

State of Minnesota  
Department of Transportation

**Statewide  
Maintenance Operations Research  
Biannual Report  
1999 – 2001**

December 2001

## Acknowledgments

When I first started putting the Biannual Report together, I realized the enormous amount of personnel involved and the importance of having a great Maintenance Operations Research (MOR) staff. Thank you to all those who have helped in making this Biannual Report possible from writing it to mailing it.

Many thanks also go out to the field maintenance personnel for their involvement in each project. Without their excitement and willingness to actively work on the projects, the program wouldn't be where it is today. I would also like to thank the Area Maintenance Engineers for their support. The program would not succeed without a champion and project originator from the field.

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### Maintenance Operations Research Unit

(from left to right) John Tarnowski, Sue Lodahl, Donna Coleman, Ken Nelson, and Ia Xiong

### Disclaimer

Trade names are used on occasion in the report to better identify the type or use of a product or material involved in field research. However, use of these names in no way implies Mn/DOT's endorsement of the product or material discussed unless there is a specific Mn/DOT recommendation to that effect. No attempt was made to identify which products or materials had registered trademarks associated with them.

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**Maintenance Operations**

**Research Program**

# **Maintenance Operations Research Program**

## **Report Purpose**

The purpose of this report is to document the maintenance operations research project activity from 1999 to 2001. Due to the large number of projects, this report will not cover each project in detail. This report is not meant to be read from front to back like a book. It is intended to be a useful resource and guide for all levels of maintenance personnel, researchers, and others interested in maintenance research to look up projects in the interested field.

## **Program History**

In 1990, Mn/DOT Area Maintenance Engineers (AME), realizing the increasing need for optimal expenditure of resources, committed \$750,000 annually from the statewide maintenance operations budget to maintenance operations research. This was seen necessary since despite the shrinking workforce and budget, the traveling public continued to expect the same or even better level of service. A full-time Maintenance Operations Research Engineer position was created to direct the program. This position was first filled in May, 1992. The Maintenance Operations Research Engineer (MORE) works closely with the AME Group's New Technology Research and Equipment Committee (NTREC) and coordinates program activities with Mn/DOT's Office of Research Services (ORS), Office of Materials Research & Engineering (MR&E), and other Mn/DOT offices. Having such an operating unit within Mn/DOT that funds and administers its own research initiative is considered unique nationally and internationally.

## **Program Goals**

The goal of the Maintenance Operations Research Program is to maintain an active and visible research effort that involves all Mn/DOT maintenance areas. The program addresses all elements of maintenance operations including snow and ice control technology, roads and bridge maintenance, roadside maintenance, maintenance management, general maintenance, work zone safety, as well as technology transfer. It seeks to develop the most effective maintenance procedures, materials and equipment and to build on research conducted or supported by other agencies, other states, Federal Highway Administration (FHWA), academia, other countries, and private industry.

## **Program Focus**

The Maintenance Operations Research Program focuses on "on the road" or applied research. It takes developed methods, materials, products or proto types out on the road and field tests them in a structured manner under actual environment, weather, traffic volumes, and other conditions. It places continued emphasis on innovation and encourages the spontaneous submission of proposals from Mn/DOT personnel with relation to maintenance operations. Principal investigators include state maintenance personnel at the truck stations, and university faculty working alone or together with Mn/DOT's maintenance and/or materials research laboratory personnel.

The object is for the state or individual maintenance areas to implement successful processes and methods, as well as to acquire and use any equipment or material developed through this research. The program's research efforts is to move from reactive to preventive maintenance.

### **Project Approval and Funding**

The annual budget committed to maintenance operations research through Mn/DOT is \$750,000. In addition to this, the program administers projects with funding, for example, from the Federal Highway Administration or the Minnesota Local Road Research Board. The program involves large research projects which may have funding approved for over two or more fiscal years, as well as spontaneous "skunk work" type projects costing less than \$12,000. Research proposals with funding request of more than \$12,000 are first considered for approval by NTREC. MORE has individual authority to authorize projects costing up to \$12,000. NTREC typically meets twice a year to consider project proposals submitted to MORE.

### **Research Criteria**

A set of criteria was developed with assistance from NTREC. It is used to ensure that the proposals submitted meet the goals and the purpose of the program. The criteria subjects are as follows:

1. Statewide Implementation/Technology Transfer
2. Safety (Public and Employee)
3. Potential Return
4. Innovation
5. Matching Resources
6. Priority to Mn/DOT Maintenance
7. New to Mn/DOT Maintenance
8. Mn/DOT proposal

