on the trucks, well in advance of the first storm. In addition to the spreader units, attention should be given to the liquid chemical equipment. Pumps and connections on the bulk storage tanks need to be inspected and serviced. Saddle tanks on the spreaders, along with hoses, connections and spray bar also need to be inspected and serviced. It is recommended that the saddle tanks be emptied back into the bulk storage tank at the end of every season. Several locations now have distribution tanks with spray bars that slide into small dump trucks. These units need to be inspected and serviced. More information on summer storage, handling and emergency procedures for dealing with liquid chemicals can be found in Appendix B.

5.4403 General Principles of Effective Ice Control

A. Prevent pack – Don't Melt It

Timely application of chemicals very early in a storm, with appropriate follow-up applications, will generally prevent pack from forming. This strategy is more cost effective and safer than trying to remove pack once it has formed.

B. If Chemicals Will Work, Use Them

If the conditions are favorable, ice control chemicals should be applied at the beginning of the storm. With the advent of liquid ice control chemicals, they could be used to treat the pavement at the beginning of or in advance of a storm, if conditions for their use are favorable. The use of abrasives when chemicals will work encourages the formation of pack. The overall resource requirements for dealing with pack are far greater than preventing pack by the timely use of ice control chemicals.

5.4404 Materials Used for Ice Control

A. General

There are a large number of chemicals and other treatments that are used for ice control. NYSDOT generally uses six – salt (Sodium Chloride or Rock Salt), Treated Salt, Calcium Chloride, Magnesium Chloride, Magnesium Chloride with Organic Based Performance Enhancer and Abrasives (Sand). Most of the chemicals are available in the liquid form and can be used as part of an on-board wetting system with our spreaders or with slide-in tank and spray bar systems. They can also be use to pre-treat salt stock piles. The use of liquid chemicals in a slide-in- tank and spray bar system has several advantages over the use of solid chemicals. Liquids can usually be applied at relatively fast spreading speeds while achieving acceptable application patterns. Liquids also allow placement prior to a storm on dry pavement, but it has to be done on pavements above 20^{o} F. These are used singly or in combination depending on the climatological and pavement conditions. As newer ice control products become available they are carefully evaluated to see if they have a place in our ice control program.

B. Salt (Sodium Chloride or Rock Salt)

Salt is the most common and least expensive ice control chemical. The ability of salt to melt ice or form brine is highly temperature dependent. At 30^{o} Fahrenheit, one pound of salt will melt 46.3 pounds of ice. At 15^{o} Fahrenheit, one pound of salt will only melt 6.3 pounds of ice. This characteristic of salt primarily dictates when it is used and how much.

C. Treated Salt

As mentioned under Section A., salt can be pre-treated or pre-wet with a variety of liquids to improve its performance. Pre-treated salt will start to work quicker than untreated salt, will continue to perform at lower pavement temperatures, and can generally be applied at a lower application rate. The pre-treatment of salt also helps to reduce the "bounce and scatter" problems of untreated salt, thus keeping more material on the pavement. Salt can be purchased and delivered already treated by the vendor. Also a salt stockpile can be treated as it is being built or with an onboard wetting system. These two methods will be discussed in Section 5.4409.

D. Calcium Chloride

Calcium Chloride has much quicker low temperature ice melting characteristics than salt. As a liquid it can be used to pre-treat salt stockpile or sprayed onto salt in the spreader chute as part of an on-board wetting system. The ability to spray it onto the salt in the spreader gives the operator more flexibility to use the Calcium Chloride only when needed. When added to salt it improves the salt's melting characteristics at lower temperatures, accelerates the working time and reduces bounce and scatter. In the liquid form that New York States specifies, the Calcium Chloride is 32% by weight with an added corrosion inhibitor. As a solid material it may be mixed with salt for use at low temperatures or used straight to open drainage facilities.

E. Magnesium Chloride

Like Calcium Chloride, Magnesium Chloride has much quicker low temperature ice melting characteristics than salt. Magnesium Chloride is only used in a liquid form on both stockpiles of salt and in on-board wetting systems or slide-in tank and spray bar systems. New York State specifications require a 25% by weight of Magnesium Chloride in the product we purchase. This chemical also comes with a corrosion inhibitor.

F. Magnesium Chloride (w/ Organic Based Performance Enhancer (OBPE))

This material like Calcium Chloride and straight Magnesium Chloride has much quicker low temperature ice melting

characteristics than salt. Magnesium Chloride with OBPE comes in a liquid form and can be applied to both stockpiles and in on-board wetting systems or slide-in tank and spray bar systems. New York State specifications require a 13 - 26% by weight of Magnesium Chloride mix in the OBPE. The end product must have enough OBPE to produce a final material having a freezing point of -20° F or lower. This product also comes with a corrosion inhibitor.

G. Abrasives (Sand)

Abrasives may be natural sand, manufactured sand, iron ore tailings, slag or lightweight aggregate conforming to New York State specifications. They provide immediate temporary improvement in the frictional characteristics of the pavement surface. While abrasives have a low initial cost, the cost per application is about the same as salt once the increased application rate, salt mixed in the stockpile and mixing costs are considered. The addition of after season clean up costs can dramatically increase the total cost of this product. Areas adjacent to certain bodies of water and certain aquatic creatures can be adversely affected by the use of abrasives.

5.4405 Guidelines for the Use of Salt

A. General Considerations

The effectiveness of salt is highly temperature dependent. Pavement Temperature is the key in this situation. Pavement temperature is seldom the same as air temperature. Starting about mid-morning, with solar warming, pavement temperature will exceed air temperature by as much as 40 degrees Fahrenheit. With nightfall, pavement temperatures will still be higher than air temperature for several hours. In early to mid-morning, pavement temperature will be lower than air temperature.

Absent the daily solar effects, seasonal geo-thermal factors do influence the relationship between air and pavement temperature. In early winter, pavement temperatures are generally warmer than air temperature. In late winter, pavement temperatures are generally colder that air temperature.

The ice content of a particular snow or ice event is another factor that influences the effectiveness of salt. There is a wide range in

the ice or water content of snow and ice events. The ice content of snow can vary from about 10% to 90%. Sleet, freezing rain, pack and glaze all have ice contents in the range of 90% to 100%. With increasing ice content per inch of snow or ice, more salt is required in order to be effective.

Salt is more effective with higher traffic volume. Frictional effects at the tire-pavement interface tend to warm the pavement. Also, the mechanical impact of traffic tends to break up the ice once the salt has prevented or broken ice/pavement bond. Given the above, reasonable judgment has to be exercised in deciding when to use salt and how much salt to use.

B. Specific Application Rate Guidelines

The Department's approach to ice control is proactive. Anti-icing is the preferred tactic to take, when appropriate. Appendix C contains general guidelines for anti – icing operation. The recommendations are in tabular form.

The use of these tables requires on knowledge of pavement temperatures and the ice bond characteristics prior to treatment. Application rates are shown for operations using untreated salt, treated salt and straight liquids. These application rates are based on several years of experience in New York and other States and are meant to be a guide. Experience of individual highways or network of highways will determine exact rates.

C. Accuracy of Application Rates

The application rates specified in Appendix C should serve as targets and actual application rates as determined from calibration data shall be within 7 ½ % of the target value. More information on calibration can be found in section 5.4412.

D. Spreading Patterns - Salt (Solid)

The spreading pattern is dictated by the type of highway, number of lanes being spread and the character of the event. Adjustments to spread pattern can be achieved by changing the spreader's baffle position, deflector position, spinner speed and direction of throw. Consideration needs to be given to the speed and volume of traffic on the highway being treated. Higher speed and volume highways will tend to spread material (liquid or solid) much quicker than on

corresponding lower speed and volume highways. For high volume highways, concentrated distribution of material should be considered. The most common cause of wider than desired spread patterns is excessive spinner speed.

1. Two Lane – Two Way Traffic

The most efficient pattern is to spread salt in about the middle third of the pavement. The normal pavement crown will allow salt brine to flow across the remainder of the pavement.

In simultaneous plowing/spreading operations the spread pattern should be within the recently plowed area to prevent working brine from being plowed off. On out-and-return beats, spreading should be limited to the lane being plowed.

In situations where the salt does not appear to be working well, the spread pattern may be further narrowed around the center line of the road.

2. Multi - Lane – One Way Traffic

Multi - lane highways usually carry heavier traffic volume. With the heavier volume, the spread pattern should be nearly full - width of the lane(s) being treated. If traffic volume is low or the salt does not appear to be working well, the salt should be distributed in relatively narrow bands around adjoining lane lines.

F. Spreading Speed

The traffic characteristics of the highway will to some extent determine the speed of the spreading truck. On high speed - high volume highways the speed will be faster than on low speed - low volume highways.

With increasing speed, "bounce" and "scatter" of salt becomes greater. Treating salt as it leaves the hopper with an on board wetting system or using pre-treated salt reduces the "bounce" and "scatter of the salt. The actual speed pattern should be checked periodically to be sure the salt is being distributed as intended.

Depending on the road and traffic condition, speeds should be in the range of 15 MPH to 35 MPH.

5.4406 Guidelines for the Use of Abrasives

A. General Considerations

Abrasives should generally be used where low traffic volume and/or low temperatures will preclude chemicals from working properly.

Abrasives may be used initially in some circumstances where chemicals will work. These include steep grades and other situations where the normal working time associated with chemicals could result in road blockage caused by vehicles stranded due to lack of traction.

The use of "sweetened" mixtures like 50-50 (1 part abrasives and 1 part salt) is wasteful and inefficient. If spread at the normal application rate for abrasives, this mixture will place 40% more salt on the road than a normal application of straight salt. The effectiveness of that salt is reduced by the presence of the abrasives.

Although snow and ice surfaces that have been treated with abrasives are safer than untreated snow or ice surfaces, they are not as safe as bare pavement. Traffic quickly diminishes the effect of abrasives and frequent re-application is necessary. This adds significantly to the overall cost and still provides a less safe surface than the bare pavement that could have been achieved with pure chemicals.

B. Specific Abrasives Application Rate Guidelines

Abrasives (as specified in the New York State Department of Transportation specification No. 96-1, issued July 8, 1996, See Appendix D) shall be applied at 750 pounds of abrasives per mile, per lane. This rate may be increased by up to 20% for hills, curves and intersections and decreased by up to 20% for tangent (straight) sections (600 – 900 lbs./lm.).

C. Accuracy of Application Rate

The actual application rate as determined from calibration data shall be within 7 ½ % of the target value. More information on calibration can be found in section 5.4412.

D. Spreading Pattern

Abrasives shall be spread as near to full pavement or lane width as possible.

E. Spreading Speed

The spreading speed should be in the range of about 15 to 30 MPH, depending on traffic and highway surface conditions.

5.4407 Mixing Salt with Abrasives

A. General

A small amount of salt must be added to abrasives in order to keep them in workable or spreadable condition and have them adhere to the snow or ice. The amount necessary will vary with the normal winter temperature of the area. For most of the State, 5% salt is sufficient. In normally colder areas, 10% salt may be necessary. In milder areas as little as 2 ½% salt will be satisfactory.

B. Density of Abrasives and Salt

For computation purposes, the following uncompacted densities are considered standard or average:

Material	Density, lbs/ yd^3
Salt	2,000
Sand	2,700

For abrasives having densities significantly different from those listed above, the application rate may be adjusted to yield the same volume of abrasives applied to the highway.

C. Guidelines for Mixing Salt with Abrasives

Using the densities in B. above, the following is a guide for mixing abrasives with salt:

	Number of Buckets	
% Salt	Sand	Salt
2.5	30	1
5.0	15	1
7.5	10	1
10.0	8	1

5.4408 Procurement and Quality of Abrasives

A. Procurement of Abrasives

Unless an in-house abrasives mine is available, abrasives should be procured through the competitive bidding process. The contract should be for abrasives delivered to the stockpile site. Studies have determined this is the more cost effective approach than having users pick up the material F.O.B. mine.

B. Quality of Abrasives

Abrasives should be comprised of granular material that is relatively free of organic impurities. The grain size distribution is important as it influences workability and the amount of salt that must be added to keep the abrasives spreadable. Gradation requirements vary around the state depending on the product availability. Gradation information can be found in the New York State Department of Transportation specification No. 96-1, issued July 8, 1996. A copy can be found in Appendix D.

Particles passing the # 50 sieve do not have much abrasive quality and particles passing the # 200 sieve have a detrimental effect on spreadability and storability.

Particle shape is also important. Abrasives containing substantial amount of flat and/or elongated particles do not store and spread well.

5.4409 Guidelines for Pre – Wetting Salt

A. General Considerations

Liquid de-icers such as Calcium Chloride, Magnesium Chloride, or Magnesium Chloride with Organic Based Enhancers are added to salt to improve low temperature characteristics, reduce bounce and scatter and accelerate working time. Salt treated with these chemicals should not be used on pavement temperatures above 20° F unless there is a special need to accelerate working time or penetrate pack. If salt is treated with these liquids, the application rates can be reduced as shown in Appendix C.

B. Mixing and Application Rate Guidelines

There are two systems used by NYSDOT for adding liquid de-icers to salt. As a stockpile of salt is being prepared it can be mixed with any of the liquid de-icers mentioned in Section A. The spinner spray system sprays the liquid de-icers onto the salt after it comes out of the spreader and before it reaches the spinner.

Mixing rates for the two systems are:

System	Gals. Of Liquid De-icer Per Ton of Salt
Stockpile	8
Spinner Spray	6

These are recommended rates to start. These rates may need to be adjusted as conditions warrant.

The application rates for salt treated with liquid de-icers are less than those for straight salt. Refer to Appendix C for the appropriate rates.

Caution with late-in-the-day application is necessary in post – storm conditions. There is a tendency for water/brine to re-freeze at night if traffic does not dry the pavement.

5.4410 Guidelines for Anti-icing with Liquids

A. General Considerations

Liquid deicing chemicals can be applied directly to pavement utilizing an adequately sized slide in tank or tanker truck with a spray bar. This process can be used to pre-treat pavement or bridge decks and other icing prone locations in advance of a storm anywhere from several hours to several days in advance of the event. Under certain conditions liquids may be applied during a storm. When using liquid chemicals in this type of application, do not apply to pavements below 20^0 F. Refer to the application tables in Appendix C, page C-9 for more detailed information.

Liquid Calcium Chloride is not the most desirable choice for the pre-treatment of pavement. Due to problems with this chemical leaving pavement slippery under certain conditions, caution must be exercised if this chemical is used. Special care is necessary to not over apply, maintain effective spray pattern, and monitor pavement temperatures to ensure that the material will dry quickly. Magnesium Chloride with or without Organic Based Enhancers and Salt Brine are more desirable products for use in the pre-treatment of pavements

B. Spreading Patterns - Liquids

Currently most of the NYSDOT equipment consists of a 700 gallon slide in tank with a spray bar mounted in a small dump truck. Liquid chemicals should be distributed on the pavement using streamer or pencil nozzles that lay strips of chemical about 10 inches apart, leaving untreated pavement between the strips. With salt brine, this method or a fan spray type of applicator may be used. While these units have the capability to spray multiple lanes, best results have been achieved by spraying one lane at a time.

C. Spreading Speed

For straight liquid applications spreading speeds can be between 40 MPH and 50 MPH on dry pavements when doing pre-treatment applications. When spraying during a storm, speeds will be lower based on conditions.

5.4411 Special Considerations in Ice Control

A. General

Good judgment in the application of chemicals is a must. Chemicals can be very effective under certain apparently adverse conditions or they may be very dangerous under some seemingly ideal conditions.

B. Time of Day

The time of day when chemicals are applied can greatly affect the action of that chemical. Spreading the appropriate material prior to the morning and afternoon commuter hours allows the material to work with the heavy traffic volumes to help break up any snow or ice on the road and get a brine solution started. Care must be given to watch pavement temperatures when they start to fall, which may increase the potential for re-freeze. Refer to your application tables in Appendix B for appropriate action as pavement temperatures fall.

C. Traffic Volume

The traffic volume greatly affects chemical action. Also, heavy traffic during the mid-part of the day may whip slush from the pavement, leaving it dry. On lightly traveled roads, traffic may only rut the slush, leaving it to freeze as temperatures drop at night, unless the slush is plowed off.

D. The No Treatment Situation

Chemicals or abrasives should not be applied in conjunction with plowing operations at very low temperatures or when plowing blowing and drifting snow at very low temperatures. Usually snow will not bond to the pavement and can be effectively removed by plowing. Traffic will whip the rest of the snow away. In this situation chemicals, or the salt in abrasives, may make the snow stick to the pavement causing icy spots. Pavement must be monitored closely to ensure that chemical treatment of the pavement can begin when needed.

E. Spot Treatments

In situations where conditions are present that require intermittent (spot) treatment (pavement of bridge icing potential, blow-overs, drifting or other snow and ice conditions that do not effect the entire State Highway system in a given area) it is recommended that only a portion of the "normal" response capability be utilized during this activity. The activity is called spot treatment.

F. Treatment of Drifts and Blow-Overs

Drifting areas are defined as those locations on the highway system where significant quantities of snow can accumulate due to blowing snow, to the point where a lane or the entire highway may become impassable to vehicle traffic. These locations are usually found in cut sections and other areas having features that promote the accumulation of snow on the highway. Blow-overs occur along numerous locations on the highway system where wind occasionally blows snow across the highway and may accumulate to a few inches. However, lane or roadway closure is less likely in blow-over situations. This situation may occur adjacent to large open areas on the upwind side of the highway associated with drifts and blow-over areas. It is impractical to use passive snow control measures to control blowing snow in blow-over areas. Because of the large number of locations and the unpredictability of wind patterns, blow-overs can occur in any location where there are open upwind areas, sufficient wind velocity and transportable snow. Passive control measures should only be considered where there is sufficient accident history associated with the blow-over location. The Regional Traffic Safety Operations Group can assist in identifying these locations.

The cyclical treatment of active drift and blow-over areas by periodic plowing and treatment with ice control chemicals, as necessary, (See D. above) is the control method of choice if bonding to the pavement has begun or is likely. However, plowing and periodic treatment with abrasives/chemical mixtures may be used as long as there is sufficient chemical in the mixture to prevent ice/pavement bond. After blowing ceases, treatment will depend on the road and weather conditions of the moment.

G. Hard Pack

Hard Pack is formed when saturated snow is compacted by traffic, usually accompanied by a drop in temperatures and the resulting ice is bonded to the pavement. Our anti-icing procedures usually prevent this condition, but occasionally pack is formed and must be removed.