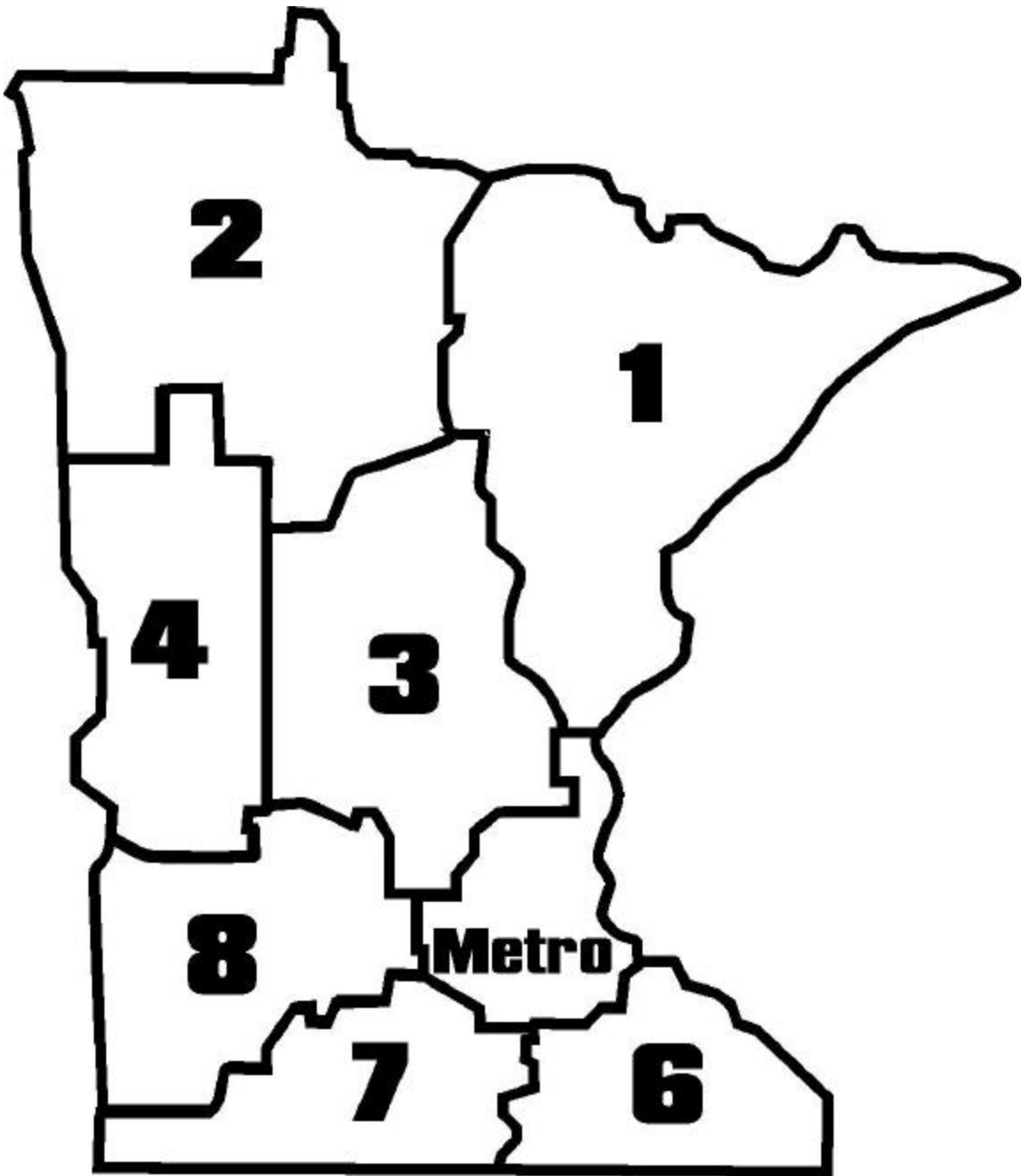
These criteria are further detailed in the NTREC Manual of Procedures and may change to meet the needs of the program.



## **Summary of 1999 – 2001 Maintenance Research Projects**

This report consists of completed and on-going projects from 1999 to 2001. Projects are in the areas of Winter Maintenance, Winter Material, Road and Bridge Maintenance, Traffic/Work Zone Safety, Roadside Maintenance, Equipment/Tools, Building, and Technology Transfer/Education. Individual projects are summarized in the following section. Similar projects are summarized as one project although it may have been conducted in more than one district.

This report gives a general overview, with the project sponsor and technical liaison being listed for further information. The project sponsor is the person directly involved in the day to day operations of the project. The technical liaison is the contact person from the MOR office and would be able to answer questions on a statewide basis in regards to the project.



Minnesota Department of Transportation – Districts

## **Winter Maintenance**

## Cryogenically Treated Cutting Edges

**Sponsor:** Dave Redig

**District/Office:** D-6A Rochester

**Contact for further information:**  
Dave Redig (507) 285-7361

**Technical Liaison:**  
Ken Nelson (651) 282-5435



### **Introduction/Background:**

The standard plow cutting edges that Mn/DOT uses have to be changed periodically when they wear out. This is a time consuming event that can take the plow off the road during a critical point in a snow removal operation. When an employee changes these cutting edges, this is a time when they will be most vulnerable to a back injury. Brake rotors and drill bits have been cryogenically treated and seem to be working good. Therefore, snow plow cutting edges were considered for treatment also.

### **Purpose:**

The purpose of cryogenically treating cutting edges was to test the durability of the treated cutting edges versus non treated cutting edges.

### **Test Procedure:**

Rochester District used five sets of cryogenically treated cutting edges during the winter of 2000 - 2001. Evaluation focused on the differences between the standard and treated cutting edges with emphasis on durability of the treated sets.

### **Results:**

The treated cutting edges were expected to last three times longer than our standard cutting edges, which is approximately a full winter season. It only lasted half a winter season. The carbide inserts fell out of the treated cutting edges and there were only about 50% of the wear time compared to the standard cutting edges that are currently in use.

### **Recommendations:**

The recommendation is to discontinue the use of the treated blades and use standard carbide cutting edges.

### **Status:**

Completed in April, 2001.

# Non-rotating Carbide Bit System for Underbody Blades

**Sponsor:** Tom Johnson

**District/Office:** D-6B Albert Lea and  
Metro Division

**Contact for further information:**  
Tom Johnson (507) 379-3414

**Technical Liaison:**  
John Tarnowski (651) 297-1843



## Introduction/Background:

Mn/DOT has an on-going effort to improve driving safety during icy and snow compacted road conditions. The PACAL 2500 Underbody Blades are designed to cut grooves in snow compaction and ice to assist in the fracture and removal during plowing. Deicers are maintained in the grooves and are in place longer even after subsequent plowing operations have been performed.

## Purpose:

The non-rotating carbide bit system will be tested for decreased fracture speed of ice and compaction in comparison to the present cutting edges. Also, longevity of the blades will be compared and tracked.

## Test Procedure:

The carbide blades were compared for longevity and cost effectiveness against standard cutting edges. One blade and bits were purchased for each of the districts listed above. Each district used them under the conditions that they were designed for. Although the amount of miles and varying conditions were difficult to monitor, a relative life expectancy and cost effectiveness was measured.

## Results:

De-icing salt stayed on the road better because of falling into grooves cut by the PACAL Blades. The 2500 Carbide Bits did cut grooves into the surface allowing better breakup of compacted snow. Cost became a major concern when compared to standard edges. The bit system appeared to last as long as the standard edges. However, the additional cost was difficult to justify.