With the exception of thin pack, removal is best done by mechanical methods, since the required amount of salt needed to melt the pack is not practical. A grader with or without ice blades is the best equipment for the job. In some cases, underbody blades and plows will work. The ideal time to remove pack is after the storm when the sun is out, however, other factors such as heavily traveled commuter routes may make it necessary to work on it at night. The recommended procedure is to apply a heavy application (360 lbs./lm. +/-) of pre-wetted salt. Pre-wetted salt tends to eat through the pack and with time will break the bond at the pavement surface, allowing mechanical removal. On thin pack, the application of pre-wet salt is usually sufficient and any slush can be plowed off. Dry solid salt can be used if pre-wet salt is unavailable. Liquid ice control chemicals are an excellent treatment for very thin ice, black ice and frost.

5.4412 Spreading Equipment and Calibration

A. Spreading Equipment

Most spreading is accomplished with "V" box spreaders that mount in the box of heavy dump trucks. In recent years we have added to our fleet, large dump trucks that have built in spreaders. The spinners can be mounted on either the right or left side of the truck in front of the rear wheels or at the back of the truck. Their capacity is similar to the "V" box spreaders. There are three different capacity "V" box spreaders in common use. The capacity and approximate range are listed below:

Spreader Capacity Cubic Yards	Range (lane – miles) Salt	Abrasives
6	53	18 – 26
7	62	20 – 30
10	89	29 – 43

These ranges depend on application rates and for abrasives the proportion of hills, curves and intersections.

B. Ground Speed Controllers

Systems that automatically change application rate with change in ground speed should be operational on all spreader trucks. These systems are relatively inexpensive and can pay for themselves in materials savings in a short period of time.

C. Calibration of Spreaders

All spreaders and ground speed controllers should be calibrated each year prior to the snow and ice season and after major repair on the spreader. There are separate calibrations for salt, mixes of liquids with salt and abrasives. Detailed calibration procedures for each type of spreader are available from the NYSDOT Office of Operations Management.

D. Back-up Calibration for Non-Automated Spreading

In addition to the calibration described in C. above, each spreader/truck should have established a back-up calibration to be used when the automatic system is not functioning. The details of this procedure are available from the NYSDOT Office of Operations Management.

5.5000 Stockpiling and Storing Chemicals and Abrasives

5.5100 Objective

The objective of providing stocks of chemicals and abrasives is to have these materials available and ready for use at locations tofacilitate a reasonable response time to snow and ice events.

5.5200 Goal

The goal of stockpiling and storing chemicals and abrasives is to assure an adequate supply of these necessary materials throughout the snow and ice season while minimizing adverse effects on the environment.

5. 5300 Methodology

5.5301 Sites for Stockpiling and Storing Chemicals and Abrasives

A. Preliminary Investigation

Prior to locating stockpile and storage areas, a check should be made of local ordinances for storage requirements. In addition, a check should be made of watershed rules and regulations made or approved by the New York State Department of Health (Section 1100 of the New York State Public Health Law) or other Regulatory Agencies for compliance purposes. NYSDOT Environmental Analysis Bureau personnel can assist in researching appropriate rules and regulations. Information about storage facilities can be found in the Department's Environmental Handbook for Transportation Operations. Sites should be selected to minimize "dead-heading". They should also be centrally located as possible. This will minimize the number of sites required. Joint stockpiles or reciprocal agreements can be made with other agencies (e.g., County or Town Highway Departments) to minimize duplication of facilities and reduce the cost of loading equipment. This necessitates close cooperation and accounting with the other agency(s) involved.

B. Site Characteristics

1. Highway Access

Since trucks and other equipment will be using stockpile and storage sites during storms and at times of poor visibility, they should be easily accessible. Access roads to the site, where possible, should not open directly onto heavily traveled highways and should be located to provide ample sight distance for the equipment operators. The Regional Traffic and Safety Group should be contacted to determine if Truck Entering warning signs should be erected.

2. Drainage

Sites should be selected or graded to provide positive drainage away from the stockpile or storage facility. The area selected should not drain directly into a stream, reservoir, well, well aquifer, or adjacent occupied property.

3. Size

Storage areas should be large enough for front-end loaders and trucks to maneuver safely.

4. Doors to Buildings

Building doors and other openings should be large enough to permit access for loading and unloading.

5. Driveway Access

The surface of the driveway and maneuver area should be paved such that there are no low or weak spots.

6. Access Platform and Loading Ramps

Access platforms and loading ramps should be provided to make loading operations safer.

7. Lighting

Yard areas should be adequately lighted and lights should also be available inside the storage buildings. Lighting should be checked prior to the beginning of the snow and ice season to ensure all are in working order.

8. Ventilation

Storage buildings should have positive ventilation to allow exhaust fumes from the equipment to safely ventilate to the outside. Trapped fumes can create a health hazard to the operators. Prior to the beginning of the snow and ice season, buildings with fans should be checked to ensure they are in working order.

9. Housekeeping

All work areas should be as unobtrusive as possible. They should be kept neat and orderly. Screening with trees and shrubs makes the area more aesthetically appealing. After every storm, loose material around loading ramps, storage buildings, etc. should be gathered up and returned to the stockpile or storage building.

5.5302 Guidelines for Storing Salt

All straight or treated salt shall be stored, covered and housed on an impermeable pad in an acceptable structure. Where acceptable structures are not available or there is insufficient storage capacity in structures, pure or treated salt shall be stored on impermeable pads and covered with secured waterproof tarpaulins, year round.

5.5303 Guidelines for Storing Liquid Chemicals

Liquid chemicals shall all be stored in non-reactive containers, protected from vehicular traffic. It is strongly encouraged that the Resident Engineer develop a plan to provide for secondary containment features for any storage tanks. These features can be part of an overall facility plan to control site runoff. All recommended handling procedures found in the manufacturer's Material Safety Data Sheet shall be followed. The containers, piping and pump systems should be inspected periodically for leaks. If any leaks are found they are to be treated as outlined in Appendix B.

5.5304 Guidelines for Storing Abrasives that Contain Chemicals

All stockpiles of abrasives containing chemicals shall be placed on an impermeable asphalt concrete pad (having an impermeable membrane) and be completely enclosed in: (1) A structure that effectively keeps rain and snow off the abrasives, or, (2) waterproof tarpaulins that are effectively secured. This requirement is effective year – round.

There are two exceptions to this policy:

A. Small working piles of abrasives containing chemicals may remain uncovered during the winter season as long as they are on an impermeable pad and have a berm of untreated abrasives around the stockpile and within the confines of the impermeable pad. At the end of the winter all abrasives on the pad (including the berm) shall be mixed together and moved within an appropriate structure or securely covered with a waterproof tarpaulin on an impermeable pad.

B. During the colder portions of the winter, the working face of untreated abrasives stockpiles may have a small amount of chemical mixed in the topmost portion. However, the working face must be protected by a small containment berm of untreated

abrasives. As with A. above, at the end of the winter, any abrasives containing chemicals must be removed and stored in appropriate structure or securely covered with a waterproof tarpaulin on an impermeable pad.

If stockpiles are to be covered with tarpaulins, low, elongated shaped piles are much easier to manage. Old guiderail installed on either side of an elongated pile provides excellent lashing points to secure the tarpaulins.

5.5305 Guidelinesfor Managing Untreated Stockpiles of Abrasives

Untreated stockpiles of abrasives having the proper grain size distribution can be effectively managed. This is usually done in conjunction with mix-and-go (mixing chemical with abrasives and immediately loading the spreading truck) operations or where small amounts of abrasives containing chemical are stored in a structure or in a small covered stockpile. There are some techniques that facilitate the management of untreated stockpiles of abrasives:

A. There must be sufficient extra material to compensate for the material that will become frozen into chunks and be unusable during the colder portions of the winter. A frozen chunk factor of about 20% is an average condition for most or the State.

B. Build the stockpile relatively low so the loading equipment can safely remove bridges and overhangs of frozen material that form on top of the working area.

C. Orient the working face of the stockpile to face the south. This will take a maximum advantage of solar heat and reduce the severity of frozen material on the working face.

D. Obtain abrasives that have:

1. Smaller proportion of minus #50 sieve size particles.

2. A small proportion of particles having flat or elongated shapes.

E. Mixing chemicals with abrasives at the working face of the untreated stockpile and removing the mixed material to smaller working piles or structural shelter has proven to be effective.

F. Utilize sunny days to the extent possible when mixing chemical with abrasives.

G. Backblading with loaders or dozers can sometimes break up frozen chunks of abrasives.

5.5306 Stockpiling and Mixing Salt Chemical with Abrasives

Abrasives are usually delivered to the site in dump trucks. Depending on management strategy, chemicals may or may not be mixed with abrasives during the stockpiling process.

A. Conveyors

Conveyors are the most efficient type of equipment for creating uncompacted stockpiles. If chemicals are being added to the stockpile, a second conveyor for chemicals will provide a well-mixed stockpile.

B. Cranes

Cranes with clamshell buckets may be used for creating both chemically treated and untreated stockpiles of abrasives. They are capable of creating reasonably well mixed uncompacted piles of treated material. However, they are not capable of a high rate of production and the stockpiling process could be lengthy and costly.

C. Other Equipment

Loaders, dozers, hydraulic excavators, power shovels and even trucks may be used singly or in combination to create stockpiles. None of these methods are capable of efficient mixing and most will produce a compact stockpile. However, in most cases, stockpiling must be accomplished with the available equipment, and these types of equipment are frequently used. Care must be exercised when utilizing trucks, loaders and dozers on inclined surfaces. If not utilized properly, this equipment could easily tip over during the stockpiling operation. Hydraulic excavators and power shovels should always operate from a flat surface.

5.6000 Snow Stake Installation

5.6100 Objective

The objective of snow stake installation is to identify possible obstructions within the plowing and winging area that may interfere with the snow removal process.

5.6200 Goal

Install snow stakes at locations of possible obstructions within the plowing and winging area that may interfere with the snow removal process.

5.6300 Methodology

A. Timing

Snow stakes that must be driven into the ground should be installed before the ground freezes and well in advance of the first anticipated snowfall.

B. Materials

Material for snow stakes may vary from wooden stakes to delineator posts. Uniformity of material is desirable and the type of material used should reflect the class of highway.

C. Functional Characteristics

Snow stakes should be long enough to extend above the anticipated depth of snow in the area. The top six inches of the stake should be painted, flagged, taped, or have an appropriate colored delineator in place, to provide better visibility.

D. Obstructions that Should have Snow Stakes

Generally, all solid objects within the plowing and winging area that are likely to be covered with snow, should be identified by snow stakes. These include, but are not limited to: Guide posts, ends of guide rail runs, culvert headwalls, traffic canalization devices, hydrants, gutters and isolated curb sections.

E. Snow Stakes to Identify Drainage Features

Catch basins, drop inlets and other drainage structures, particularly in median areas, should be marked with snow stakes to permit location of the structures when it is snow covered. In urban areas a painted arrow in the middle of the curb lane helps to locate these types of structures.

F. Snow Stakes Used as Shoulder and Median Markers

On divided highways snow stakes should be used to delineate the shoulder and median area. The stakes should be about 5 feet above the ground and be placed 1 to 2 feet beyond the shoulder. Spacing on tangent sections should be 200 feet. Closer spacing on curves may be utilized. When snow stake median markers are

used in conjunction with permanent delineators on the right shoulder, they should be placed directly opposite every other (alternate) permanent right shoulder delineator post.

5.7000 Maintaining the Capability of Drainage Features

5.7100 Objective

The objective of maintaining critical drainage features is to minimize flooding during thaw conditions.

5.7200 Goal

Maintain the functional capability of critical drainage features so that flooding and ponding on the highway are minimized during periods of thaw.

5.7300 Methodology

A. General

Through knowledge and experience, the critical drainage features should have been identified. It is important to maintain their functionality throughout the snow and ice season.

B. Closed Drainage Systems

In order to maintain safe roadways and protect against flooding and freezeovers, the top of catch basins and drop inlets should be cleared of snow and provided with reasonable means to prevent possible development of ice. If a system is likely to freeze up, chemicals should be applied periodically to critical catch basins and drop inlets, subject to existing conditions in the area involved.

C. Open Drainage Systems

Prior to thaws and the subsequent runoff, it is advisable to remove packed snow and ice from the ends of culverts and their inlet and outlet ditches. At the beginning or middle of the winter, if water is flowing adequately underneath the snow, the snow should not be removed since this might allow the water to freeze and block the culvert. As the weather moderates and a continued thaw is anticipated, the snow and ice should be removed as indicated above. Weather forecasts will aid in making the decision whether or not to remove the snow. Generally, a forecast of two or more days of thaw indicates need for snow removal at known locations.

D. Structures

Finger joints, expansion joints and the bridge deck drainage systems should be kept functional during the winter. Removal of surface snow and ice and the thawing of drainage and expansion features with chemicals may be necessary.

E. Thawing Drainage Structures

Frozen drainage features are usually cleared by adding liberal amounts of chemicals to the upstream frozen surface subject to existing conditions in the area involved. A Steam Jenny may also be used if available and deemed reasonably effective given existing conditions in the area involved and can be used from both upstream and downstream sides of the frozen location. The steam approach is more environmentally sound and should be used to the extent possible.

5.8000 Passive Snow Control

5.8100 Objective

The objective of passive snow control is to reduce or eliminate persistent snow drifting on roadways to improve visibility during blowing snow conditions by installing snow fence, planting shelterbelts, or altering the roadway cross section.

5.8200 Goal

The goal of passive snow control is to reduce or eliminate areas of persistent drifting and/or low visibility where resources, right-of-way and cost effectiveness will permit.

5.8300 Methodology

5.8301 General

Use of passive snow control techniques will improve roadway safety and reduce supplementary snow removal in areas of recurrent drifting. The erection of snow fence or the establishment of shelterbelts in areas of frequent drifting and/or whiteouts can dramatically improve or eliminate the condition. Drifting problems may also be mitigated by reconstructing the roadway cross section to provide a windswept aerodynamic cross sections which will remain drift free. Partial improvement should be considered at locations where total mitigation measures are not possible. Additional information on passive snow control can be found in the Department's Highway Design Manual, – Chapter 5.

5.8302 Snow Fence

Snow fences may be permanent or temporary. Permanent fences erected on private property will require the acquisition of a permanent easement. The Regional Real Estate Officer should be contacted for easement procedures. Temporary fences may be erected on private property under Article 3, Section 45 of the Highway Law.

Snow fences should be of adequate height to store the usual expected amount of snow that will be transported (blown) through the location. The snow transport will vary by location. The Regional Design Group may be consulted for an accurate estimate of this snow transport. The required fence height is given by **H** in the following equation:

H = 0.065 ($Q^{0.454}$), where Q = average snow transport (lbs.)

The length of the upwind drift created by a snow fence is equal to 15 x height. The downwind drift length is equal to 35 x height. For this reason, snow fences should be placed at a distance of 35 x height from the road to ensure that the drift generated by the fence will not encroach onto the roadway. The fence may be placed closer to the road only if there are topographic features, such as a ravine, which will provide significant additional storage. If the fence becomes full during most winters, the height should be increased and the distance from the highway adjusted accordingly. Although additional rows of fence will increase the amount of available snow storage, it is much more cost effective to increase the height and use a single fence. Fence heights should generally exceed six (6) feet except in limited areas. Fences should have a gap ratio of 50%.

All fences should have a gap at the bottom to prevent the fence from becoming buried. The gap should be 10% of the total fence height and should be measured from the top of the expected winter vegetation. Fences should be oriented parallel to the road except when the prevailing wind direction is more than 30 degrees from the perpendicular to the road.

Fences should be extended a distance of 50 feet beyond the area to be protected to prevent snow from being blown around the ends.

5.8303 Shelterbelts (Living Snow Fences)

Also referred to as "living snow fences", shelterbelts are multiple rows of trees, preservation of agricultural crops, or shrubs planted to provide protection from wind-driven snow. There are many advantages to shelterbelts as compared to snow fences, including roadside beautification, wildlife benefits, little or no maintenance after establishment, and long service life. The Regional Landscape

Architect and Maintenance Environmental Coordinator should be consulted whenever shelterbelts are considered.

Some design tips for planting shelterbelts are:

- Trees should be placed no closer than 3 times their mature height from the edge of the shoulder.
- Generally, trees should be coniferous. Shrubs may be effective in areas of limited blowing and drifting snow.
- Two or more staggered rows should be planted to provide full coverage and to prevent gaps caused by plant loss or damage.
- Trees should be spaced so that crown closure will be achieved within ten years.
- An effective shelterbelt can be achieved by requesting farmers to leave six to eight rows of corn stalks standing through the winter. The minimum setback from the road shoulder should be 35 times the effective stalk height (height minus ambient snow depth).

This may be accomplished by using appropriate real estate procedures of the NYSDOT Real Estate Division.

5.8304 Modifications of Roadway Features

Providing an aerodynamic cross section will allow the roadway to be swept clear by the wind. It should be recognized that this is not a solution where whiteouts are a problem. In some areas it may be possible to alter the cross section to provide for additional snow storage upwind from the road. Minor grading on private property may be accomplished with appropriate real property procedures. The details of these procedures are available from the NYSDOT Real Estate Division.

The following guidelines will improve drift prone areas:

- Back and fore slopes should be flattened to a 1:6 slope or flatter.
- Ditches should be widened as much as possible.
- The profile of the road should be raised to two feet above the ambient snow cover.
- Provide a ditch adequate for storing the snow plowed off the roadway.
- Widen cuts to allow for increased snow storage.
- Eliminate the need for guiderail.

5.9000 Municipal Snow & Ice Contracts

5.9100 Objective

The objective of municipal Snow & Ice contracts is to provide the traveling public with a passable highway as much of the time as possible – given the constraints of operational resources and the character of the snow or ice event.

5.9200 Goal

The goal is to have properly executed contracts in place prior to the beginning of each snow and ice season. These contracts are to ensure that a municipality is able to provide adequate response to snow and ice work on our highways.

5.9300 Methodology

Municipal contracts are a means by which the Department of Transportation has municipalities perform the full range of snow and ice control activities on sections of the State Highway System. These contracts require municipal contractors to perform snow and ice activities as outlined in this document. Administration of the contracts is covered in the Department of Transportation's publication Municipal – State Agreements for Control of Snow and Ice on State Highways: Terms, Reimbursement Procedures and Documentation, dated December 1999.