## Recommendations:

The PACAL Carbide Bit system should only be used on heavy compaction and ice for longevity. Plows with this system should make the first pass on compacted snow or ice and then a vehicle with a standard cutting edge should follow.

## Completed or On-going

Completed in June, 2000.

## Hydraulic Driven Snow Blower

**Sponsor:** Dan Peterson

**District/Office:** D-4 Detroit Lakes

**Contact for further information:**

Dan Peterson (218) 847-1557

**Technical Liaison:**

Ken Nelson (651) 282-5435



**Introduction/Background:**

In an effort to improve snow and ice operations and to utilize the single axle plow trucks for snow blowing, a hydraulic driven blower may prove to be a valuable asset to the snow removal fleet. The snow blower can be mounted on the front of a single axle plow truck utilizing the plow hookup. This snow blower will be used in emergency situations to get to a snow-closed road faster than a traditional loader mounted blower.

**Purpose:**

The purpose of this test is to evaluate how a truck mounted snow blower will perform as a quick responder for removing snow from roads closed due to a snow event. The snow blower will perform tasks such as cleaning snow around guardrails, crossovers, and in rest areas.

**Test Procedure:**

Different operators will use and evaluate this blower during snow and ice operations. Comments and conditions will be monitored and recorded.

**Results:**

The unit has been used in the 2000-2001 winter and fits the expectations for what is needed in blowing out the guard rails and plate-beams. The unit was used for heavier blowing. Although it does not perform like a sno-go, it can blow from the top of the road similar to an agriculture tractor. One of the limitations is that the snow blower will get stuck where an agriculture tractor can get off the road and continue to blow. An agriculture tractor can only dead head down the road 18 mph where this unit can run road speed between banks and is more operator friendly because the blower is in front of the operator.

**Recommendations:**

Some changes can be made to this unit to further improve performance such as flared wings on the leading edge of the sidewalls to protect the bearings and augers. This will also aid in strengthening the blower. The snow blower can not be used in an 18" snowfall, but can be used for a 6" snowfall.

**Status:**

On-going until 2002-2003 winter season.

# Infrared Ice Detector Maintenance Upgrade

**Sponsor:** Roberta Dwyer

**District/Office:** D-1A Duluth

**Contact for further information:**  
Jerry Salquist (218) 723-4960

**Technical Liaison:**  
Ken Nelson (651) 282-5435



## **Introduction/Background:**

The Infrared Ice Detector from Innovative Dynamics, Inc was installed on the west tunnel on I-35 in downtown Duluth as part of the Duluth Transportation Operations Communications Center (TOCC). It remotely senses ice presence across the full width of the roadway and then alarms the Minnesota State Patrol dispatcher.

## **Purpose:**

The purpose is to determine viability and accuracy of non-intrusive ice detection. This infrared sensor provides detection across the entire width of four lanes and shoulders.

## **Test Procedure:**

The pavement temperatures from infrared, non-intrusive detector will be compared to known, calibrated sensors (Road Weather and Truck Mounted) for accuracy. There will be continued testing of ice crystals.

## **Results:**

This device very accurately detects minute ice crystals and reports pavement temperature. It is still a high maintenance item. However, promise is shown for ice detection over a broad area. Technology is still in the development stage but the recent upgrades to software may prove to be very useful.

## **Recommendations:**

There are no recommendations at this time.

## **Status:**

Installation is complete, but the project will be on-going for 9 years. A full report will be published at a later date.

# Swenson Precision Placement System

**Sponsor:** Randy Reznicek

**District/Office:** D-3A St. Cloud

**Contact for further information:**  
Randy Reznicek (320) 255-4177

**Technical Liaison:**  
Ken Nelson (651) 282-5435



## **Introduction/Background:**

The importance of keeping de-icing materials on the road is well known. The concept of “zero velocity” sanding is to propel the sanding materials rearward at the same speed that the snow-plow is moving forward reducing scatter and keeping the sanding material on the road.

## **Purpose:**

The purpose of this project is to work with the Precision Placement Sander (PPS) system and research it's effectiveness.

## **Test Procedure:**

The unit will be installed on a tandem truck and used throughout the 2002-2003 winter season. The operators will monitor and record it's use. Comments and information will be collected and evaluated at the end of the season. The PPS system will be compared to currently used spreaders.

## **Results:**

There are no results at this time.

## **Recommendations:**

There are no recommendations at this time.

## **Status:**

On-going until Spring of 2003.



## Expansion and Implementation of Anti-Icing Methods

**Sponsor:** Tim Sheehy

**District/Office:** D-1B Virginia

**Contact for further information:**  
Tim Sheehy (218) 749-7793

**Technical Liaison:**  
Ken Nelson (651) 282-5435



### **Introduction/Background:**

District 1B has been researching the use of liquid chemicals for anti-icing for three years. The results have been very promising. This process of applying liquid chemicals will be tested in other remote truck stations.

### **Purpose:**

The research will address the issue of installing the equipment on one-ton trucks which normally would not be outfitted with anti-icing tanks, pumps, spray bars and controls. Anti-icing will be deployed in critical areas to assist in developing a broad base of experience using various chemicals, methods, rates, and timing.

### **Test Procedure:**

The evaluation will focus on comparisons between de-icing and anti-icing areas using operator observations, bare pavement indicator, chemical usage data, cost information, and law enforcement. Magnesium chloride with anti-corrosion additives will be used to treat these critical areas.

### **Results:**

Equipment has been purchased and will be used starting in the 2001-2002 winter season.

### **Recommendations:**

There are no recommendations at this time.

### **Status:**

On-going until Spring of 2002.

## Adaptable “Slide-in” Anti-ice/Herbicide/Spray Unit

**Sponsor:** Curt Larson

**District/Office:** D-2 Crookston

**Contact for further information:**  
Curt Larson (218) 463-2821

**Technical Liaison:**  
John Tarnowski (651) 297-1843



### **Introduction/Background:**

The issue of maintenance equipment being used for one specific job or season has arisen many times. Equipment can be better utilized and adapted to other jobs so that it would produce a higher level of cost effectiveness. This unit would allow a slide-in spray tank to be used year round by adding different types of attachments and controls.