APPENDIX A

OPERATIONAL PLAN OUTLINE

April, 2006

OPERATIONAL PLAN OUTLINE

REQUIRED INFORMATION:

Staffing Distribution

Equipment Distribution

Equipment Calibration

Beat Descriptions

- Written Description
- Length of the Beat in Lane Miles
- Typical Cycle Time
- Typical Application Rates and amounts of the various materials required for the beat
- Maps of the Beats

Storm Manager Procedures

Radio Watch Procedures

Crossovers Used as Turnarounds

After Storm Cleanup Procedures

Approved Snow Disposal Sites

Municipal Contracts

- Routes
- Contacts
- Contact Information (chain of command, phone numbers, etc.)

SUGGESTED INFORMATION:

Main Office, Regional Office and Residency Snow & Ice Policies

Any Other Pertinent Information

APPENDIX B

DEFINITIONS, HANDLING CHEMICALS & EQUIPMENT CHECKLIST

SNOW AND ICE CONTROL DEFINITIONS	B – 1
SUMMER STORAGE OF ON BOARD WETTING SYSTEMS	B – 2
NYSDOT SAFETY GUIDELINES FOR HANDLING LIQUID CHEMICALS	B – 3
NYSDOT SAFETY GUIDELINES FOR RESPONDING TO CHEMICAL SPILLS	B – 4
TRUCK CHECK SHEET (WINTER SEASON)	B – 5

SNOW & ICE CONTROL DEFINITIONS

Benching of Shelving	Using a wing plow to displace the top portion of snow berms adjacent to the pavement or shoulder.
Berm or Windrow	A linear accumulation of snow cast by a plow, or other equipment, or wind.
Close Echelon	Snowplows in adjacent lanes working in a tight plowing group that do not permit traffic to pass between them.
One Way Plow	This is a plow mounted on the front of a truck that can cast snow only in one direction. Usually the snow is cast to the right.
Plow Angle of Attack	The angle (less than 90^{o}) formed in plan view where the plow blade face deviates from a 0^{o} set position which is parallel to the front grill of the plow truck.
Plowable Snow	Generally, accumulation of greater than ½ inch to 1 inch of snow.
Reversible Plow	This is a plow mounted on the front of a truck that can cast snow to either the right or left depending on the angel of attack of the plow.
Snow Plowing	The displacement of snow from paved surfaces with plows and wing plows.
Snow Removal	Physically relocating areas of accumulated snow. This is usually a slow operation that may be accomplished with plows, loaders or snow blowers.
Tandem Plowing	Snowplows working in groups having sufficient space (a minimum of 1000 feet or about the distance between two reference markers) between them for traffic to pass.
Wing Plow	A plow mounted on either the left or right side of a truck, which in combination with a One Way or Reversible plow casts snow off of paved surfaces.

SUMMER STORAGE OF ON-BOARD WETTING SYSTEMS

It is important to properly store On-Board Wetting Systems to ensure their availability for the next Snow and Ice Season. Improper storage can lead major damage. The following are the recommended procedures for storing these units:

Empty the saddle tank(s) into the bulk storage tank.

The pump should be flushed with a solution of warm water and then windshield washer fluid. The washer fluid will prevent any residual water from freezing prior to the next spreading season.

When connecting and disconnecting electrical plugs, treatment with electrical spray or dielectric grease (for use with electrical equipment) is recommended to prevent corrosion and protect from intrusion of water.

All exterior surfaces should be thoroughly rinsed off with water to lessen the possibility of corrosion.

The system should be visually inspected for wear or other problems prior to storing for the summer. Any necessary repairs should be documented and brought to the attention of the Equipment Management Mechanic.

SUMMER STORAGE OF BULK STORAGE TANKS

As with the truck mounted on board systems, several areas of the bulk storage tanks need to be addressed.

The pump should be disconnected and then flushed with a solution of warm water and then windshield washer fluid. The windshield washer fluid will prevent any residual water from freezing prior to the next spreading season.

Electrical connections should be checked for wear. Any electrical plugs should be treated with electrical spray or dielectric grease to prevent corrosion and protect from intrusion of water.

Hose and pipe connections to and from the pump should be inspected for wear and repaired or replaced as appropriate.

It is recommended that de-icing liquids in bulk storage tanks be re-circulated (agitated) every two weeks during extended periods of non-use.

NYSDOT SAFETY GUIDELINES FOR HANDLING OF LIQUID CHEMICAL DE-ICERS

Personal Protective Equipment (PPE) must be worn when handling these materials. As a minimum, PPE gear includes splash goggles, face shield, rubber gloves and rubber boots. A copy of the Material Safety Data Sheet (MSDS), for each chemical used, shall be readily available at every work site where these chemicals are being used. The MSDS will give further guidance on PPE requirements.

Keep a one liter eyewash bottle on hand during the entire filling operation.

Avoid contact with skin and leather apparel (boots, gloves, etc.)

Prior to pumping check all hoses and piping to insure secure connections and sound hoses.

Prior to and at the end of pumping, check valve settings to insure proper flow control.

While pumping, stand clear of hose and pipe connection points.

Visually monitor tank filling to avoid overfilling.

When filling is complete shut off pump, check valve settings, disconnect and store fill hose properly (e.g. return to hose rack).

FIRST AID MEASURES

EYES:	Flush promptly with plenty of water continuing for at least 15 minutes. GET MEDICAL ATTENTION!!!
SKIN:	Wash with plenty of water.
INHALATION:	Remove to fresh air (for cases of airborne mist and dust)
INGESTION:	Contact Poison Control and/or refer to MSDS sheets for ingestion instructions.

NYSDOT SAFETY GUIDELINES FOR RESPONDING TO LIQUID CHEMICAL DE-ICER SPILLS

Minor Spills (Less than 20 Gallons)

Put on appropriate Personal Protective Equipment (PPE) (splash goggles, face shield, rubber gloves and rubber boots).

If possible, safely stop the source of the spill (e.g. shut off pump, close valve, etc.).

Notify shift supervisor.

Contain spill with sand.

Spread sand to absorb the liquid chemical de-icer.

Collect saturated sand and stockpile separately.

If possible, cover stockpile with a waterproof covering.

When operation is completed, wash down all equipment used.

Major Spills (Greater than 20 Gallons)

Put on appropriate PPE (splash goggles, face shield, rubber gloves, and rubber boots).

If possible, safely stop the source of the spill (e.g. shut off pump, close valve, etc.)

Notify the shift supervisor and Resident Engineer.

Contain spill with sand.

If full containment is not possible, dilute liquid chemical de-icer runoff with large volumes of water (control subsequent icing problems, if required)

Spread sand to absorb contained liquid chemical de-icer.

Collect saturated sand and stockpile separately.

If possible, cover stockpile with a waterproof covering.

When operation is completed, wash down all equipment used.

TRUCK CHECK SHEET (WINTER SEASON)

Truck ID: _____

Unload and Wash Hopper/Combo _____
Wash Truck _____
Refuel _____
Lube Chassis _____

Date: _____
Time: _____
Mileage: _____
Operator: _____

Interior	Checked	SDR/VTR
1. Head Lights	1._____	_____
2. All Exterior Spot Lights	2._____	_____
3. Revolving Lights	3._____	_____
4. Hopper Lights (Spot & Warning)	4._____	_____
5. Reverse Lights	5._____	_____
6. Directional Lights/4-Way Flashers	6._____	_____
7. Brake Lights	7._____	_____
8. Wipers, Washer	8._____	_____
9. Defrost/Heater	9._____	_____
10. 2- Way Radio	10._____	_____
11. Dickey John Operation	11._____	_____
12. Levers & Pins	12._____	_____
13. Clutch Free Play (1.5"), Steering. And Brake Operation	13._____	_____
14. First Aid Kit, Fire Extinguisher, Triangles	14._____	_____
15. Mirrors, Mirror Heaters, All Gauges, All Glass	15._____	_____
16. Clean Cab (Litter, Projectiles/Objects, etc.)	16._____	_____
17. Seats and Seat Belts	17._____	_____
18. Copy of Overwidth Permit & Accident Reporting Forms (Glove Box)	18._____	_____
Under Hood		
19. Engine Oil (15w40)	19._____	_____
20. Anti Freeze	20._____	_____
21. Power Steering Fluid	21._____	_____
22. Window Washer Fluid	22._____	_____
23. Hoses and Belts	23._____	_____
24. Check for Leaks	24._____	_____
Exterior: Left Side		
25. Duals (Condition, PSI, Spun, Lug Torque (230 spoke, 450 bud))	25._____	_____
26. Hydraulic Fluid (5w20)	26._____	_____
27. Hopper: Hoses, Fittings, Tie downs, Electric Connections	27._____	_____
28. Hopper: Tie Downs and Flaps	28._____	_____
29. Combo Body: Front discharge spinner, gate setting, etc.	29._____	_____
30. Cab Steps and Grab Bar	30._____	_____
31. Front Tire (Condition, PSI, Spun, Lug Torque (230 spoke, 450 bud)	31._____	_____
32. Hub Oil Level (90w mineral oil)	32._____	_____
33. Block Heater and Cord	33._____	_____
34. Left Front Leaf Springs	34._____	_____
35. Operate Tail Gate Latch Several Times (Be sure to secure afterwards)	35._____	_____
Exterior: Left Wing		
36. Overall Condition	36._____	_____
37. Cables, Clamps and wing cylinder hose's (For Damage & Rust)	37._____	_____
38. Wing Braces, Tension Springs, Shear Pins and Bolts	38._____	_____
39. Clevis Pins and Bolts	39._____	_____
40. Cutting Edges, Curb Runner, Bolts	40._____	_____
41. D-Block Assembly	41._____	_____
42. Wing Marker	42._____	_____

	Checked	SDR/VTR
Exterior: Front Plow		
43. Overall Condition	43._____	_____
44. Cutting Edge	44._____	_____
45. Shoes	45._____	_____
46. Plow Springs	46._____	_____
47. Lifting Chains	47._____	_____
48. Push Pins, Cotter Keys	48._____	_____
49. Plow Markers	49._____	_____
50. Hoses	50._____	_____
51. PTO Drop Box Oil Level (90w mineral oil)	51._____	_____
52. Push Frames, Braces (For cracks and/or Damage)	52._____	_____
Exterior: Right Wing		
53. Overall Condition	53._____	_____
54. Cables and Cable Clamps (For Damage & Rust)	54._____	_____
55. Wing Braces, Tension Springs, Shear Pins and Bolts	55._____	_____
56. Clevis Pins and Bolts	56._____	_____
57. Cutting edge, Curb Runner, Bolts	57._____	_____
58. D-Block Assembly	58._____	_____
59. Wing Marker	59._____	_____
Exterior: Right Side of Truck		
60. Front Tire (Condition, PSI, Spun, Lug Torque (230 spoke, 450 bud)	60._____	_____
61. Hub Oil Level (90w mineral oil)	61._____	_____
62. Ladder, Cab Steps and Grab Bar	62._____	_____
63. Duals (Condition, PSI, Spun, Lug Torque (230 spoke, 450 bud)	63._____	_____
64. Hopper Tie Downs, Flaps	64._____	_____
65. Hopper Grates	65._____	_____
66. Right Front Leaf Spring	66._____	_____
67. Exhaust System	67._____	_____
68. Under the Hood Tool Box (Fitted Tire Chains & Adjusters)	68._____	_____
Exterior: Rear of Truck		
69. Gate Setting	69._____	_____
70. Hopper Chain Condition	70._____	_____
71. Mud Flaps	71._____	_____
72. Spinner Chute, Deflectors, Dickey John Sensor	72._____	_____
73. Gate Crank Operable	73._____	_____
74. Left & Right Side Rear Leaf Springs	74._____	_____
75. Hydraulic Hoses	75._____	_____
76. Hopper Gear Box Oil Level (90x140 gear oil)	76._____	_____
77. Grease Hopper	77._____	_____
78. Liquid Saddle Tanks (Check for Operation & Leaks)	78._____	_____
79. Hoses from Saddle Tanks	79._____	_____
80. Conveyor Chain Gear Box Vent	80._____	_____

REMARKS:

_____ _____

_____ _____

_____ _____

_____ _____

APPENDIX C

APPLICATION RATES

FACTORS THAT AFFECT APPLICATION RATE DETERMINATION	C – 1
GLOSSARY OF TERMS	C – 3
BLACK ICE RATES	C – 4
FREEZING RAIN RATES	C – 5
SLEET RATES	C – 6
LIGHT SNOW RATES	C – 7
MODERATE/HEAVY SNOW RATES	C – 8
ANTI-ICING WITH STRAIGHT LIQUID CHEMICALS	C – 9
LIQUID APPLICATION RATES (TABLE A)	C – 10

FACTORS THAT AFFECT APPLICATION RATE DETERMINATION

TRAFFIC:

AADT – Higher traffic volumes result in mixing action along with heat from friction. Higher volumes are also an indication of more important roads.

Rush Hour – This affects timing and maneuverability as treatments are applied ahead of the rush. In extreme cases, it may be necessary to avoid a road because trucks will be trapped and non-productive. Rush hours can also create a directional situation where good mixing action takes place in one direction and almost none in the other.

Day of the Week – Different days, especially the weekend create different traffic patterns and volumes and the application may need to be changed to adjust for this.

Corridors – This is an evolving issue from Transformation, but has always influenced level of response. Certain roads are key to the function of the system and if they are not open the rest of the system fails regardless of the conditions on the feeder roads.

ROAD CONDITIONS:

Geometrics – Steep grades, sharp curves, bridge decks, etc. all influence our application rates. Some of these situations determine the application rate for a whole beat, and others require the driver to make adjustments during his run.

Cold Spots – Areas at higher elevations or shaded most of the day create cold spots which normally require more material than adjacent sections of the beat.

Length of Beat – This affects cycle time. The longer the time between plowings the more material is needed to prevent bonding. Narrowing of the spread pattern should accompany the increased application rate in this circumstance.

Plow Speed – While ideal plow speed is around 30 mph, it does vary considerably due to traffic adjacent buildings, pedestrians, high speed roadways, etc. This can create different cycle times between beats of the same length, or even the same beat at different times of the day.

Multiple Lanes – While in some cases a beat consists a uniform number of lanes so that the assigned trucks can plow in echelon in one pass. However in most cases the number of lanes varies and trucks have to double back or trucks from other beats have to be assigned to help. This results in increased cycle time.

Pavement Surface –Pavement treatments like Nova Chip and some Superpave mixes have an open graded structure which draws the brine away from the surface. More chemicals may need to be applied to prevent bonding.

WEATHER:

Time of Season –Usually, chemicals are required in January than March because of colder pavement temperatures and continued cold weather is likely.

Sunlight – The amount and angle of sunlight influences pavement temperatures and the resulting melting action of ice control chemicals.

Type of snow or ice – The wetter the precipitation the more chemical dilution occurs which requires more chemicals to keep the freezing point reduced.

Intensity of the precipitation – The harder the snowfall the more chemical will be needed to prevent bonding before the next treatment.

Pavement Temperature – While changes in air temperature are useful to watch, the pavement temperature is what really matters. When deciding on application rates the expected trend in the pavement temperature is important to be taken into account.

Note: The tables for application rates attempt to take into account the last three items.

GLOSSARY OF TERMS

Black Ice. Popular term for a very thin coating of clear, bubble free, homogenous ice which forms on a pavement with temperature at or slightly above 32° F when the temperature of the air in contact with the ground is below the freeze-point of water and small super cooled water droplets deposit on the surface and coalesce (flow together) before freezing. This often occurs when pavement temperature is 32° F or below and is at or below Dew Point.

Chemical Spread Rate. Also known as chemical application rate. For solid applications it is simply the weight of the chemical applied per lane mile. For liquid applications it is in gallons per lane mile when applied straight and gallons per ton when used to pre-wet solid chemicals.

Freezing Rain. Super cooled droplets of liquid precipitation falling on a surface whose temperature is below or slightly above freezing, resulting in a hard, slick, generally thick coating of ice commonly called a glaze or clear ice. Non-super cooled raindrops falling on a surface whose temperature is well below freezing will also result in a glaze.

Frost. Also called hoarfrost. Ice crystals in the form of scales, needles, feathers or fans deposited on the surfaces cooled by radiation or other process. The deposits may be composed of drops of dew frozen after deposition and of ice formed directly from water vapor at a temperature below 32° F (sublimation). Most often occurs when pavement temperature is 32° F or below and is at or below Dew Point.

Light Snow. Snow falling at the rate of less than ½ inch per hour: visibility is not affected adversely.

Liquid Chemical. A chemical solution; with a specified percentage of chemical that is applied at the rate of gallons per lane when applied straight and gallons per ton when used to pre-wet solid chemicals.

Moderate or Heavy Snow. Snow falling a rate of ½ inch per hour or greater; visibility may be reduced.

Sleet. A mixture of rain and snow which has been partially melted by falling through the atmosphere with a temperature slightly above freezing.

Slush. Accumulation of snow which lies on an impervious base and is saturated with water in excess of the freely drained capacity. It will not support any weight when stepped or driven on but will "squish" until the base support is reached.

BLACK ICE

Surface Temp. Range (° F)	Surface Condition	Initial Maintenance Action	Dry Rock Salt Lbs./lm.	Pre-Wetted Rock Salt Lbs./lm	Follow Up Action	Follow Up Rock Salt Lbs./lm	Follow Up Pre- Wetted Rock Salt Lbs./lm	Comments
Above 32	Dry or Damp	Apply pre-wetted rock salt or direct liquids to prevent formation.		115	None, see comments.			Monitor pavement temperature closely; begin treatment if pavement temperature starts to fall toward 32 and it is at or below the dew point.
23 to 32	Frost or Black Ice	Apply pre-wetted rock salt or direct liquid; use dry salt if pre-wetted not available.	275	225	Re-apply pre-wetted rock salt as needed.	115	90	1) Monitor pavement temperatures closely; if pavement becomes wet or if thin ice forms re-apply chemicals. 2) Do not apply direct liquids on ice so thick that the pavement cannot be seen. 3) Heavier follow up application(s) may be necessary.
15 to 23	Frost or Black Ice	Apply pre-wetted rock salt; use dry rock salt if pre-wetted not available.	360	275	Re-apply pre-wetted or dry rock salt as needed	115	90	1) Monitor pavement temperature closely; if pavement becomes wet or if thin ice forms re-apply chemicals. 2) Do not apply direct liquids on ice so thick that the pavement can not be seen. 3) Heavier follow up applications(s) may be necessary.
Below 15	Frost or Black Ice	Apply abrasives			Apply abrasives			1) Refer to Snow and Ice Guidelines Section 5.4406, paragraph B. for abrasive application rates.

Notes: 1) Black ice or frost is normally a spot condition – these application rates would be applied to areas susceptible to the formation of black ice or areas where black ice has developed. Watch for freezing surface temperatures below dew point with sources of vapor, clear night skies and light winds. 2) Refer to direct liquid chemical application guide lines (Appendix C Page C – 10) if anti-icing liquids are used.

FREEZING RAIN

Surface Temp. Range (° F)	Surface Condition	Initial Maintenance Action	Dry Rock Salt Lbs./lm.	Pre-Wetted Rock Salt Lbs./lm	Follow Up Action	Follow Up Rock Salt Lbs./lm	Follow Up Pre- Wetted Rock Salt Lbs./lm	Comments
Above 32	Wet or Slushy	Apply pre-wetted or dry rock salt, plow if plowable.	115	90	Monitor precipitation and temperature.			1) Monitor pavement closely and anticipate drops toward 32° F and below. 2) Adjust application rates as surface conditions and precipitation intensities change.
Above 32, but dropping to 32 or below soon	Wet or Slushy	Apply pre-wetted or dry rock salt, plow if plowable.	180	115	Re-apply pre-wetted or dry rock salt as needed.	180	115	1) Monitor pavement temperatures and precipitation closely. 2) Treat icy patches and colder areas with higher applications. 3) Increase applications if precipitation intensity increase or surface shows signs of icing.
23 to 32	Wet or Slushy	Apply pre-wetted or dry rock salt, plow if plowable.	275	225	Re-apply pre-wetted or dry rock salt as needed.	275	225	1) Monitor pavement temperatures and precipitation closely and adjust application rates as surface conditions and precipitation intensities change. 2) Treat icy patches and colder areas with higher applications. 3) Increase applications if precipitation intensity increase or surface shows signs of icing.
23 to 32	Icy	Apply pre-wetted or dry rock salt.	360	320	Re-apply pre-wetted or dry rock salt as needed.	360	320	1) Use Application Rate for "wet and slushy" when icing condition is removed. 2) Increase application rate if precipitation intensity increases or if pavement shows signs of re-freezing.
15 to 23	Wet or Slushy	Apply pre-wetted or dry rock salt, plow if plowable.	360	275	Re-apply pre-wetted or dry rock salt as needed.	360	275	1) Monitor pavement temperatures and precipitation closely and adjust application rates as surface conditions and precipitation intensities change. 2) Treat icy patches and colder areas with higher applications. 3) Increase applications if precipitation intensity increase or surface shows signs of icing.
15 to 23	Icy	Apply pre-wetted or dry rock salt.	450	360	Re-apply pre-wetted or dry rock salt as needed.	450	360	1) Use Application Rate for "wet and slushy" when icing condition is removed. 2) Increase application rate if precipitation intensity increases or if pavement shows signs of re-freezing.
Below 15	Dry, wet or icy	Apply abrasives			Re-apply abrasives			Refer to Snow and Ice Guidelines Section 5.440 (B) for application rates.

Notes: 1) Freezing Rain requires a timely and aggressive response to prevent ice formation; application rates should be increased if not effective or cycle times are increased due to difficult driving.

SLEET

Surface Temp. Range (^{o} F)	Surface Condition	Initial Maintenance Action	Dry Rock Salt Lbs./lm.	Pre-Wetted Rock Salt Lbs./lm	Follow Up Action	Follow Up Rock Salt Lbs./lm	Follow Up Pre- Wetted Rock Salt Lbs./lm	Comments
Above 32	Dry	Patrol and spot treat as needed. See comments.			Patrol and spot treat as needed. See comments.			1) Monitor pavement temperatures closely and anticipate drops toward 32 F and below. 2) Treat icy patches with pre-wetted rock salt at 115 lbs./lm.
Above 32	Snow, slush, or wet.	Apply pre-wetted or dry rock salt, plow if plowable.	115	90	Re-apply pre-wetted or dry rock salt as needed.	115	90	1) Monitor pavement temperatures closely and anticipate drops toward 32F. 2) Treat icy patches and colder areas with higher applications. 3) Increase rates if precipitation intensity increases.
Above 32, but dropping to 32 or below soon.	Snow, slush, or wet.	Apply pre-wetted or dry rock salt, plow if plowable.	180	115	Re-apply pre-wetted or dry rock salt as needed.	180	115	1) Monitor pavement temperatures and precipitation closely. 2) Treat icy patches and colder areas with higher application rates. 3) Increase application rates if precipitation intensity increases.
23 to 32	Snow, slush, or wet.	Apply pre-wetted or dry rock salt, plow if plowable.	225	180	Re-apply pre-wetted or dry rock salt as needed.	225	180	1) Monitor pavement temperatures and precipitation closely. 2) Treat icy patches and colder areas with higher application rates. 3) Increase application rates if precipitation intensity increases.
15 to 23	Snow, slush, or wet.	Apply pre-wetted or dry rock salt, plow if plowable.	275	225	Re-apply pre-wetted or dry rock salt as needed.	275	225	1) Monitor pavement temperatures and precipitation closely. 2) Treat icy patches and colder areas with higher application rates. 3) Increase application rates if precipitation intensity increases.
Below 15	Any condition.	Apply abrasives.			Re-apply abrasives.			1) Refer to Snow and Ice Guidelines Section 5.4406 (B) for abrasive application rates.

Notes: 1) Sleet that creates accumulating ice will require more aggressive treatment.

LIGHT SNOW

Surface Temp. Range (° F)	Surface Condition	Initial Maintenance Action	Dry Rock Salt Lbs./lm.	Pre-Wetted Rock Salt Lbs./lm	Follow Up Action	Follow Up Rock Salt Lbs./lm	Follow Up Pre- Wetted Rock Salt Lbs./lm	Comments
Above 32	Wet, slush or light snow covered.	Patrol and spot treat as needed. See comments.			Patrol and spot treat as needed. See comments.			1) Monitor pavement temperature for drops toward 32 F. 2) Blast isolated icy patches with salt, treat slushy areas beginning to freeze with 225 dry/180 pre-wet, lbs./lm and plow as needed
Above 32, but dropping to 32 or below soon.	Dry	Apply pre-wetted rock salt or direct liquids. Patrol and spot treat as needed. See comments.		180	Patrol and spot treat as needed. See comments.			1) Monitor pavement temperature and precipitation and use select appropriate follow up as conditions change. 2) Refer to Snow and Ice Guidelines for appropriate direct application of liquid anti-icing chemicals.
Above 32, but dropping to 32 or below soon.	Wet, slush, or light snow covered.	Apply pre-wetted or dry rock salt, plow as needed.	225	180	Plow and re-apply pre-wetted or dry rock salt as needed.	115	90	1) Application will need to be more frequent at lower temperature and higher snowfall rates. 2) Adjust application rates as surface conditions and precipitation intensities change.
23 to 32	Dry	Apply pre-wetted rock salt or direct liquids.		180	See comments.			1) Monitor pavement temperature and precipitation and use select appropriate follow up as conditions change. 2) Refer to Snow and Ice Guidelines for appropriate direct application of liquid anti-icing chemicals.
23 to 32	Wet, slush or light snow covered.	Apply pre-wetted or dry rock salt, plow as needed.	225	180	Plow and re-apply pre-wetted or dry rock salt as needed.	115	90	1) Application will need to be more frequent at lower temperature and higher snowfall rates. 2) Adjust application rates as surface conditions and precipitation intensities change.
15 to 23	Wet, slush or light snow covered.	Apply pre-wetted rock salt, plow as needed.	275	225	Plow and re-apply pre-wetted rock salt as needed.	180	115	1) If sufficient moisture is present, dry rock salt can be applied. Dry pavement at these temperatures is better left untreated if snow does not track to surface.
Below 15	Dry or light snow covered.	Plow as needed.			Plow as needed.			1) Abrasives can be applied to enhance traction, a heavy salt mix will create glazing. Refer to Snow & Ice Guidelines Section 5.4406 (B) for abrasive application rates. Apply rock salt in anticipation of rising temperatures.

Notes: 1) Rush Period Traffic on high volume highways may require more aggressive initial treatments. 2) Use weather information to anticipate changes in storm intensity, surface temperatures and adapt the storm treatment accordingly. Use guidelines for moderate/heavy snow during periods of heavier intensity. . 3) Refer to direct liquid chemical application guides lines (Appendix C, Page C – 10) if anti-icing liquids are used.

MODERATE OR HEAVY SNOW

Surface Temp. Range (° F)	Surface Condition	Initial Maintenance Action	Dry Rock Salt Lbs./lm.	Pre-Wetted Rock Salt Lbs./lm	Follow Up Action	Follow Up Rock Salt Lbs./lm	Follow Up Pre- Wetted Rock Salt Lbs./lm	Comments
Above 32	Wet, slush or light snow covered.	Patrol and spot treat as needed. See comments.			Patrol and spot treat as needed. See comments.			1) Monitor pavement temperature for drops toward 32 F. 2) Blast isolated icy patches with salt, treat slushy areas beginning to freeze with 225 dry/180 pre-wet, lbs./lm and plow as needed.
Above 32, but dropping to 32 or below soon.	Dry	Apply pre-wetted rock salt or direct liquids. Patrol and spot treat as needed. See comments.		180	Patrol and spot treat as needed. See comments.			1) Monitor pavement temperature and precipitation and use select appropriate follow up as conditions change. 2) Refer to Snow and Ice Guidelines for appropriate direct application of liquid anti-icing chemicals.
Above 32, but dropping to 32 or below soon.	Wet, slush, or light snow covered.	Apply pre-wetted or dry rock salt, plow as needed.	225	180	Plow and re-apply pre-wetted or dry rock salt as needed. Slushy Conditions	225 115	180 90	1) If normal cycle times can not be maintained, the application rates can be increased to 275dry/225 pre-wet, lbs./lm to accommodate longer cycles. 2) Rates may be reduced during periods of light snow but use full applications in anticipation of heavy intensities/falling surface temperatures.
23 to 32	Dry	Apply pre-wetted rock salt or direct liquids.		180	See comments.			1) Monitor pavement temperature and precipitation and use select appropriate follow up as conditions change. 2) Refer to Snow and Ice Guidelines for appropriate direct application of liquid anti-icing chemicals.
23 to 32	Wet, slush or light snow covered.	Apply pre-wetted or dry rock salt, plow as needed.	225	180	Plow and re-apply pre-wetted or dry rock salt as needed. Slushy Conditions	225 115	180 90	1) If normal cycle times can not be maintained, the application rates can be increased to 275dry/225 pre-wet, lbs./lm to accommodate longer cycles. 2) Rates may be reduced during periods of light snow but use full applications in anticipation of heavy intensities/falling surface temperatures.
15 to 23	Wet, slush or light snow covered.	Apply pre-wetted rock salt, plow as needed.	275	225	Plow and re-apply pre-wetted rock salt as needed. Slushy Conditions	275 225	225 115	1) If normal cycle times can not be maintained, the application rates can be increased to 360dry/275 pre-wet, lbs./lm to accommodate longer cycles. 2) Rates may be reduced during periods of light snow but use full applications in anticipation of heavy intensities.
Below 15	Dry or light snow covered.	Plow as needed.			Plow as needed.			1) Abrasives can be applied to enhance traction, a heavy salt mix will create glazing. Refer to Snow & Ice Guidelines Section 5.4406 (B) for abrasive application rates. Apply rock salt in anticipation of rising temperatures.

Notes: 1) Rush Period Traffic on high volume highways may require more aggressive initial treatments. 2) Increased cycle times will require heavier application rates. Anticipate changes in storm intensity and surface temperatures and use appropriate chart selection. 3) Refer to direct liquid chemical application guides lines (Appendix C, Page C –10) if anti-icing liquids are used.

ANTI-ICING WITH STRAIGHT LIQUID CHEMICALS

The strategy of anti-icing is to be proactive in the application of chemicals to prevent the formation or development of bonded snow and ice to the pavement surface. This tactic is used to "buy time" prior to the onset of a snow and ice event or anticipated black ice conditions. When the event actually begins, conventional reactive strategies are then used.

This strategy can be particularly useful on A1 type highways where conventional methods may be slowed due to high traffic volumes. These methods are also useful for unique trouble areas such as bridge decks, high elevations, and shaded areas that freeze quicker than adjoining segments.

Anti-icing can be done by applying conventional solid and pre-wetted solids on low speed, low volume roads. This tactic is prone to wasting material, particularly if the pavement surface is dry. High volumes and speeds will scatter most of the material off of the travel lanes. Higher treatment effectiveness can be achieved by placing the material on the high portion of the traffic lane where it is not subject to as much traffic. The preferred material for anti-icing is the use of salt brine or liquid chemicals such as magnesium chloride sprayed directly on the pavement surface using a tank and spray bar system. Various slide in tank and spray bar systems are now available.

Liquid Chemicals:

Liquid ice control chemicals are made up of solid ice control chemicals in a water solution. After application, the water evaporates and a residual dry chemical is left on the pavement surface. This material is not prone to scattering or dispersal from traffic conditions.

Salt brine is most effective at a 23% solution. It can be produced in house by agitating solid NACL in water. It is also a byproduct of the oil and gas industry and can be acquired in certain geographic areas at little or no cost.

Liquid Magnesium Chloride, Liquid Calcium Chloride, Potassium Acetate, Calcium Magnesium Acetate, and a variety of proprietary formulas that contain anti-corrosion inhibitors and agricultural byproducts are also available. Although generally higher in cost than salt brine, they can be more effective at lower temperatures.

Application Criteria:

Straight liquid chemical applications can be made up to 3 days prior to the onset of a winter weather event if the chemical is allowed to dry on the pavement surface. Rain events and particularly high traffic volumes will lesson the anti-icing effects. Table A gives a general range of application rates. The rates to achieve effective results can vary significantly with the type of

liquid chemical used and pavement temperatures. Too little material will not produce desired results. On very rare occasions too much material (liquid chemicals other than salt brine) can result in hazardous slippery conditions before the material has fully dried. The use of pencil or streamer nozzles to distribute these liquid chemicals onto the pavement will further reduce the potential for any unintended slipperiness. It is recommended that new users start at the lower end of the range and gradually increase application rates until desired results are achieved. It is also very critical that liquid spray units are calibrated at the beginning of each snow and ice season. This can be accomplished by collecting liquid at the spray bar over a pre-measured distance. Because results are very sensitive to application rates, calibration is critical.

Liquid chemicals should only be applied as an anti-icing strategy when the pavement temperatures are 20°F or higher. Application of salt brine at lower temperatures would require excessive application rates and may be prone to rapid refreeze. Liquid chemicals such as magnesium chloride and other proprietary products may be used at lower temperatures, but again, application rates may negate any cost benefit. Conversely, liquid applications should not be made if pavement temperatures are much above freezing. Above 38°F and at high humidity, liquid chemicals will not properly dry on the surface and can result in hazardous slippery conditions.

De-icing:

Straight liquid chemicals may be applied as a de-icing strategy during low moisture, light snowfall at pavement temperatures above 20°F. Cycle times should be minimized as dilution of straight liquids occurs much quicker than solid chemical applications. At temperatures near freezing, it can be very effective at melting thin ice in the absence of precipitation.

Liquid chemicals are more sensitive to temperature and dilution than solid abrasives. If used as a de-icing strategy, more caution is required to avoid refreeze without the friction enhancement characteristics of a solid material.

Table A

SUGGESTED APPLICATION RATES FOR STRAIGHT LIQUID ANTI-ICING			
Temperature °F	*Application Rate gals/lm		
	23% Salt Brine	27% Mag Chloride	32% Calcium Chloride
32°F	30	28	33
20°F	40	30	36

** Application rates as high as 60 gal/lm have been successfully used in salt brine straight liquid applications. It is strongly recommended however, to start with the application rates as illustrated by this table.*

APPENDIX D

ABRASIVES – SNOW AND ICE CONTROL SPECIFICATIONS

NEW YORK STATE DEPARTMENT OF TRANSPORTATION
GROUP SPECIFICATION
ABRASIVES – SNOW & ICE CONTROL (Delivered to Stockpile)

BIDDERS ARE REQUESTED TO RETAIN THIS SPECIFICATION FOR FUTURE REFERENCE

DIRECT INQUIRIES REGARDING THIS SPECIFICATION TO: Mike Lashment, Transportation Operations Division, (518) 457 - 5796

SCOPE

This specification covers the material requirements and basis of acceptance for abrasives used to treat snow and ice on pavements.

MATERIAL REQUIREMENTS

The material for abrasives shall be either natural sand, manufactured sand, iron ore tailings, slag or lightweight aggregate conforming to the requirements of these specifications. All abrasives shall consist of hard, durable particles that are free from injurious amounts of clay, loam or other undesirable material or hazardous substances.

Abrasive materials meeting the requirements of these specifications shall be accepted unless the Director of Transportation Operations Division determines, from test results, or service records that (1) the material contains sufficient unsound or undesirable material to be harmful, (2) the particles degrade due to weathering in storage or while in service such that the abrasive material is ineffective.

CERTIFICATION AND GRADATION ANALYSIS

Bidders are required to submit a current gradation analysis (sample taken within 6 months of bidding) for each proposed source of supply on their bids. This requirement is waived if the proposed source is named on the most current listing of the NYSDOT approved list of sources of fine and coarse aggregates for Portland Cement Concrete Sand published by the Materials Bureau of the New York State Department of Transportation. Attachment 1 of the proposal is to be used for recording the gradation test results or indicating the NYSDOT Approved Source Number. The gradation test, if required, may be performed by the producer, bidder or an independent testing laboratory. On Attachment 1, the bidder is further required to certify that the gradation analysis represents the material to be supplied and that sufficient acceptable material is available to meet the requirements of the item(s) bid. Bids shall be rejected if the certified gradation is not in conformance with the *"Special Gradation"* for the locations bid. If the certification sheet is not properly executed (completely filled out and signed), the bid shall be declared incomplete.

INCOMPLETE BIDS

Bidders will have ten (10) calendar days from issuance of notice by the Department to provide missing gradation or other information. Failure to provide the missing information within the specified time period shall be cause for rejection of the bid.