### **Purpose:**

The purpose of this truck is to demonstrate the cost effectiveness of a multipurpose spray unit of this type. This equipment will also be used for testing and evaluating anti-icing in high wind and low average daily traffic areas.

### **Test Procedure:**

This unit will be installed in a tandem axle truck and can be easily removed. It will be used as an anti-icing unit in the winter and a herbicide sprayer/bridge and sign washer in the summer. Anti-icing will be compared against areas that were not anti-iced for recovery and bare-pavement times. Operator comments on the ease of operation and dependability of the equipment will be recorded and compared. The adaptability from winter to summer use will also be monitored and recorded.

### **Results:**

There are no results at this time.

### **Recommendations:**

There are no recommendations at this time.

### **Status:**

On-going until Fall of 2002.

## Micro-Track Systems Anti-icing

**Sponsor:** Dennis Redig and Craig Bakken

**District/Office:** D-4 Detroit Lakes

**Contact for further information:**  
Dennis Redig (218) 847-3795

**Technical Liaison:**  
John Tarnowski (651) 297-1843



### **Introduction/Background:**

Anti-icing has been used with success in many parts of the country. Safer driving conditions and a reduction in material for winter maintenance can be achieved with its use. The application of a liquid freeze point depressant to perform anti-icing measures requires different types of equipment than what is in use for de-icing. The Micro-Track System is a complete liquid anti-icing unit including a radar style-ground oriented controller. This system has the capability to deposit liquids at a controlled and monitored rate for the best results with this process.

### **Purpose:**

The purpose of this project is to determine the benefits of anti-icing technology in wind driven areas and to test the capabilities and reliability of the Micro-Track equipment. The results of this project will help shape anti-ice guidelines for Mn/DOT and contribute to other efforts for snow and ice control.

### **Test Procedure:**

Anti-ice chemicals will be applied and results will be compared to non-anti-iced road surfaces. Varying conditions and chemicals will be closely monitored and results will be determined using bare pavement measurements. The equipment will be evaluated for ease of use, reliability, and cost effectiveness.

### **Results:**

There are no results at this time.

### **Recommendations:**

There are no recommendations at this time.

### **Status:**

On-going until Spring of 2003.

## Anti-icing Equipment

**Sponsor:** Mark Fischbach

**District/Office:** Metro Division

**Contact for further information:**

Mark Fischbach (651) 582-1429

**Technical Liaison:**

Ken Nelson (651) 252-5435



**Introduction/Background:**

The Metro Division has been exploring in anti-icing methods and its results. The Division realized some of the benefits associated to anti-icing such as safer driving conditions throughout the storm and less overall material usage, but there was a need to explore more in detail of its advantages and disadvantages.

**Purpose:**

The purpose of this project is to provide a high quality 2500 gallon anti-icing and de-icing system that was purchased from Spokane Industries to allow operators the opportunity to work with this additional method for snow and ice control. The results will help in putting together Mn/DOT's anti-icing guidelines.

**Test Procedure :**

The test area will be used primarily on high occupancy lanes where bare pavement indicators can be monitored and compared. Operator's comments and visual reports will be recorded and chemical usage on these routes can also be compared to non anti-iced routes.

**Results:**

There are no results at this time.

**Recommendations:**

There are no recommendations at this time.

**Status:**

On-going until Spring of 2002.

## Critical Area Spot Spreaders

**Sponsor:** Norm Ashfeld

**District/Office:** Metro Division

**Contact for further information:**  
Norm Ashfeld (651) 582-1437

**Technical Liaison:**  
Ken Nelson (651) 282-5435



### **Introduction/Background:**

Intersections, bridges, ramps and hills are most of the dangerous areas encountered and require a different method of treatment during the snow and ice season. The Metro Division has many of these problem areas which takes more time to regain bare pavement.

### **Purpose:**

The purpose of using these spreaders is to improve service levels and reduce regain times in critical areas by providing anti-icing and de-icing techniques using liquid chemicals.

### **Test Procedure:**

Magnesium chloride anti corrosion additives was used and applied just before an event. It was also applied on a regular schedule on Mondays, Wednesdays, and Fridays. The Metro Division monitored conditions through the radio dispatch office. Accidents and surface conditions were compared against past seasons. The coordinators documented any additional information deemed necessary.

### **Results:**

Salt usage was reduced because of anti-icing effort. Prior to an event the magnesium chloride did prevent ice and frost build-up on the critical areas that were treated.

### **Recommendations:**

The equipment works well on low volume roads but needs to be modified to allow for high-speed operation.

### **Status:**

Completed in May, 2001.

# New Component Test Bed Truck

**Sponsor:** Curt Pape, John Tarnowski, and Ken Nelson

**District/Office:** Office of Maintenance

**Contact for further information:**  
John Tarnowski (651) 297-1843

**Technical Liaison:**  
John Tarnowski (651) 297-1843



## **Introduction/Background:**

The evaluation of new equipment and components in the field can be both problematic and costly. To reduce the hardships and inconvenience of research on district fleet vehicles, a specially assigned test truck is needed which will reduce down time for installing, repairing, and testing new components.

## **Purpose:**

The purpose of this project is to test the feasibility of a specialized vehicle used for both actual maintenance purposes and testing of new, innovative technology. This will eliminate the overall disruption that is caused when district plow trucks are used for this purpose.

## **Test Procedure:**

The vehicle will be assigned to different areas throughout the winter. Operators in each area will have approximately three weeks to drive and test the equipment during actual maintenance activities. An evaluation and survey will be filled out and the information will be collected and analyzed. Some of the equipment to be evaluated includes: slotted trip plow, trip edge wing, and hydraulic pre-wet pump.

## **Results:**

This project is in progress and during the 2000-2001 winter season toured the northern half of Minnesota. An interim report has been distributed throughout Mn/DOT. The southern half of Minnesota will be able to use and test the truck during the 2001-2002 winter season.