GRADATION

The gradation requirements for the various items in this proposal are listed on the gradation sheet of this specification. NOTE: The Specification Gradation Sheet is to be used for bidding purposes. The Rejection Gradation Sheet will only be used at the time of delivery to determine the acceptability of the load.

GRADATION ACCEPTANCE

Gradation acceptance of abrasive material shall be based on the condition that the material meets the specification requirements. Acceptance shall be determined at the final point of sampling. Depending on the production operation and uniformity of delivered material, the final point of acceptance sampling could be the producer's stockpile, production operation, pit or a lot of delivered material. Depending on the production operation, the Department may require that exclusive stockpiles be built, tested and approved prior to delivery. If the material deviates from the SPECIFICATION GRADATION requirements listed on the attached gradation sheet, an adjusted price may be paid for the material. The adjusted price shall be based on the average values of at least two samples representing a pit location, lot, stockpile or process.

SAMPLING

Sampling will be performed by Department personnel or their representatives and will depend on the operation of the successful low bidder. Where stockpiles exist, the material will be sampled in the stockpiles prior to delivery. Where material is being processed shortly in advance of or at the time of delivery, the process will be sampled. Where the material is unprocessed, specific working areas of the source will be sampled prior to delivery. All delivered materials are subject to random and/or specific sampling if a problem is suspected. Sampling methods, locations and point of final acceptance will be determined by the Department of Transportation.

LOT

A lot shall be the total of one eight hour day's delivery during normal Residency working hours.

TESTING METHOD

Gradation testing shall be performed on samples by sieving in conformance with NYSDOT Materials Bureau Test Methods 703-1P and 703-2P. Moisture content shall be determined by AASHTO Test Method T-255.

– USE FOR BID ELIGIBILITY –

Specific Gradation Sheet*

		PERCENT PASSING
GRADATION	SIEVE SIZE	SPECIFICATION GRADATION
A	1/2"	100
	3/8"	100
	#4	80-100
	#50	0-18
	#200	0-3
B	1/2"	100
	3/8"	100
	#4	80-100
	#50	0-25
	#200	0-5
C	1/2"	100
	3/8"	100
	#4	80-100
	#50	0-35
	$200	0-5

*NOTE: The above table is to be for determining bid eligibility. To be acceptable, the Gradation Analysis must show that the proposed source meets the specifications.

– DO NOT USE FOR ELIGIBILITY –

Rejection Gradation Sheet**

GRADATION	SIEVE SIZE	PERCENT PASSING REJECTION GRADATION	PENALTY FACTOR
A	1/2"	100	-
	3/8"	95-100	1
	#4	70-100	1
	#50	0-22	2
	#200	0-5	5
B	1/2"	100	-
	3/8"	95-100	1
	#4	70-100	1
	#50	0-30	2
	#200	0-8	5
C	1/2"	100	-
	3/8"	95-100	1
	#4	70-100	1
	#50	0-40	2
	#200	0-8	5

**NOTE: The above table is *NOT* to be used to determine bid eligibility (see Specification Gradation sheet for that use). Rejection Gradation is used to determine the acceptability of delivered material and calculate reduced payment, if necessary.

MOISTURE CONTENT

Abrasives when delivered shall have a maximum moisture content of 7.0% as determined by AASHTO Test Method T-255 (moisture content of fine and coarse aggregate).

METHOD OF DELIVERY

The bidding unit for abrasives is U.S. Tons (weight). The method for accounting for delivery involves collecting weight tickets from scales that have been certified by the appropriate Municipal jurisdiction and are signed by certified weigh masters.

ESTIMATE OF QUANTITIES

Quantities indicated in the Bid Proposal represent the Resident Engineer's best estimate for a normal winter. The Department reserves the right, afterward, to order 20% more or less than the quantities called for in the contract. Notwithstanding the foregoing, the Department may purchase greater or lesser percentages of the contract quantities with the Contractor's concurrence.

DELIVERY SCHEDULES

Delivery schedules shall be approved by the Resident Engineer. The delivery of material shall not be less than 200 tons and not more than 1,000 tons per day. Deliveries will be accepted between the hours of 7:30 A.M. and 3:00 P.M. unless exceptions are specifically granted by the Resident Engineer.

REJECTED MATERIALS

When materials are rejected, they must be removed by the Contractor within ten (10) days of notification of rejection. Rejected items not removed by the Contractor within the said ten (10) days shall be regarded as abandoned by the Contractor. The Department then shall have the right to dispose of said abandoned material as its own property. The Contractor shall promptly reimburse the Department for any and all costs incurred in effecting such disposal.

WEIGHT/VOLUME CONVERSION

Locations (delivery sites) where volumetric delivery is acceptable shall be specifically identified in the Bid Proposal. These are typically areas where certified scales and weigh masters are not available within a reasonable distance of the delivery site. In those cases, the weight/volume conversion ratio shall be determined by the Resident Engineer with assistance from the Regional Materials Group as necessary.

There are two acceptable methods for establishing weight/volume conversion;

Method 1

Each delivery truck shall have its "level struck" (all material in the dump body being level with the top of the sides of the dump body); volume determined by the Resident Engineer. This will be the payment volume for each load delivered. A representative of the Resident Engineer shall record each load delivered and certify that the truck contained at least the payment (level struck) volume.

The test method for determining unit weight for the purpose of determining weight/volume conversion is:

Equipment Required

1 - 1/4 cu. ft. container (typically used for measuring the air content 9of plastic concrete).

1 - 20 oz. Rubber mallet.

1 - straight edge suitable for striking the abrasive level with the top of the container.

1 - smooth working surface.

1 - scale having a minimum 40 lb. capacity and accuracy of ± 0.3 lbs.

1 - flat shovel.

Sampling of Abrasives

A representative sample of about ½ cu. ft. (4 gal.) of abrasives shall be obtained from a prepared stockpile according to procedures found in Appendix "A" of Materials Method 9.1 "Plant Inspection of Portland Cement Concrete" prior to delivery.

Testing the Sample for Unit Weight

1.The sample shall be air or oven dried until it is visibly dry.

2.Thoroughly mix the "room temperature" sample into a pile on the smooth surface with a flat shovel and "quarter" the pile.

3.Remove about 1/16 cu. ft. (about two quarts) of material from one of the quarters. Place it in the 1/4 cu. ft. container and roughly level it off.

4.Strike the container firmly three times about midway on the side at one point. Repeat the striking procedure at three more points about 90 degrees apart on the container.

5.Repeat steps 3 & 4 three more times with material from each of the remaining three "quarters" of the same pile. Be sure that 1/4 cu. ft. container is "overfull" after material from the fourth quarter of the sample pile is placed in it.

6.Screed the material level with the top of the container.

7.Weigh the "level full" container on the scales and record the weight in pounds.

8.Subtract the weight in pounds of the empty 1/4 cu. ft. container from the weight recorded from step #7 above. This is the weight, in pounds, of 1/4 cu. ft. of the abrasive material. To obtain the weight, in tons, of 1 cubic yard of the abrasive material, multiply the weight of the 1/4 cu. ft. by 0.054.

Method 2

Each delivery truck shall have its "level struck" weight of abrasives determined by a weigh master on a certified weight scale. This is obtained by subtracting the empty weight of the truck from the certified loaded "level struck" weight. As in Method 1, each load delivered shall be recorded by a representative of the Resident Engineer and be certified that the truck contained at least the same volume of the "level struck" weight previously recorded.

PRICES

Prices shall be FOB destination, including delivery to the locations specified.

PAYMENT OF INTEREST

The payment of interest on payments due and owed by a State Agency will be made in accordance with the criteria established by Chapter 153, Laws of 1984 (Article 11A of the New York State Finance Law) and the Comptroller's Bulletin No. A-91 (Prompt Payment).

PAYMENT

Payment will be made upon satisfactory delivery and acceptance of material. Invoices are to be sent to the New York State Department of Transportation at the address indicated on the Purchase Order issued by the Resident Engineer.

DELIVERY

Bidders must guarantee delivery within 14 calendar days or less after receipt of an order (written or verbal) from the Department. Orders shall not call for deliveries of less than 200 tons or more than 1,000 tons per day.

SUSPECTED PROBLEMS DURING DELIVERY

If the Resident Engineer, or an authorized representative of same, as a result of visual inspection, suspects the abrasives being delivered are not within specification limits, they shall immediately notify the supplier of the nature of the suspected problem(s) verbally and in writing. At that point, all deliveries from that supplier will cease until the Department has had reasonable opportunity to sample and test the suspect material (3 working days, not including the date of written notification). If the supplier requests to continue delivering material after notification in writing, the Resident Engineer may approve that request in writing. However, the material delivered after notification must be kept separate from that which was delivered prior to notification. The action deemed necessary by the test results shall be applicable to the lot delivered the day of notification and any subsequent lots delivered during the three day testing and sampling period. This process shall be utilized at any time when delivery of out of specification material is suspected.

ADJUSTED BID PRICE AND REJECTION RELATIVE TO GRADATION

The bid price shall be adjusted for any delivered material outside the limits given under "Specification Gradation" and within the limited of the "Rejection Gradation". Any material that has one or more sizes that fall outside the "Rejection Gradation" limits shall be rejected and no payment will be made for that material.

Example of Bid Price Adjustment for Out-of-Gradation Material

Percent Passing

Sieve	Example Specification Gradation	Example Rejection Gradation	Example Penalty Factor
1/2"	100	100	-
3/8"	100	95-100	1
#4	80-100	70-100	1
#50	0-25	0-30	2
#200	0-5	0-8	5

April, 2006

Reduced price per ton = contract price times (1.0 - X)

The percent out of tolerance shall be to the nearest 1%. The sum of the individual sieve tolerance deviations (%) times the appropriate penalty factors divided by 100 shall be used as "X".

Example: Sand delivered was bid at $5.00 per ton and is satisfactory in passing the 3/8" and #4 sieve but has 30% passing the #50 sieve and 6% passing the #200 sieve. The reduced price is computed as follows:

X = (30% - 25%) X 2 + (6% - 5%) X 5 = 15% = 0.15

Reduced price per ton = $5.00 X (1.00 - .15) = $4.25

Rejection and Reduced Price for Excess Moisture Content

Excessive moisture content has a significant negative impact on mixing, stockpiling and storage operations. Abrasives delivered that have a moisture content in excess of 7.00% and less than 10% may be rejected or accepted at a reduced unit price at the discretion of the Resident Engineer. Abrasives that have moisture content of 10% or higher shall be rejected.

The reduced unit price for affected delivery lots shall be computed as follows:

Moisture Content, %	**Reduction in Unit Price, %**
7.01 - 8.00	10.0
8.01 – 9.00	20.0
9.01 – 9.99	30.0
10.00 or higher	Rejection Required

APPENDIX E

REFERENCE MATERIAL

April, 2006

REFERENCE MATERIAL

Ketcham, S., L.D. Minsk, R. R. Blackburn, E. J. Fleege, "Manual of Practice for Effective Anti-Icing Program: A Guide for Highway Winter Maintenance Personnel," Report No. FHWA-RD-95-202, Federal Highway Administration, Washington, D.C., June 1996.

Blackburn, R. R., K. M. Bauer, D. E. Amsler, Sr., S. E. Boselly, A. D. McElroy, "Guidelines For Snow and Ice Control Materials and Methods," NCHRP Report No. 6-13, National Cooperative Highway Research Program, Washington, D.C., May 2003.

Boselly, S. E., R. R. Blackburn, D. E. Amsler, Sr., "Guide For Snow and Ice Control", NCHRP Report No. 20-7, National Cooperative Highway Research Program, Washington, D.C., February 1998.

Keep, Dale, "Snow & Ice Control Chemicals: Theory & Practice," Washington State DOT

Nixon, W. A., A. D. Williams, "A Guide For Selecting Anti-Icing Chemicals Version 1.0", University of Iowa, Iowa City, IA, October 2001.

"Guide for Snow and Ice Control", American Association of State Highway and Transportation Officials, Washington, D.C., 1999.

Amsler, Sr., D. E., "Snow and Ice Control", Cornell Local Roads Program, Ithaca, N.Y., 2000.

Amsler, Sr., d. E., "Level of Service – Strategies and Tactics – Liquid Ice Control Chemicals", Cornell Local Roads Program, Ithaca, N.Y. September 2003

"Highway Design Manual – Chapter 5: Basic Design", New York State Department of Transportation, Albany, N.Y., August 2001

"Environmental Handbook for Transportation Operations", New York State Department of Transportation, Albany, N.Y., January 2002

"Municipal-State Agreements For Control of Snow and Ice on State Highways: Terms, Reimbursement Procedures and Documentation", New York State Department of Transportation, Albany, N.Y., December 1999.

"Equipment Rental Rate Schedule", New York State Department of Transportation, Albany, N.Y., January 2000.

"The Snow fighter's Handbook", Salt Institute, Alexandria, VA, 1999

"Salt Storage Handbook", Salt Institute, Alexandria, VA, 1997

Service Levels

Six levels of service are established so that operations will generally start in the areas of greatest traffic and progress to the low volume routes. Each District shall classify their routes along these guidelines and coordinate their activities with adjoining districts to maintain continuity.

Classification	Desired Recovery Time	Desired Pavement Condition	Desired Coverage	
			Days/Week	Hours/Day
Urban Areas Level 1	1 - 3 hrs.	All lanes/ramps interchanges cleared	7 days/week	18 hrs/day 4 am - 10 pm local time
Rural Interstate Level 2	2 - 6 hrs.	All lanes/ramps interchanges cleared	7 days/week	14 hrs/day 5 am - 7 pm local time
Interregional System Level 3	2 - 8 hrs.	All lanes cleared	7 days/week	14 hrs/day 5 am - 7 pm local time
State Corridor Level 4	3 - 10 hrs.	All lanes cleared	7 days/week	14 hrs/day 5 am - 7 pm local time
District Corridor Level 5	6 - 12 hrs.	All lanes cleared	7 days/week	10 hrs/day 7 am - 5 pm local time
District Collector Level 6	8 - 24 hrs.	All lanes cleared	7 days/week	10 hrs/day 7 am - 5 pm local time

Urban Areas: Bismarck, Minot, Grand Forks, and Fargo

Desired recovery time is the time following a storm event that it takes to reach the desired pavement condition, which is all lanes cleared. Lanes cleared means all plowable snow and ice is removed. Compacted snow or ice could still remain so lanes cleared does not necessarily mean bare pavement. The desired coverage (expanded work schedule - hours/day) should continue until roadways are bare and cleanup is completed shoulder to shoulder. For purposes of this manual, a storm event means any weather occurrence that results in an accumulation of ice or snow on the roadway, from a thin layer up to and including an eight-inch snowfall within a 24 hour period.

Each maintenance section shall commit adequate resources available to attain the desired recovery time for the roadway classifications within their sections. The highest roadway class in each section shall be completed first. The District Engineer may extend the desired recovery times on roads with lower classifications to attain the desired recovery times on roads with higher classifications. Actual starting times are left up to the District Engineer, and staggered work schedules may be used during the winter to assist in attaining the desired pavement condition. Once the desired pavement condition has been reached and maintained, cleanup operations should start. District Engineers shall coordinate work efforts between districts and sections to provide for a seamless boundary.

INTRODUCTION

The purpose of this standard is to establish the level of service for winter snow and ice control for all classes of Provincial Highways.

Winter maintenance operations are provided to maintain a consistent level of service across the province for varying classes of Highways.

REFERENCE

- Maintenance Manual - Maintenance Quality Standards MQS-702 & MQS-703
- Maintenance Manual - Maintenance Best Practices MBP-701, 702, 703, & 704
- Maintenance Manual - Environmental Protection
- Maintenance Manual - Occupational Health and Safety Hazards

LEVEL OF SERVICE

Winter traffic volume is the primary indicator used to determine the winter level of service for each class of Highway. All Highways in Ontario have been divided into five classes: Class 1, 2, 3, 4, and 5 with Class 1 being the highest level of service and Class 5 being the lowest.

CLASS 1

The defined level of service for Class 1 is essentially bare pavement, and is the objective to be reached as soon as reasonably possible after the storm has ended or abated, normally within 8 hours. This level of service applies to hard-surfaced Highways with a Winter Average Daily Traffic volume greater than 10,000 vehicles per day.

CLASS 2

The defined level of service for Class 2 is essentially bare pavement, and is the objective to be reached as soon as possible after the storm has ended or abated, normally within 16 hours. This level of service applies to hard-surfaced Highways with Winter Average Daily Traffic volumes between 2,000 and 10,000 vehicles per day in Southern Ontario and 1,500 and 10,000 vehicles per day in Northern Ontario*. This level of service also applies to the Trans-Canada Highway system throughout Ontario.

CLASS 3

The defined level of service for Class 3 is essentially bare pavement, and is the objective to be reached as soon as reasonably possible after the storm has ended or abated, normally within 24 hours. This level of service applies to hard-surfaced Highways with Winter Average Daily Traffic volumes between 1,000 and 2,000 vehicles per day in Southern Ontario and 800 and 1,500 vehicles per day in Northern Ontario*****.

CLASS 4

The defined level of service for Class 4 is essentially bare pavement. A minimum centre bare condition (the centre 2.5m), should be reached within 24 hours after the storm has ended or abated and be maintained until conditions permit baring the pavement to full width. This level of service applies to hard-surfaced Highways with Winter Average Daily Traffic volumes between 500 and 1,000 vehicles per day in Southern Ontario and 400 and 800 vehicles per day in Northern Ontario*****.

CLASS 5

The defined level of service for Class 5 is that a snow pack condition on the Travelled Portion be achieved, within 24 hours after the storm. A snow pack condition on the Travelled Portion is defined as a smooth, hard, snow covered driving surface with Shoulders that are void of loose snow. This level of service applies to gravel, surface treated or prime surfaced Highways with a Winter Average Daily Traffic volume less than 500 vehicles per day in Southern Ontario and less than 400 vehicles per day in Northern Ontario*****.

*** For the purpose of this Maintenance Quality Standard, Northern Ontario includes all Highways within the MTO districts of Thunder Bay, Sault Ste Marie, Sudbury, New Liskeard as well as Highways in Huntsville and Bancroft Districts north of the MNDM/MTO boundary defined as the southern Muskoka and Nipissing District Boundaries**

REFERENCES

- Maintenance Manual - Maintenance Quality Standards MQS-701 & MQS-702
- Maintenance Manual - Maintenance Best Practices MBP-702 & MBP-703

The following winter maintenance summary is a compilation of Maintenance Quality Standards, and Maintenance Best Practices. Conditions will dictate the appropriate work required:

	CLASS 1	CLASS 2	CLASS 3	CLASS 4	CLASS 5
WINTER MAINTENANCE - LEVEL OF SERVICE (MQS-701)					
Primary Objective	Essentially Bare Pavement	Essentially Bare Pavement	Essentially Bare Pavement	Essentially Bare Pavement	Snow Pack
Time to Meet Primary Objective A.S.A.P. after the storm, not exceeding:	8 Hrs.	16 Hrs.	24 Hrs.	Centre-bare within 24 Hrs. And essentially bare pavement when conditions permit	24 Hrs.
WINTER MAINTENANCE - OPERATIONS (MQS-702 & MBP-702)					
SALTING					
Begin salting: - When snow accumulation:	<0.5 cm	<0.5 cm	<0.5 cm	<0.5 cm	N/A
- During icy conditions	when required	when required	when required	when required	N/A
- Follow-up salting: **	when required	when required	when required	when required	N/A
PLOWING					
- Begin plowing when accumulation: ***	≤ 2.0 cm	≤ 2.0 cm	≤ 2.0 cm	≤ 2.0 cm	≤ 2.0 cm
SANDING					
- Sand when: ****	Slippery conditions	Slippery conditions	Slippery conditions	Slippery conditions	Slippery conditions
EQUIPMENT COMPLEMENT CALCULATION (MBP-703)					
SALTING					
- Theoretical circuit time: *	1.3 Hrs.	1.8 Hrs.	2.9 Hrs.	4.9 Hrs.	N/A
PLOWING					
- Maximum single lane km/plow:	55 km	75 km	120 km	206 km	336 km
SANDING					
- Theoretical circuit time: *	NA	NA	NA	NA	8 Hrs.

WINTER MAINTENANCE - SUMMARY

***** Circuit time is the **theoretical time** required to complete the entire route but does not include the dead-head time to return to the point of departure upon completion of the entire route.

** The need for follow-up salting will be determined by the precipitation, road conditions and weather.

*** Generally, salt on the road takes time to become fully effective and therefore plowing should not normally occur until at least 30 minutes after the salt has been placed, but may occur earlier if warranted due to snow accumulation, ambient temperature, and traffic volume.

**** Sanding should begin as soon as slippery conditions are detected.

Feature	Outcome Target
Asphalt and Concrete Pavement Surfaces	
Debris	• Debris on the Travelled Portion of the Roadway is removed Immediately upon Detection or being Made Aware • Accumulation of Gravel on paved driving surfaces and intersection aprons is removed upon Detection or being Made Aware • Accumulation of winter sand from paved driving surfaces, fully paved shoulders including medians, intersection aprons, curb & gutter, paved traffic islands, commuter parking lots and commercial vehicle inspection stations shall be removed by June 15th of every year.
Potholes	• No single Pothole that is deeper than 7.5cm and greater than 0.04 m² • No more than 3 Potholes within an area of 20 m² • No more than 10 Potholes per lane km
Joint Failure	• All concrete joint failures exceeding a differential of 5cm are signed.
Distortion	• All bumps or depressions with a differential of 5cm or more over a 3-metre length are signed.
Pavement Edge Surface Loss	• No pavement edge surface loss which extends more than 15cm inward from the edge of pavement.
Shoulders	
Washouts	• No washout of 15.0 cm or deeper and measuring an area greater than 1.0 m². • No washout of 15.0 cm or deeper and measuring an area greater than 0.5 m² within 1.0 m of the travelled portion of the roadway.
Debris	• Debris greater than 0.010 m^3 is removed Immediately upon Detection or being Made Aware. • A maximum of 5 pieces of debris measuring more than 0.001m^3 and less than 0.010m^3 over a distance of 1 km.
Drainage	• No preventable condition that impedes the shoulder drainage to function as designed
Drop Off	• No Drop-off exceeding 7.5 cm in depth.
Ruts	• No ruts deeper than 10.0 cm
General	
Dead Animals	• Dead animals removed and disposed of as Detected
Dusty Conditions	• No Dusty Conditions which results in: • Further loss of fine particles from the pavement aggregates

Feature	Outcome Target
	• Loss of driving surface stability

Feature	Outcome Target
Deployment during Winter Transition Periods	• 50% of the full winter complement of the assigned Winter Vehicles by patrol location shall be Deployed within 30 minutes after the Start of a Winter Event on any Route as measured by Weather Information.
Deployment during Winter Season	• 100% of the full winter complement of the assigned Winter Vehicles by patrol location shall be Deployed within 30 minutes after the Start of a Winter Event on any Route as measured by Weather Information.
Ground Frost during Transition Periods	• No Ground Frost on roadway causing slippery conditions during Transition Periods
During a Winter Event	
Circuit Times	• Meeting the total Circuit Time for Salting of 1.6 hours on any Class 1 Highway Route on every circuit • Meeting the total Circuit Time for Salting of 2.2 hours on any Class 2 Highway Route on every circuit • Meeting the total Circuit Time for Salting of 3.3 hours on any Class 3 Highway Route on every circuit • Meeting the total Circuit Time for Salting of 5.5 hours on any Class 4 Highway Route on every circuit • Meeting the total Circuit Time for Plowing of 1.6 hours on any Class 1 Highway Route on every circuit • Meeting the total Circuit Time for Plowing of 2.2 hours on any Class 2 Highway Route on every circuit • Meeting the total Circuit Time for Plowing of 3.3 hours on any Class 3 Highway Route on every circuit • Meeting the total Circuit Time for Plowing of 5.5 hours on any Class 4 Highway Route on every circuit

Feature	Outcome Target
	• Meeting the total Circuit Time for Plowing of 10.0 hours on any Class 5 Highway Route on every circuit
Winter Equipment Utilization	• Providing continuous winter operations using all Winter Vehicles available until prescribed level of service has been achieved on any Route
Sand/Salt application rates	• Application of salt and/or sand at or over the prescribed minimum application rates specified in this performance requirement 100% of the time
Calibration Rates	• 100% of spreader units within 10% of calibration settings.
Continuous Plowing	• Continuous plowing to maintain the established level of service 100% of the time
Plowing Priority	• Plowing of areas identified in section 2002.05 given first priority 100% of the time during Winter Events
Echelon Plowing	• Echelon plowing performed 100% of the time when through lanes are plowed to the right on multi-lane Highways
Snow accumulation	• Snow accumulation adjacent to median barrier walls removed prior to the End of the Winter Event.
After The Winter Event	
Level of Service	• Achieve Bare Pavement on any Route on Class 1 Highways within 8 hours after the End of the Winter Event
Level of Service	• Achieve Bare Pavement on any Route on Class 2 Highways within 16 hours after the End of the

Feature	Outcome Target
	Winter Event
Level of Service	• Achieve Bare Pavement on any Route on Class 3 Highways within 24 hours after the End of the Winter Event
Level of Service	• Achieve Centre Bare Pavement on any Route on Class 4 Highways within 24 hours after the End of the Winter Event
Level of Service	• Achieve Snow Pack Condition on any Route on Class 5 Highways within 24 hours after the End of the Winter Event
Snowbanks	• Snow accumulation at any location impairing visibility removed or lowered within 48 hours after Detection
Snow accumulation	• Snow accumulation that could cause ramping at any location removed or in the process of being removed within 4 hours after Detection
Commuter lots, truck inspection stations and HOV pockets and turnarounds	• Commuter parking lots, truck inspection stations through lanes, HOV enforcement pockets and turnarounds are plowed and salted/sanded within 24 hours after the End of the Winter Event
Shoulders/Medians	• Bare Shoulder reached within 24 hours after the End of the Winter Event on the right hand shoulders of Highways 400 and 404. • Other shoulders/medians plowed within 24 hours of the End of the Winter Event and during the event if accumulation of snow/slush is greater than 15cm
General	
Winter Equipment	• 100% of lighting on Winter Vehicles conforming to specifications in appendices of this performance requirement.
Hazards	• Address any Hazard Immediately upon Detection or being Made Aware
Equipment Breakdowns	• Any Route not left unserviced for more than 2 hours due to equipment breakdown or redeployment
Salt Storage	• Salt stored in covered buildings at all times
Winter Drainage	• No flooding on roadway caused by snow and/or ice impeding drainage through or to culverts and ditches.
Snow fence	• Fence installed/removed within specified times

Feature	Outcome Target
Retroreflectivity *****	• 80% of white pavement markings exceed 225 millicandelas, • 80% of yellow pavement markings exceed 150 millicandelas, • No results less than 130 mcd/m^2lx for white markings and no results less than 110 mcd/m^2lx for yellow markings, • Above measured by the Ministry conforming to ASTM D 6359-99.
Durability *	• 80% of all Pavement Markings shall exceed Class 1 condition, as determined by the Ministry's visual assessment using the MTO Durability Classification Guidelines.
Visibility *	• 100% of all Pavement Markings meet the requirements of Table 2003-1 from Section 2003.04.01.04.
Colour *, **	• 100% conformance with the Chromacity Coordinates specified in Appendix 2003-A as measured by the Ministry conforming to ASTM E-1347.
Daytime Luminance Factor *, **	• All luminance measurements for white shall be ≥ 45% • All luminance measurements for yellow shall be ≥ 25% as measured by the Ministry conforming to ASTM E-1347.
Submission and Documentation	• The required documents specified in Section 2003.04.04 and 2003.04.05 shall be performed in conformance with the accuracy, timeliness and completeness requirements.

Feature	Outcome Target
Barriers and energy Absorbing Systems	
Cable guide Rail	• No frayed and/or broken cables, no cable sags exceeding 5cm, no exposed anchors or missing hardware, • When ground is not frozen, all damaged posts are repaired within 21 days of Detection or being Made Aware. • When ground is frozen, temporary repairs are to be completed. All temporary repairs and all damaged posts, cables and hardware are permanently repaired by the 15th of June in every calendar year.

Feature	Outcome Target
	• No missing or damaged reflectorized strips
Steel Beam Guide Rail	• No more than two consecutive posts that are missing, broken, excessively split or cracked or generally unsound. • No more than 10% of the posts in the system (terminal to terminal) missing, broken, excessively split or cracked or generally unsound. • All rails or channels that are dented, bent, twisted or rusted affecting the integrity and effectiveness of the system are repaired or replaced within 7 days for median installations and 21 days for shoulder installations. • Any broken post repaired within 30 days of Detection or being Made Aware
Temporary Concrete Barriers	• Any two adjacent sections of temporary/modular barriers are not misaligned by more than 7.5cm or longitudinally separated by greater than 2.5cm. • All temporary repairs are removed and are permanently repaired between April 1 and October 1 of each year • Any "break out" area is secured within 24 hours of occurrence.
Concrete Barriers	• Any "break out" area is secured within 24 hours of occurrence.
Energy Absorbing Systems	• All damaged Energy Absorbing Systems which compromise the integrity and effectiveness of the system are repaired or replaced within 7 days of Detection • All Energy Absorbing Systems which have shifted or moved out of original position are realigned within 7 days of Detection • All systems that contain moving parts are cleaned by June1st every year
Anti Glare Screens	• All damaged or missing anti-glare screens are repaired or replaced
Signs	
Signs (General)	• Missing, damaged, illegible, obscured, twisted or deflected Stop and Yield signs, Advanced Stop and Advanced Yield signs, and Checkerboard signs replaced/repaired Immediately upon Detection or being Made Aware.
Regulatory Signs	• All other missing, damaged, illegible, obscured, twisted or deflected regulatory signs not listed above, are Addressed within 3 days of Detection.

Feature	Outcome Target
Warning Signs	• Missing or illegible warning signs are Addressed within 7 days of Detection • Missing or damaged delineators are Addressed within 30 days of Detection
Information Signs	• Missing or illegible information signs are Addressed within 30 days of Detection
Sign Hardware	• All missing/broken/loose/cracked/bent fasteners and brackets are repaired or replaced within 7 days of Detection
Sign Posts	• All twisted, cracked, out of plumb, bent, unsound posts or posts not solid in the ground are repaired or replaced within 60 days of Detection
Sign Supports	• All debris against the structure is removed upon Detection • Annual inspection reports completed for all structures and submitted to the ministry by July 1st of every year.
Unauthorized Signs	• All unauthorized signs removed as Detected.
Curb and Gutter	
Obstructions	• All obstructions impeding proper drainage is removed.
Gaps/Separation	• Gaps between curb and gutter and pavement surface not to exceed 5 cm
Erosion	• Erosion damage to the shoulder and embankment behind the curb where water may flow over the curb is repaired as Detected
Drainage Systems	
Catch Basins and Maintenance Access Points	• All missing catch basins and maintenance access – frames or grates are replaced Immediately • All damaged catch basins and maintenance access – frames or grates are repaired or replaced within 7 days of Detection or being Made Aware • Sumps not filled to capacity • Roadside stormwater management ponds are inspected in the spring (by 01 May) and Fall (by 15 October) of each year
Erosion Damage	• All erosion damage is repaired and all obstructions to proper functioning of the drainage system are removed by October 1 of every year.
Beaver Dams	• All beaver dams within the Highway limit removed as Detected.
Sub Drains	• All obstructions impeding water flow are removed within 30 days. • All crushed or buried pipe ends are repaired or replaced within 30 days.

Feature	Outcome Target
	• All missing and damaged rodent/wildlife screens are repaired or replaced within 60 days.
Culverts	
Debris	• All debris causing blockage in culverts is removed Immediately. • All debris restricting water flow through culverts is removed when Detected
Washout/Erosion	• Washouts of culvert backfill and erosion damage under or around the culverts are repaired within 30 days.
Components	• All damaged or missing bars, screens or grids installed for the prevention of entry by animals or unauthorized personnel are repaired or replaced within 14 days
Ditches	
Erosion/Slope Protection	• Eroded or damaged ditch slopes, linings, back slopes and slope protection are repaired within 60 days.
Inlets/Outlets	• Erosion of ditch inlets/outlets is repaired within 60 days. • Obstructions that may reduce flow capacity are removed within 60 days.
Obstructions	• All non-planned obstructions that stop, reroute, or reduce the free flow of water; or may cause flooding are addressed Immediately
Vegetation Control	
Sight Distance	• Vegetation that impairs or obstructs sight visibility (hills, curves, intersections etc.) is removed. • Vegetation, trees or branches that impede traffic or obstruct regulatory signs are removed Immediately Note: Table PERF 4001-1 (below) provides sight distances
Grass Mowing	• Vegetation within 2m of any shoulder edge not longer than 60cm • Vegetation in Designated Areas as per section 4001.05 mowed to 15cm and be started no earlier than June 15 and completed prior to July 31 of each year
Weed Control	• Noxious weeds identified through a weed order eradicated as specified in the weed order.
Ground Cover	• Removed or destroyed ground cover causing a negative environmental impact or impacting the infrastructure restored within 30 days upon Detection or being Made Aware
Concrete/Asphalt Joints	• Vegetation between curb and asphalt joints in curb and gutter and between asphalt shoulders and a concrete barrier is eradicated during the months of July and August every year.
Fences and Other Barriers	

Feature	Outcome Target
Fences	• Damaged or missing security or farm fence allowing access to the highway is repaired (temporarily if necessary) Immediately.
Security Fence	• All damaged or missing security fence is permanently repaired or replaced within 7 days.
Farm Fence (Ministry owned)	• All ministry owned, damaged or missing farm fence is permanently repaired or replaced within 14 days
Farm Fence (Owned by others)	• The property owner is notified and arrangements made for permanent repairs.
General	
Graffiti	• All graffiti visible by the public is removed within 28 days of Detection by soda blasting • All offensive graffiti is removed within 3 days of Detection or being Made Aware.
Litter Control	• All visible litter in Designated Areas as per section 4001.05 removed once per year prior to the first long weekend in May. • All litter within the Roadside measuring more than 0.015m3 removed upon Detection or being Made Aware.
Adopt-a-Highway	• Meeting all adopt-a-highway requirements 100% of the time

Roadway Treatment Goals

Due to the dynamic and changing nature of winter weather and resultant road condition variations, WSDOT maintenance personnel will use a variety of treatments to prevent snow and ice formation on state highways. Outcomes of snow and ice control treatments will vary, dependent upon severity and type of winter weather, geography, traffic levels, traffic speeds, and support facilities (i.e. liquid chemical storage tanks and salt stockpiles). While results can be measured in a variety of ways, the motoring public most often measures maintenance efforts in terms of road conditions during and immediately after inclement weather. Maintenance personnel rate roadway conditions during the winter season (see performance measure chapter). This information can be used to project expected road conditions associated with different snow and ice treatment levels. The variable and unique nature of individual winter weather events limits the relevance of projected expectations on a per-storm basis. When ratings from an entire winter season's storm events are averaged, this becomes a good indicator of the Level of Service (LOS) provided by maintenance personnel for the winter season.

Inherent differences in winter climates between Eastern and Western Washington, means that road treatment levels may vary. As limited funding requires prioritization of different roads for snow and ice control services, different treatments will be employed for individual roads and sections of roads.

For the purpose of the road condition ratings, "Bare Pavement" is defined as a wet pavement surface free of most, but occasionally not all ice, slush, or snow. After snowplows clear snow from a travel lane, some of the surface area of a travel lane may have scattered remnants of ice, snow, or slush remaining. This will still be considered a "Bare Pavement" condition.

Eastern Washington Treatment Goals:

In Eastern Washington, the winter season is typified by periodic snowfall events, freezing temperatures for the duration of the winter season, and generally drier conditions. This drives the maintenance approaches of more extensive anti-icing (because there's less precipitation in the form of rain to wash it away), and more snow removal. The winter maintenance program (labor, equipment, and materials) is sized and developed to facilitate the movement and safety of traffic under normal expected winter conditions. The exceptional winter weather event in Eastern Washington is typically going to be a severe, wide spread ice storm or a snowstorm of very severe intensity, duration, and expanse. Since this happens infrequently, it would be an inefficient management of resources to size and base a winter maintenance program for this type of exceptional winter weather event.

The WSDOT program is based on history and the expected average conditions of winter for Eastern Washington. Therefore, when the rare, extremely severe winter weather occurs, the program is unable to respond to the accustomed level due to a "shortage" of resources. The short-term consequences of this scenario would be far outweighed by consequences of wasted resources if the program were sized and based on the worst case scenario.