## **Recommendations:**

There are some adjustments, repairs, and changes that have been made due to experiences from the first round of survey.

## **Status:**

On-going until Spring of 2002.

## **Winter Material**

## Ice Ban M-50

**Sponsor:** Norm Ashfeld

**District/Office:** Metro Division

**Contact for further information:**  
Norm Ashfeld (651) 582-1437

**Technical Liaison:**  
Ken Nelson (651) 282-5435



### **Introduction/Background:**

Metro Division is looking for best practices in using winter maintenance materials. Pre-wetting material normally requires additional equipment and mechanical support that is difficult to manage by the current work force. Discussion sessions were held and it was decided that stock-pile pre-treatment needed to be tested.

### **Purpose:**

The purpose is to mix Ice Ban M-50 with both salt and sand piles.

### **Test Procedure:**

Material usage will be monitored by employees at each truck station. The costs associated with this project will be monitored at the Metro Division's main office, Water's Edge. Different concentration levels will be monitored and results recorded. Costs will be compared to using salt brine for pre-wetting. The effectiveness will be measured by operator's comments and observations. Regular meetings are held by supervisors, superintendents, and field workers to discuss and evaluate the materials and its effects.

### **Results:**

So far there are positive performance in the product when it is used in temperatures below the normal working temperature of salt products.

### **Recommendations:**

A more in depth look at how the product performs over several more winters is needed in order to make sure that all aspects of the winter season are covered.

### **Status:**

On-going until Spring of 2002.



## Medium Grade Salt (Nu-Salt)

**Sponsor:** Tim Sheehy

**District/Office:** D-1B Virginia

**Contact for further information:**  
Tim Sheehy (218) 749-7793

**Technical Liaison:**  
John Tarnowski (651) 297-1843

**Nu Salt**



**Rock Salt**



### **Introduction/Background:**

Historically sources of salt have been limited to coarse grade material in Minnesota. Distributors of medium grade material are now readily available. This competition may help decrease the price, provide better performance and improve cost effectiveness when compared to rock salt. Other names that have been used interchangeably are NuSalt and Mineral Melt.

### **Purpose:**

The purpose is to test the cost effectiveness and performance of medium grade salt for de-icing purposes.

### **Test Procedure:**

Two routes were compared using salt solutions guidelines. One route used medium grade salt and the other used regular salt. Operator's observations and feedback were also documented. Mn/DOT's Operations Management System was used to track costs and bare pavement indicators tracked recovery time.

### **Results:**

The performance of the Medium Grade Salt combined with on-board pre-wetting lowered total recovery time to regain bare pavement in comparison to the route with regular on-board pre-wetted rock salt. Operators reported positive results, quicker melting time, and easier brine production. With on-board pre-wetting, the finer grade salt stayed on target with less bounce off the roadway.

### **Recommendations:**

The recommendation from the district is to have Medium Grade Salt included as a choice for state-wide bid.

### **Status:**

Completed in February, 2001.

## Anti-icing Liquid (Caliber)

**Sponsor:** Norm Ashfeld

**District/Office:** Metro Division

**Contact for further information:**  
Norm Ashfeld (651) 582-1437

**Technical Liaison:**  
Ken Nelson (651) 282-5435



### **Introduction/Background:**

Material usage in the Metro Division is increasing each year as traffic levels and customer's expectations require a higher level of service. With increased material costs and equipment costs, there needs to be other methods of reducing the cost to the tax payers. It has been decided that alternatives be tested to reduce the amount of chemicals going into the environment. This should also reduce the amount of money spent each year for snow removal. The chemical that Metro chose to test was Caliber M1000, a magnesium chloride based product.

### **Purpose:**

The purpose of this test is to evaluate the benefits of using an alternative deicing chemical during the winter.

### **Test Procedure:**

The test area that will be used is located in the Camden subarea and will be used primarily on the high occupancy lanes where bare pavement indicators can be monitored and compared. Operator's comments and visual reports will be recorded and chemical usage on these routes can also be evaluated and compared to non anti-iced routes.

### **Results:**

There are no results at this time.

### **Recommendations:**

There are no recommendations at this time.

### **Status:**

On-going until Spring of 2002.

## **Road and Bridge Maintenance**

## Air Prep System

**Sponsor:** Dale Dombroske

**District/Office:** Metro Division

**Contact for further information:**  
Dale Dombroske (763) 785-5664

**Technical Liaison:**  
Ken Nelson (651) 282-5435



### **Introduction/Background:**

When preparing plows, under carriages, sanders, and other equipment for painting, sandblasting is the preferred method of cleaning the surface. Drier air can reduce contaminates, wear, downtime and maintenance of the sand blasting equipment. Using the Air Prep system will create a healthier work environment along with saving time and money.

### **Purpose:**

The purpose is to compare this sand blaster system to the method currently in use. The evaluation will focus on cost savings and safety.

### **Test Procedure:**

The Air Prep System will be evaluated on how much drier, cooler and cleaner the air is. Downtime and maintenance will be tracked and recorded as well as operator's comments.

### **Results:**

This equipment was used on a limited basis and preliminary evaluations of the Air Prep System has been favorable. There will be one more season of evaluation.

### **Recommendations:**

There are no recommendations at this time.

### **Status:**

On-going until Fall of 2002.

## Laser Based Clearance Measuring System

**Sponsor:** Roger Schultz

**District/Office:** Metro Division

**Contact for further information:**  
Roger Schultz (651) 582-1414

**Technical Liaison:**  
John Tarnowski (651) 297-1843



### **Introduction/Background:**

The FHWA requires that overhead clearances be measured and recorded along each lane periodically. Past practice has been to set up a lane closure for taking these measurements. It is time consuming and costly when the Metro Division has approximately 800 bridges that have to be measured.