Western Washington Treatment Goals:

In Western Washington, diverse microclimates are numerous. Typically the winter season lasts from mid to late November thru early March. The weather is generally wet with cool, moderate and occasional icy events. The winter maintenance program (labor, equipment, and materials) is sized and based to facilitate the movement and safety of traffic under normal expected winter conditions. This will typically be when temperatures drop and create black ice or frost conditions. A light to moderate snowfall event may also occasionally take place. These are typically characterized by localized events. The exceptional winter weather event in Western Washington is going to be a heavy snowstorm, short in duration over a wide geographic area. Since this happens very infrequently, it would be an inefficient management of resources to size and base a winter maintenance program for this type of exceptional winter weather event.

The WSDOT program is based on history and the expected average conditions of winter for Western Washington. Therefore, when the rare, heavy snow storm occurs, the program is unable to respond to the accustomed level of service due to a "shortage" of resources and gridlock caused by heavy traffic volumes in the urban areas. The short term consequences of this scenario would be far outweighed by consequences of wasted resources if the program were sized and based on the worst scenario.

Treatment Level Goals	**Washington State** **Description of Roadway Treatment Actions**
Level 1	**1. Pre-treat as conditions allow* with anti-icing chemicals prior to snow, black ice, frost or freezing rain / mist events.** **2. Apply deicing chemicals to roadway if snow is accumulating to try to keep snow from compacting and bonding to pavement.** **3. If compact snow and ice or heavy black ice forms on the roadway, apply pre-wet solid chemicals to the surface to ease the process of snow/ice removal.**
Level 2	**1. Pre-treat as conditions allow* with anti-icing chemicals prior to snow, black ice, frost or freezing rain / mist events.** **2. Apply deicing chemicals to roadway if snow is accumulating to try to minimize snow compacting and bonding to pavement.** **3. If compact snow and ice or heavy black ice forms on the roadway, apply a prewet combination of sand and / or deicing chemicals to provide traction and ease the process of snow/ice removal.**
Level 3	**1. Pre-treat as conditions* allow with anti-icing chemicals prior to snow, black ice, frost, or freezing rain / mist events.** **2. If snow accumulates, plow with or without the moderate use of prewet sand and / or solid deicing chemicals.** **3. Treat existing amounts of compact snow and ice with the moderate use of prewet sand and / or solid deicing chemicals.**
Level 4	**1. Limited pre-treatment of anti-icing chemicals for snow, black ice, frost or freezing rain as conditions allow.** **2. If snow accumulates, plow with the limited use of prewet sand and / or solid deicing chemicals.** **3. Treat existing amounts of compact snow and ice by plowing with the limited use of prewet sand and / or solid deicing chemicals.**
Level 5	**1. Treat like level 4 roads while open.** **2. Road will remain passable as conditions allow.** **3. Road closed when conditions dictate.**

1 = Prior to Weather Event 2 = During Weather Event 3 = After Weather Event

* Rainy or wet conditions do not lend themselves to pre-treatment maintenance.

WESTERN WASHINGTON TREATMENT LEVEL

Latest version: 09/10/2008
Supercedes Previous Editions

N

0 12.5 25 Miles

Washington State Department of Transportation

Treatment Level

- City Maintained
- Level 1
- Level 2
- Level 3
- Level 4
- Level 5

★ WSDOT Maintenance Facility

Regional Boundary

County Boundary

Western Washington
Snow and Ice Plan
Roadway Treatment Goals
2008

EASTERN WASHINGTON TREATMENT LEVEL

Latest version: 09/10/2008
Supercedes Previous Editions

N

0 12.5 25 Miles

Washington State Department of Transportation

Treatment Level

- Level 1
- Level 2
- Level 3
- Level 4
- Level 5

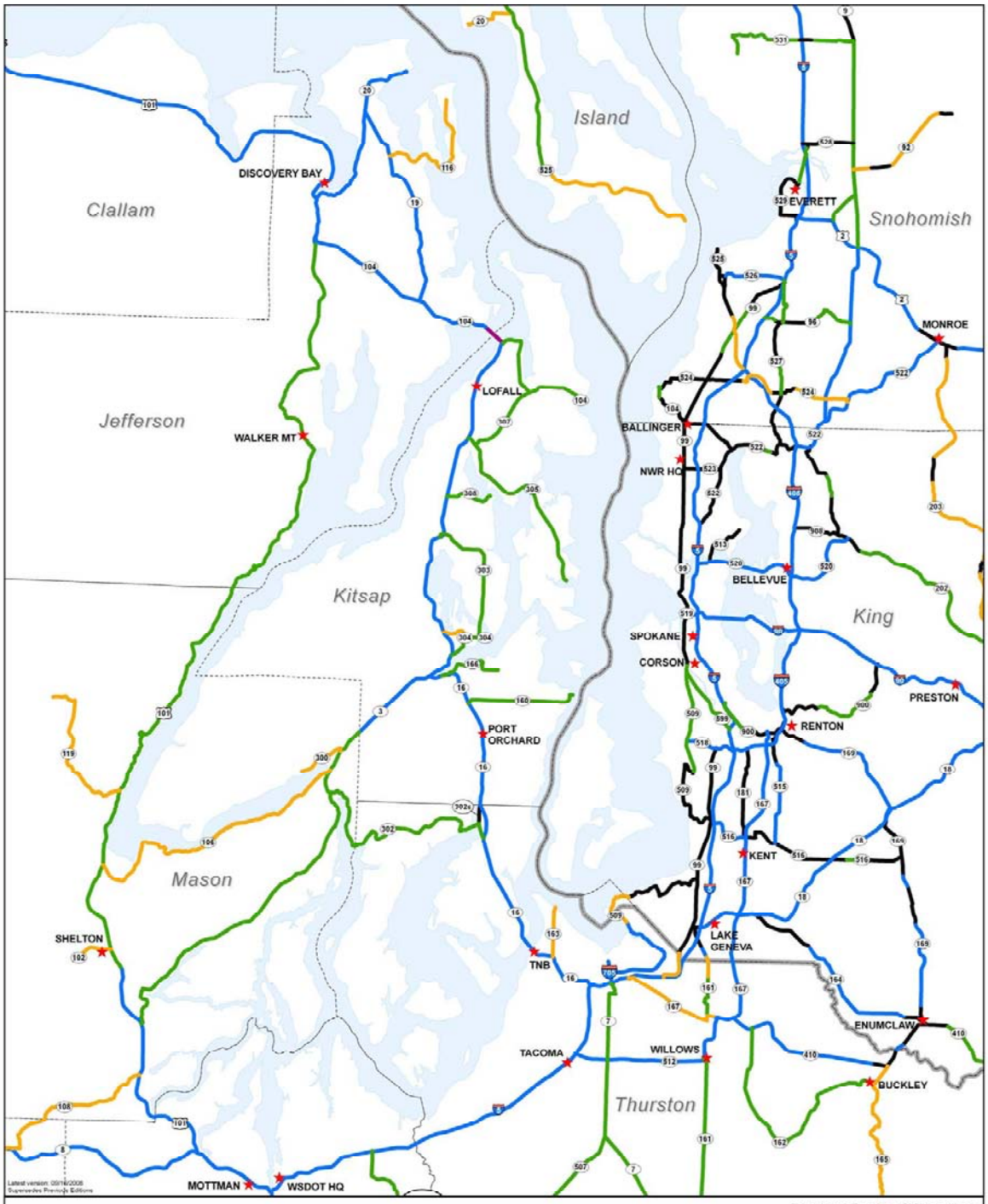
★ WSDOT Maintenance Facility

Regional Boundary

County Boundary

Eastern Washington
Snow and Ice Plan
Roadway Treatment Goals
2008

PUGET SOUND REGION TREATMENT LEVEL



Chapter 2

Winter MAP Snow and Ice Level of Service (LOS)

Data Collection Process

Statewide Weather Forecasting

Winter MAP Snow and Ice Level of Service (LOS)

What: The performance of the Maintenance Program as Snow & Ice control activities are conducted is measured in terms of the results of these activities. The most important, overall result for snow and ice control is the condition of the travel lanes provided by maintenance actions (i.e. anti-icing or deicing) during winter conditions (i.e. snow, ice, frost).
Performance measure information is used to determine the Level of Service (LOS) provided by the maintenance program through out a given winter season. LOS ratings can be determined on different scales that range from statewide to route specific.

When: Road conditions are assessed after roadway treatments are made during the winter season. There are no specified days or times during which road conditions should be documented. This documentation should be made after the roadway treatment is completed and the outcome (i.e. bare pavement) is known. Maintenance personnel should document road conditions as they drive over previously-treated roads in the course of their daily work as opposed to making a special trip to a roadway location solely to document road conditions.

Where: Roadway conditions outcomes which result from maintenance actions can be documented at any location where a treatment was performed.

How: Maintenance personnel conduct the condition assessments by observing the condition of a roadway (all lanes, both directions). Observations are documented on the winter maintenance Personalized Digital Assistant (PDA) application/database.

Ratings: Different road conditions are assigned different point values. The point values are used to calculate the LOS ratings. There are two classes of road conditions on the form that represent the two primary ways that WSDOT provides snow and ice control services. One is to enhance traction on top of snow/ice by spreading abrasives (i.e. sand) on the travel lane. The other is to attempt to provide a bare pavement surface by applying chemicals to the travel lane. Point values for different conditions are as follows with commensurate LOS ratings:

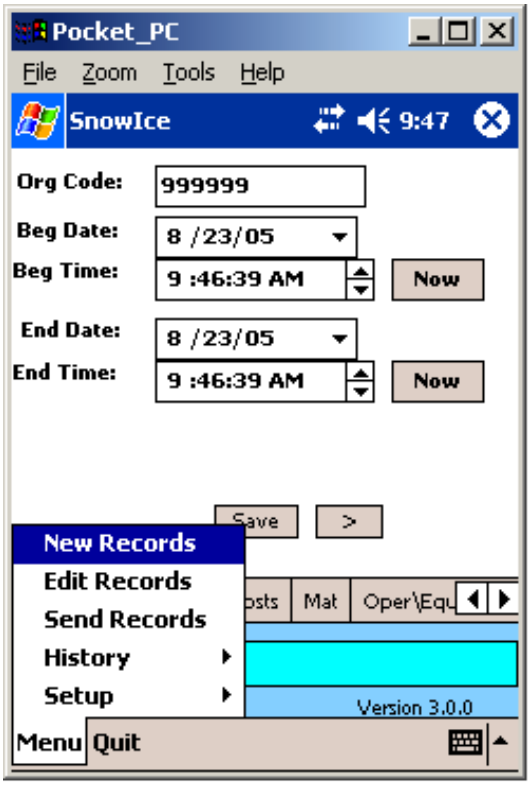
Road Condition Rating for Sand Treatment	Points	LOS Rating
100% of roadway has sand present	3	C+
50% or more of roadway has sand present	3.5	C
All emphasis areas have sand present	4	D+
50% or more of emphasis areas have sand present	5	F+
50% or less of emphasis areas have sand present	5.9	F
Unable to evaluate	-	-

Road Condition Rating for Chemical Treatment	Points	LOS Rating
Bare Pavement	1	A+
Patches of frost, black ice, slush, or compact.	1.5	A
Wheel tracks bare, frost, snow, or ice encountered.	2	B+
50% of roadway with compact snow and ice.	3	C+
Entire roadway covered with compact snow and ice.	4	D+
Unable to evaluate	-	-

Note: Emphasis Areas include hills, bridges, curves, intersections and known problem areas.

Expected Season LOS	Expected Road Condition after Treatment Completed
A to B	Snow or ice buildup encountered rarely. Bare pavement attained as soon as possible. Travel delays rarely experienced. 
B To C	Snow or ice build up encountered at times but infrequent. Travel at times may experience some isolated delays with roads having patches of black ice, slush, or packed snow. 
C to D	Snow or ice buildup encountered regularly. Travel likely to experience some delays with roads having black ice or packed snow with only the wheel track bare. 
D to F	Compact snow buildup encountered regularly. Traveler will experience delays and slow travel. 
N/A	Closed periodically or for the duration of the winter season.

Data Collection Process



In the fall of 2002, WSDOT embarked on a mission to manage the snow and ice portion of the maintenance program more effectively. Prior to this time, there was no standard for data collection or information storage about what we did, where we made applications, when we applied material, how much we applied, who applied the material and the result of our efforts. Information retrieval was a cumbersome process and could take weeks or months.

Our first attempt to standardize data collection for the snow and ice program came in the fall of 2002, when a small input computer program was written to run on a Personal Digital Assistant (PDA). The main criteria for this are the ease of use by the equipment operator and the common data elements collected. The implementation was limited in scope due to the small number of PDA's available but was positively received by those employees that had them.

The Department is solving the lack of PDA's by systematically buying and deploying units every year. Regions will continue to add PDA's as funding becomes available or until every employee has a PDA or equivalent device.

Feedback from employees since implementation has been instrumental in redeveloping the system. The current version now includes many information elements, on drop down menus that previously had been entered by the employee, such as a materials list, an equipment list and state route number list. Furthermore, the new application is customizable to the employee or the organization.

They can limit the number of items the drop down menus display to those elements that they use most frequently for quicker data entry.

The current version incorporates the M.A.P. (Maintenance Accountability Process) level of service rating and is based on the type of material applied, sand or chemicals. This will give the department more opportunities to evaluate the results of the work we do and will give us data we can use to improve our methods.

Another part of the data collection system resides on the WSDOT intranet. Here records can be reviewed, corrected and reported. The web site address is: http://dothqrd03:8080/. Click on Winter Activities to access the application.

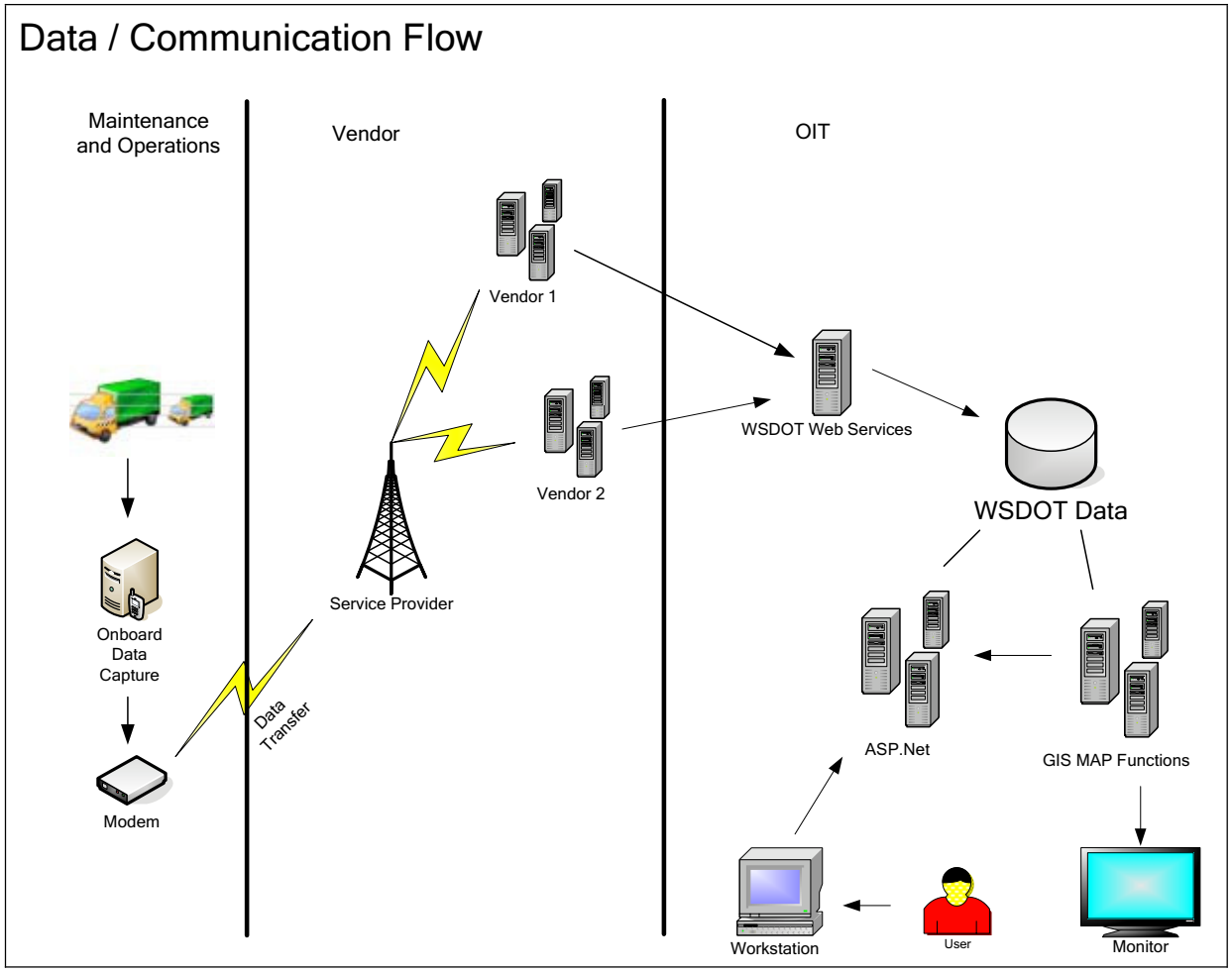
Winter Operations Automatic Data Collection:

Over the last several years WSDOT has tested many vendor developed automatic data collection systems for use in winter operations. This project took on significantly more focus in the winter of 2007 – 2008 when nearly 50 trucks statewide were equipped with precision material controllers and data collection devices. These data collection devices sent real-time operational information through multiple vendors to a WSDOT developed database using cell phone technology.

As currently configured, the operator enters a select few data items at the start of operations and the data device does the rest. Real-time operational data is viewable by managers, including equipment location, application data (product type, application rates,), route information (SR number, milepost, direction), and weather and road condition information. The winter operations application includes a GIS (Geographical Information System) interface for querying historical data using search and filter menus. Supervisors, managers and executive staff can use this information to assist with planning and implementing more efficient responses to snow and ice events.

This project will be expanded in the winter of 2008 – 2009 to include additional maintenance areas, trucks, and vendors. The ultimate vision for this project is to have all snow and ice response equipment set up with precision material controllers and data collection devices which will update a central internal database through cell phone, IP radio, or Wi-Fi technology. The eventual statewide implementation of this program will eliminate the need for manual data entry and allow operators to concentrate solely on critical functions in snow and ice control, and will provide accurate and reliable real-time and historical operational information.

Automatic Data Collection Business Flow:



The diagram depicts a state-wide data collection and mapping system on the web that staff inside the agency can look at. The trucks capture data from onboard sensors and components, send it through a service provider (cellular, radio, 802.11 etc.) to a specific vendor site. WSDOT can poll the vendor site periodically and pull the data into the WSDOT system. The system with GIS mapping technology displays truck icons that show current equipment location, travel direction, and the function the truck is performing (i.e., chemical treatments, plowing, etc.) along with the current road conditions (icy, compact snow and ice, bare and wet, clear).

Examples of business problems expected to be answered with the new system:

- How much deicer have we applied in the last 24 hours on this stretch of road?
- What resources are deployed for a given maintenance area?
- What logistics do we have positioned to resolve a winter event?
- What were the road conditions over a given time period?

A. General

The purpose of this guideline is to outline the level of effort that should be undertaken on the five different categories of roadway during a winter storm event. After the event has ended the effort will switch to cleanup with the intermediate goal of bare/wet pavement and finally the ultimate goal of bare/dry pavement. The time to achieve these goals will depend on the limitations imposed by climatological conditions, the availability of resources, and environmental concerns.

B. Level of Effort by Roadway Category

Category 1: Major urban freeways and most highways with six lanes and greater

(These highways are considered "high volume" and receive 24-hour coverage, during the winter storm event. See Section 30.20.)

Highways in this category often have traffic congestion and snow storage problems, making typical plowing and deicing agent applications very difficult or inappropriate. Therefore, when traffic volumes and snow storage are problems on these highways it may be appropriate to use extraordinary efforts, such as chemical removal, so that snow does not pack on the roadways during the winter storm event.

On these highways counties should maintain **all lanes and ramps equally,** during the winter storm event. Plowing is the first priority for snow removal, however extraordinary efforts (as described above) **may** be taken so that snow does not pack on the roadways during the winter storm event. The appropriateness of using extraordinary efforts shall be agreed upon with the District maintenance office. When extraordinary efforts are not deemed appropriate, de-icing application rates as described in Guideline 35.30 should be followed.

Category 2: High volume four-lane highways (AADT >= 25,000) and some four-lane highways (AADT < 25,000), and some 6-lane highways.

(These highways are considered "high volume" and receive 24-hour coverage, during the winter storm event. See Section 30.20)

Highways in this category typically do not have the traffic congestion and snow storage problems of those in category 1. However, they still have high traffic volumes that make it necessary to focus on more than just the driving lanes during the winter storm event.

On these highways counties should maintain the **driving lanes, ramps, and passing lanes equally** during the winter storm event. Plowing is the first priority for snow removal. De-icing applications should be conducted according to Guideline 35.30 of the Maintenance Manual. The counties should strive to keep the snow from packing on the **driving lanes, ramps, and passing lanes (if not needed for snow storage)** during the winter storm event. Only enough de-icing agents should be used to keep the total accumulation workable, thereby minimizing bonding during the winter storm event. It is considered inappropriate to attempt to melt the snow as fast as it hits the ground or keep the highway wet so as to eliminate any accumulation or packing. If packing should occur, counties should continue to plow and use sensible salting. When the winter storm event ends and conditions allow, counties will remove any packed snow and continue working towards the goals of bare/wet and ultimately bare/dry pavement.

Category 3: All other four-lane highways (AADT < 25,000)

(These highways may be considered either "high volume" or "all other" and should receive either 18-hour or 24-hour coverage, during the winter storm event. See Section 30.20.)

Highways in this category have lower traffic volumes and do not fit into either category 1 or 2. Also some of the highways in this category do not receive 24-hour coverage. The typical cycle times in this category are long enough that it can sometimes be impractical to keep the snow "workable" in both the driving and passing lanes without excessive de-icing agent usage.

On these highways counties should maintain the **driving lanes and ramps equally as a first priority** during the winter storm event. Plowing is the first priority for snow removal. De-icing applications should be conducted according to Guideline 35.30 of the Maintenance Manual. The counties should strive to keep the snow from packing on the **driving lanes and ramps** during the winter storm event. However, only enough de-icing agents should be used to keep the total accumulation workable, thereby minimizing bonding during the winter storm event. It is considered inappropriate to attempt to melt the snow as fast as it hits the ground or keep the highway wet so as to eliminate any accumulation or packing. If packing should occur, counties should continue to plow and use sensible salting on the **driving lane and ramps only** according to the appropriate coverage (either 18 or 24 hours). When the winter storm event ends and conditions allow, counties will remove any packed snow and continue working towards the goals of bare/wet and ultimately bare/dry pavement.

Plowing with minimal salting should be conducted on the **passing lanes** throughout the winter storm event but the majority of effort required to eliminate any packing conditions and eventually obtain bare/wet and ultimately bare/dry pavement conditions on the **passing lanes** should be done, as soon as practical, after the winter storm event.

Category 4: Most high volume two-lane highways (AADT >= 5,000) and some 2-lanes (AADT <5000)

(These highways may be considered either "high volume" or "all other" and should receive either 18-hour or 24-hour coverage, during the winter storm event. See Section 30.20.)

On these highways counties should maintain the **driving lanes**, during the winter storm event. Plowing is the first priority for snow removal. De-icing applications should be conducted according to Guideline 35.30 of the Maintenance Manual. The counties should strive to keep the snow from packing on the **driving lanes** during the winter storm event. Only enough de-icing agents should be used to keep the total accumulation workable, thereby minimizing bonding during the winter storm event. It is considered inappropriate to attempt to melt the snow as fast as it hits the ground or keeping the highway wet so as to eliminate any accumulation or packing. If packing should occur, counties should continue to plow and use sensible salting. When the winter storm event ends and conditions allow, counties will remove any packed snow and continue working towards the goals of bare/wet and ultimately bare/dry pavement.

Category 5: All other two-lane highways

(These highways are considered "all other" and receive 18-hour coverage, during the winter storm event. See Section 30.20)

On these highways counties should maintain the **driving lanes**, during the winter storm event. Plowing is the first priority for snow removal. De-icing applications should be conducted according to Guideline 35.30 of the Maintenance Manual. The counties should strive to keep the snow from packing on the **driving lanes** during the winter storm event. Only enough de-icing agents should be used to keep the total accumulation workable, thereby minimizing bonding during the winter storm event. It is considered inappropriate to attempt to melt the snow as fast as it hits the ground or keep the highway wet so as to eliminate any accumulation or packing If packing should occur, counties should continue to plow and use sensible salting. When the winter storm event ends and conditions allow, counties will remove any packed snow and continue working towards the goals of bare/wet and ultimately bare/dry pavement, during normal work hours (including Saturdays and Sundays).

During the time between the winter storm event ending and achieving the ultimate goal of bare pavement it is acceptable that only clear wheel tracks be provided when conditions warrant.

C. Exceptions

Exceptions to providing the desired level of effort on the five categories of roadway can occur when the department, because of budget restrictions or unavailability of de-icing chemicals, has requested that counties reduce the level of effort during the winter storm event. In such a case the department, after notifying and in cooperation with the counties, may reduce level of effort expectations on one, several, or all five categories described in item B above.

D. Best Practices for Acceptable Roadway Conditions After the Storm has Ended (While Crews are on Overtime).

If the following roadways conditions exist on the five categories of roadways after the storm has ended and while crews are on overtime hours, then it is desirable and acceptable to cease plowing and salting and to wait until the next day (on normal hours) to continue working towards the bare/wet and ultimately bare/dry pavement conditions.

The termination of plowing and salting at this time assumes that the weather forecast and other factors will allow this to happen.

Category 1: Major urban freeways and most highways with six lanes and greater

Category 2: High volume four-lane highways (ADT >= 25,000) and some four-lane highways (ADT < 25,000), and some 6-lane highways.

Category 3: All other four-lane highways (ADT < 25,000)

Category 4: Most high volume two-lane highways (ADT >= 5,000) and some 2-lanes (ADT <5000)

Category 5: All other two-lane highways

5. Personnel listings should include telephone numbers, planned on call schedule, equipment assignments and assigned maintenance sections for typical situations if applicable. Equipment and personnel may be revised as deemed necessary by the crew leader and the district maintenance engineer. These snow plan revisions will be provided to the state maintenance engineer as soon as practical.
6. A map showing each maintenance station's roadway maintenance sections by levels of snow removal service and the locations of the road closure gates.
7. General procedures for handling various emergencies. i.e. road closures, etc.
8. Modification of priorities such as different traffic needs on weekends, holidays, etc., due to intermittent recreational activities (ski areas), etc.
9. Information regarding coordination with adjoining districts and/or neighboring states.

The Department's objective is to maintain sufficient resources for normal snow plowing operations. However, for an abnormal storm it may be beneficial to supplement department resources with privately-owned and/or operated equipment. In anticipation of this, the district maintenance engineer should check available sources in his district as to the price and availability of such equipment. Use of these resources requires WYDOT approval through the use of a blanket purchase order or contract. In areas of known resource deficiencies, or where it is more economically feasible, it may be advantageous to advertise for a full-time snow removal contract. See Chapter Six (6).

14.04 LEVELS OF SERVICE: (Quality and Workmanship)

1. 1a. LEVEL I (A) ROADS

a. Strive to provide, up to 24 hours per day, a bare roadway surface which is free from drifts, snow ridges, and have as much ice and snow pack removed as practical so that it can be traveled safely at reasonable speeds. A bare road should not be confused with a "black road," which is essentially a road free of all ice and snow. This "black road" condition may not exist until several days after the storm has subsided.

b. Apply abrasives and chemicals on travel and passing lanes where required.

c. Close roads when warranted by visibility limitations or other extreme conditions. Open road as soon as possible as weather conditions improve. (Refer to the

reasons and/or conditions for closing roads and review the methods and procedures for closing roads - Chapter 9).

1b. LEVEL I(B) ROADS

a. Strive to provide service up to 20 hours a day with the minimum service necessary that allows traffic to move safely at a restricted rate. Plowing methods and frequency should be sufficient to minimize any snow ridges and dangerous drifting.

b. Apply abrasives and chemicals on travel and passing lanes where required.

c. Close roads when warranted by visibility limitations or other extreme weather conditions. Open road as soon as possible as weather conditions improve. (Refer to the reasons and/or conditions for closing roads and review the methods and procedures for closing roads - Chapter 9).

2. LEVEL II ROADS

a. Strive to provide service up to 16 hours per day for traffic observing reasonable winter driving precautions and speeds. Plowing methods and frequency should be sufficient to minimize minor snow ridges and dangerous drifting.

b. Apply abrasives and chemicals on hills, curves and hazardous locations, as necessary.

c. Close roads when warranted by visibility limitations or other extreme weather conditions. Open road as soon as possible as conditions allow and resources become available. (Refer to the reasons and/or conditions for closing roads and review the methods and procedures for closing roads - Chapter 9).

3a. LEVEL III (A) ROADS

a. Provide minimum service necessary for traffic observing reasonable winter driving precautions and speeds. Plowing methods and frequency should be sufficient to minimize larger snow ridges and dangerous drifting.

b. Apply abrasives and chemicals as necessary on hills, curves and hazardous locations.

c. If necessary allow roads to close as a result of the weather and reopen as soon as resources become available. (Refer to the reasons and/or conditions for closing roads and review the methods and procedures for closing roads - Chapter 9).

3b. LEVEL III (B) ROADS

a. Provide minimum service as resources become available.

b. Apply abrasives and chemicals as necessary on hills, curves and hazardous locations.

c. Road conditions shall govern, the public may travel at their own risk, as conditions allow.

4. LEVEL IV SEASONALLY CLOSED ROADS

Close roads in the fall as mandated by heavy snow and weather. Reopen as soon as practical in the spring.

5. CLEANUP

Cleanup operations at the end of a storm are to be performed only during normal scheduled working hours and after all other levels of snow removal service have been accomplished.

14.05 METHODS AND PROCEDURES

1a. LEVEL I (A) ROADS

a. Ambient temperature and the related snow type are usually the prime determining factors as to when snow plowing operations should begin. “Wet snow” associated with warmer temperatures requires more immediate plowing and sanding response to prevent an excessive snow and ice pack than cold “dry snowfall”, which may be allowed to build up minor accumulations before plowing work begins.

b. Once plowing begins, plows should endeavor to obtain a bare road (as defined previously) over the entire traveled way. As the storm subsides, extend plowing to climbing lanes and other important widening areas.

c. Application of abrasive and chemical material is also related to the type of snow. Predicted “wet snows” may require advanced treatment prior to a storm and then additional application during plowing. This enables the development of a brine on the pavement which will facilitate keeping the pavement “bare.” Immediate application of abrasive and chemical materials when plowing “dry snow” is usually not effective or warranted. Application rates are dependent on ambient temperature, weather and road conditions.

d. During periods of severely reduced visibility, plows may be taken off the road and the road closed. Reduced visibility warranting closing of a road is a judgement situation.

e. Crews should be organized by staggering or rotating shifts to allow plowing work to continue through all hours. Each district must establish actual hours of service to be provided. This decision will be influenced by traffic volumes, etc. Twenty-four hour service may be used where traffic volumes dictate and manpower is available. Overtime policy and differential pay guidelines must be observed. (See Operating Policy 35-4 and SEMM 2-3.)

f. At the end of the storm, provide **Cleanup**.

1b. LEVEL I (B) VOLUME ROADS

a. Ambient temperature and the related snow type are usually the prime determining factors as to when snow plowing operations should begin. "Wet snow" associated with warmer temperatures requires more immediate plowing and sanding response to prevent an excessive snow and ice pack than cold "dry snowfall", which may be allowed to build up minor accumulations before plowing work begins.

b. Once plowing begins, plows should endeavor to obtain a bare road (as defined previously) over the entire traveled way. As the storm subsides, extend plowing to climbing lanes and other important widening areas.

c. Application of abrasive and chemical materials is also related to the type of snow. Predicted "wet snows" may require advanced treatment prior to a storm and additional application during plowing. This enables the development of a brine on the pavement which will facilitate keeping the pavement "bare." Immediate application of abrasive and chemical materials when plowing "dry snow" is usually not effective or warranted. Application rates are dependent on ambient temperature, weather and road conditions.

d. During periods of severely reduced visibility, plows may be taken off the road and the road closed. Reduced visibility warranting closing of a road is a judgement situation.

e. Crews should be organized by staggering or rotating shifts to allow plowing work to continue through all hours. Each district must establish actual hours of service to be provided. This decision will be influenced by traffic volumes, etc. Twenty four hour service may be used where traffic volumes dictate and manpower is available. Overtime policy and differential pay guidelines must be observed. (See Operating Policy 35-4 and SEMM 2-3.)

f. At the end of the storm, provide **Cleanup.**

2. LEVEL II ROADS

a. As stated in Level I Road Service, initial plowing response is usually dependent upon the type of snow. "Wet snow" associated with warmer temperatures requires more immediate plowing and sanding response to prevent an excessive snow and ice pack than cold "dry snowfall", which may be allowed to build up minor accumulations before plowing work begins.

b. After plowing is started, the major effort should be maintained to keeping the road open with less emphasis on keeping it bare. This does not preclude the practice of removing loose snow before it becomes snow or ice packed, when practical.

c. Abrasive treatment and chemical additive rates should follow that outlined in Level I Road Service. However, this level of service does not provide adequate time and/or equipment for treatment of most straight sections of road, unless they are considered a hazardous area.

d. The work schedule should be such that plowing is generally done between 5:00 A.M. and 10:00 P.M.; however, each station should fit their schedule according to local conditions and traffic demands.

e. Close the road when warranted due to poor visibility or other pertinent conditions using the same guidelines as described under Level I Road Service.

f. At the end of the storm, provide **Cleanup.**

3a. LEVEL III (A) ROADS

a. Plowing is usually not commenced until men and equipment are released from Level I and Level II Roads. An exception to this is the plowing of a road for school buses or emergency vehicles.

b. Abrasive treatment and chemical additive rates should follow that outlined in Level I Road Service. However, this level of service does not provide adequate time and/or equipment for treatment of most straight sections of road, unless they are considered a hazardous area.

c. The work schedule should normally be such that plowing is done during daylight hours. Minimum service should consist of one plowing per 24 hour period.

d. At the end of the storm provide **Cleanup**.

3b. LEVEL III (B) Roads

a. Plowing is usually not commenced until men and equipment are released from Level I and Level II Roads. An exception to this is the plowing of a road for school buses or emergency traffic.

b. Abrasive treatment and chemical additive rates should follow that outlined in Level I Road Service. However, this level of service does not provide adequate

time and/or equipment for treatment of most straight sections of road, unless they are considered a hazardous area.

c. Service may consist of one plowing per 24 hour period. In severe storms, Level III B Roads may be left longer than 24 hours without plow service. This road is usually defined as self closing and the public is warned to travel at its own risk.

d. At the end of the storm, provide **Cleanup.**

4. LEVEL IV ROADS

a. Close roads as conditions dictate at the beginning of the winter season.

b. The roads should then be opened as soon as practical in the coming spring.

5. CLEANUP

a. **Cleanup** operations are not to be performed until all roads in the area have been provided with their designated level of service.

b. Perform cleanup operations as per levels of snow removal service.

c. **Work is normally to be done during normal scheduled working hours.**

d. Work generally consists of removal of snow ridges at the shoulders, and widening areas for future snow storage. Mailbox turnouts should be cleared as soon as practical. Cleaning of minor interchanges and smoothing out snow ridges at approaches is done under this item. The Department of Transportation assumes no obligation for the clearing of approaches.

e. Snow in Urban areas can be plowed into windrows, then loaded and hauled away. Care should be taken to maintain safe sight distances at crossing openings when placing a windrow.

NOTE: *Although it is not the department's intent to clean approaches, any snow ridges created by WYDOT plowing operations should be moved to allow users of approaches access to a highway.*

14.06 ROTARY SNOW PLOW OPERATION

Rotary snow plows are considered emergency equipment and are not intended for off-roadway use. This equipment is to be used only on paved roads or on prepared surfaces around underpasses and interchanges. The only exception will be a loader-mounted rotary. Misuse of rotaries during routine widening operations often causes expensive repairs and results in breakdowns at a time when equipment is needed during emergency situations.