### **Purpose:**

This unit will replace the current method of measuring heights to meet FHWA requirements. "Stick Methods" require a lot of time and additional personnel for traffic control. Expedition and safety will be improved if successful. The unit uses a laser beam to measure the distance. It is mounted on the vehicle and can be operated at five miles per hour and still measure bridge heights accurately. A moving traffic control set up is all that is required.

### **Test Procedure:**

A section of highway will be tested using both the current method of measuring and the laser based system. Times needed for completion of job will be recorded and analyzed. Safety of personnel and dollars saved will be documented.

### **Results:**

There are no results at this time.

### **Recommendations:**

There are no recommendations at this time.

### **Status:**

On-going until Fall of 2002.

## For the Birds

**Sponsor:** Larry Cooper



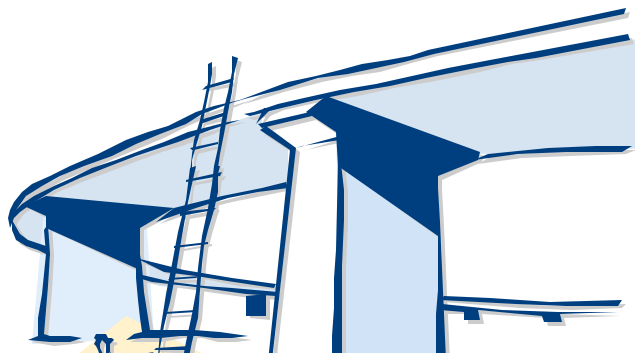
**District/Office:** D-7E Mankato

**Contact for further information:**

Larry Cooper (507) 389-6959

**Technical Liaison:**

Ken Nelson (651) 282-5435



**Introduction/Background:**

Personal health hazards can be attributed to the birds that are roosting under bridge decks and other structures. Also, considerable effort is directed to cleaning up the droppings, which creates an eyesore for traveling public and motorists.

**Purpose:**

The purpose of this project is to use a chemical deterrent that will prevent the birds from nesting.

**Test Procedure:**

Chemical deterrent was applied and monitored for bird activity and was successful in keeping the birds from nesting under the bridge.

**Results:**

No birds were observed roosting on the bridges for approximately six months during the fall and winter months. It was very effective and kept the birds from nesting. The chemical gave the effect of the bird's feet being burned.

**Recommendations:**

Reapplication will probably be needed periodically to repel the birds. Another two gallons of the product were ordered. However, the product has been pulled off the vendor's inventory. If it had not been pulled off the shelf, the recommendation would be to use it through out the state. Due to the uncertain reason of the product no longer being sold, the recommendation is to not use the product. There was a cost saving and increased safety of not having to return to the bridges and washing off the bird droppings every six months.

**Status:**

Completed in November, 2000.

# Rubberized Asphalt Melter Applicator

**Sponsor:** Brad Johnson

**District/Office:** D-1A Duluth

**Contact for further information:**

Brad Johnson (218) 384-3282

**Technical Liaison:**

John Tarnowski (651) 297-1843



**Introduction/Background:**

Currently the bridge crews in Duluth are heating rubber joint sealer in melting pots using a bertha torch. This leads to inaccurate application temperatures, increased heating times, and results in reduced performance of the material.

**Purpose:**

The purpose of this research is to compare safety, efficiency and reliability of this new system to the conventional method. Material is heated in a controlled hopper that maintains uniform temperatures. The heating unit and applicator are mounted on a small cart like structure that facilitates ease and control of the process.

**Test Procedure:**

The District 1-A Bridge Crew used the Rubberized Asphalt Melter Applicator throughout the Duluth area in 2001. Operator comments were recorded and evaluated to determine the additional safety factors involved with this system. Performance and reliability of the equipment was evaluated in this manner.

**Results:**

The Kera-10 Rubberized Asphalt Melter Applicator reduced labor costs by approximately 50% over the silicone tube method. Also the costs of rubberized asphalt were \$3.00 per gallon compared to \$104.00 per gallon for silicone. This unit was also much safer to use when compared to a melting pot and a hand held torch. After the initial start up and a few minor adjustments, employees no longer have to come in contact with the burner or pot.

**Recommendations:**

This unit will be used wherever possible in District 1A.

**Status:**

Completed in November, 2001.

# Aging Optimization Study

**Sponsor:** Wes Smith, and Tom Wood

**District/Office:** D-6B Owatonna and Office of  
Materials & Road Research

**Contact for further information:**  
Wes Smith (507) 455-5804

**Technical Liaison:**  
Ken Nelson (651) 282-5435



## Introduction/Background:

Mn/DOT's maintenance has been changing from a reactive to a proactive approach. This project has been to determine the optimal time of the placement of surface treatments to extend the useable life of hot mix asphalt pavements and shoulders.

## Purpose:

The goal of this project will help address some of the following questions:

1. Is Pavement Preventative Maintenance (PPM) cost effective?
2. When should a PPM treatment be placed in a pavement life?
3. How do different types of treatments compare?

## Test Procedure:

The research will be completed by using the most current seal coat methods as developed on Mn/DOT's TH 14 and TH 21 seal coat research projects and currently accepted methods of applying fog seals on the shoulders. The methodology will be to divide a new paved segment of highway or shoulders into a number of equal length test segments. The highway segment will be crack sealed using the route and seal method two years after construction. Starting in year two, one of the test segments will receive a surface treatment. Each of the following years the adjoining test segment will receive a surface treatment using the same, or currently recommended materials and application methods. This plan will continue until all test segments but one have been treated with a surface treatment, the remaining test segment will serve as a control section and will be compared to the method that is currently being used in the district.

## Results:

Phase one of the study has been completed with the surface treatments and will be monitored to determine the proper time for PPM.

## Recommendations:

An interim report was written. Outcomes and recommendations are further detailed in this report.

## Status:

This project will be on-going for five years.



## Hot Box

**Sponsor:** Gary Siebenaler

**District/Office:** D-6B Cannon Falls

**Contact for further information:**

Gary Siebenaler (507) 263-2323

**Technical Liaison:**

John Tarnowski (651) 297-1843



**Introduction/Background:**

During the winter months, it is difficult to keep patching materials warm and pliable. The maintenance crew at the Cannon Falls Truck Station were able to design and build a “Hot Box” that increases the workability of patching mixes by keeping them warm. The warm mixture improves the quality and longevity of the repair.

**Purpose:**

This project will address the issue of keeping the mix warm during it’s use in cold weather conditions. Non-pliable, hard to pack down, and non-adhesive qualities will be eliminated by keeping the mix warm. A low cost, insulated, electrically heated “box” will be constructed and tested for it’s effectiveness at keeping patching material warm.

**Test Procedure:**

The opinions of the sub-area personnel will determine the effectiveness of this “Hot Box.” It will be compared to the cold method that is currently being used in the district.

**Results:**

The “Hot Box” has been constructed and will be tested and evaluated over the winter season of 2001-2002.

**Recommendations**

There are no recommendations at this time.

**Status:**

On-going until Spring of 2002.

## Spalding RMV Hot Patcher/Reclaimer

**Sponsor:** Tony DeSantiago

**District/Office:** D-7E Mankato

**Contact for further information:**  
Tony DeSantiago (507) 389-6958

**Technical Liaison:**  
Ken Nelson (651) 282-5435



### **Introduction/Background:**

District 7E Mankato wanted to re-use and recycle unused bituminous asphalt that is left over from patching and overlay jobs to save money and use material that otherwise would be wasted and placed in landfills.

### **Purpose:**

The purpose of the project was to rent a hot patcher/reclaimer machine to make it possible to use hot mix during the winter.

### **Test Procedure :**

The re-heated bituminous was used for patching in the winter when hot mix is not available. The performance was tracked against regular cold mix. This machine was rented and compared to the existing methods.

### **Results:**

In theory using hot mixed bituminous during the winter is great but the rented equipment did not perform as well as expected. The reclaimer did not have any mixing capabilities. So this process had to be performed by hand. If it was not monitored closely, the heater would burn the oil out of the blacktop.

### **Recommendations:**

Heating the pavement and tack helped to some extent but other modifications would also be needed before a positive recommendation could be made. District-7E has no further plans to rent or purchase the patcher/reclaimer in the future.

### **Status:**

Completed in March, 2001.

## **Traffic/Work Zone Safety**

## Smart Arrow Message Board

**Sponsor:** Ron Bulthious

**District/Office:** D-3B St.Cloud

**Contact for further information:**  
Ron Bulthious (320) 255-4878

**Technical Liaison:**  
Ken Nelson (651) 282-5435



### **Introduction/Background:**

For employee and public safety, it is important to have the best lighting possible during maintenance activities at night and low light visibility. New lighting concepts and ideas may provide safer work zones for both employees and the driving public.

### **Purpose:**

This project will experiment with a new style of arrow board light system that is claimed to improve visibility of maintenance vehicles during all operations.

### **Test Procedure:**

The reaction and traffic control effects of the smart arrow light will be compared against arrow and message boards currently being used in Mn/DOT. Comments from operators will be recorded in regards to the effect on traffic and to the appearance of the light board.

### **Results:**

This lighting system was evaluated and has a very positive review. The areas that used the Smart Arrow Message Board were very impressed with the machine because it can be used as a message board or as an arrow board. This was a very versatile piece of equipment.

### **Recommendations:**

The recommendation is to use the Smart Arrow Messenger in work zones.

### **Status:**

Completed in Fall of 2001.

## Scorpian Truck Attenuator

**Sponsor:** Dave Redig

**District/Office:** D-6A Rochester

**Contact for further information:**  
Dave Redig (507) 285-7361

**Technical Liaison:**  
John Tarnowski (651) 297-1843



### **Introduction/Background:**

Safety has always been a priority for Mn/DOT. Employees and public with-in stationary and mobile work zones benefit from crash attenuators. The cost of attenuators is a major and extremely important expense.

### **Purpose:**

The purpose for this project is to reduce costs and yet improve the safety factor for work crews and motorists alike. This attenuator is a tubular aluminum style with individually replaceable parts. Damaged parts can be replaced which reduces the costs associated with units currently in use. Also, a changeable message board that is voice activated will be included in this project.

### **Test Procedure:**

This unit will be compared by operators against attenuators and message boards that are currently in use. Driver reaction and awareness to the new type of message board will also be monitored. Operators and other employees will comment as to the use, durability, and safety of this equipment.

### **Results:**

There are no results at this time.

### **Recommendations:**

There are no recommendations at this time.

### **Status:**

Project to be completed at the end of the 2002 Summer work season.

## Solar Powered Warning Signals/Flashers

**Sponsor:** Dave Schmidt and Richard Frick

**District/Office:** Metro Division

**Contact for further information:**

Dave Schmidt (763) 797-3156

**Technical Liason:**

John Tarnowski (651) 297-1843



**Introduction/Background:**

Battery powered flashers used for attracting attention of motorists are a constant maintenance item because of dead and weak batteries. This presents a safety hazard for the crews and the motorists. A potentially dangerous situation could be avoided by eliminating the need to service the batteries in the flashers.

**Purpose:**

The purpose of this research is to compare the solar powered flashers against the battery flashers currently in use.

**Test Procedure:**

The Solar Flashers will be compared and tested for durability and the reduction in maintenance costs. All maintenance performed on the solar lights will be recorded and evaluated against the battery flashers.

**Results:**

There are no results at this time

**Recommendations:**

There are no recommendations at this time

**Status:**

On-going until there is sufficient use of the solar powered warning signal/flasher.

## Zephyr Portable Sign Stand

**Sponsor:** Dewayne Jones

**District/Office:** Metro Division

**Contact for further information:**  
Dewayne Jones (612) 861-1655

**Technical Liaison:**  
Ken Nelson (651) 282-5435



### **Introduction/Background:**

Currently the portable sign stands that are in use are heavy, awkward, and sometimes difficult for one person to set up. The Zephyr Portable Sign Stand is a light weight, stackable sign stand made of recycled rubber that weighs 38 pounds. When folded in the storage position, it is only four inches in height. These units are also easy to stack which helps save storage space. As an added benefit, it has met the test requirements of the NCHRP-350 specifications.

### **Purpose:**

The purpose of this project is to test the durability, ease of operation, and space required for transport and storage of these units. Weight is also a factor that will be considered when the evaluation is completed.

### **Test Procedure:**

Operator usage and comments were monitored and recorded for comparison to the stands currently in use. This gave a good overview of the overall performance of these units.

### **Results:**

These sign stands did not stand up to the wind and kept blowing over. Constant adjustments needed to be made.

### **Recommendations:**

The stand needs to be redesigned to better stand up in different weather conditions and should not be used until further modifications are made.

### **Status:**

Completed in the spring of 2001.

## **Roadside Maintenance**



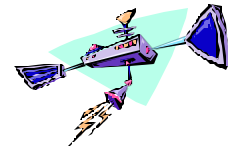
# Noxious Weed GIS/GPS Mapping

**Sponsor:** Dan Peterson

**District/Office:** D-4 Fergus Falls

**Contact for further information:**  
Dan Peterson (320) 763-5045

**Technical Liaison:**  
Ken Nelson (651) 282-5435



## **Introduction/Background:**

Noxious weeds listed in the Minnesota statutes, section 18.78, and plants included on the prohibited noxious weeds list are considered a hazard to public health, the environment, crops, livestock, public roads, and must be eradicated.

## **Purpose:**

The purpose of this research is to use GPS mapping technology to help track and treat infested areas. It is also to be used for maintenance scheduling.

## **Test Procedure:**

This system will be compared against the current method of manually locating and tracking noxious weed growth.

## **Results:**

There are no results at this time.

## **Recommendations:**

There are no recommendations at this time.

## **Status:**

On-going until Fall of 2002.

# Posi-track Soil Compaction Reduction Project

**Sponsor:** Pete Stadler

**District/Office:** Metro Division

**Contact for further information:**  
Dwayne Stenlund (651) 779-5638

**Technical Liaison:**  
Ken Nelson (651) 282-5435



## **Introduction/Background:**

Soil compaction from maintenance and construction work along Mn/DOT right of way prevents the establishment and growth of plant materials such as grass, trees, shrubs, and flowers.

## **Purpose:**

This project will develop a partnership with Mn/DOT, Office of Environmental Services and the University of Minnesota Soil Department to research the feasibility, efficiency, and effectiveness of the Posi-Track crawler tractor. The goal is to reduce soil compaction after construction or maintenance work affecting plant stability, growth, and development along right-of-ways.

## **Test Procedure:**

Soil compaction on plant roots will be tested using a cone penetrometer that measures how densely the soil is compacted and by visual observations.

## **Results:**

The results to date have exceeded all expectations. New growth has developed in areas where this equipment was used. The Posi-Track is an exceptional piece of equipment.

## **Recommendations:**

The Metro Division recommends that more of this equipment be made available to Mn/DOT.

## **Status:**

Completed in May, 2001.

## Harley HSRT6 Shoulder Reclaimer

**Sponsor:** Steve Hufnagle

**District/Office:** D-2 Thief River Falls

**Contact for further information:**  
Steve Hufnagle (218) 634-2232

**Technical Liaison:**  
John Tarnowski (651) 297-1843



### **Introduction/Background:**

Shoulder reclaiming is a huge part of maintenance during the summer months. This unit would replace or add to the motor grader or disc method of reclaiming shoulder material.

### **Purpose:**

The purpose is to test the effectiveness of the Harley Reclaimer in comparison to the equipment and method that is currently being used.

### **Test Procedure:**

The tracking process will include the number of passes needed in comparison to disc style reclaimers and motorgraders. The smoothness of the shoulder and the amount of time it takes to achieve the desired results will also be monitored.

### **Results:**

The Power Box worked best on a 4 to 5 1/2 foot shoulder. The reclaimer did a nice job of mixing up the gravel and left no large pieces of sod to contend with. The longevity of the carbide tips is disappointing and showing major signs of wear after 250 miles.

### **Recommendations:**

Recommendation is to purchase the eight foot model instead of the six foot model and to have a narrower tractor with 35 plus horsepower and dual hydraulics.

### **Status:**

On-going until Spring of 2002.

# Geotextile Fabric Laying Machine

**Sponsor:** Wes Smith and Dan Gullickson

**District/Office:** D-6B Owatonna and  
Office of Environmental Services

**Contact for further information:**  
Wes Smith (507) 455-5804

**Technical Liaison:**  
Ken Nelson (651) 282-5435



## **Introduction/Background:**

District 6B Owatonna and the Office of Environmental Services will use a fabric-laying machine to address the problem of weed control and to aid in the establishment of living snow fences. Geotextile fabric provides dependable weed control the first day that it is applied. The geotextile fabric laying machine is not dependant on the weather to work, as is the case with chemical herbicides.

## **Purpose:**

This project will address the issue of weed control and will eliminate the need to apply chemical herbicides or wood chips. The evaluation will focus on the fabric laying machine.

## **Test Procedure:**

The evaluations and opinions of the sub-area personnel helped to determine the effectiveness of the fabric. The process was compared to the traditional method of spraying with chemical herbicides.

## **Results:**

Using this machine, the project was completed with a reduction in chemicals being introduced into the environment and helped in the start of living snow fences.

## **Recommendations:**

The evaluations of this machine were very good and it is recommended that Mn/DOT utilize this technology.

## **Status:**

Completed in Spring of 2001.

## Living Snow Fence

**Sponsor:** Steve Kortuem and Dan Gullickson

**District/Office:** D-7A Mankato

**Contact for further information:**

Steve Kortuem (507) 389-6959

**Technical Liaison:**

Ken Nelson (651) 282-5435



### **Introduction/Background:**

District-7A Mankato is working towards the implementing of a Statewide Living Snow Fence Program. During the winter seasons roads that have open areas or farm fields allow blowing snow to drift across the roadway making some roads impassable. The use of snow fences has long been used to help prevent these conditions. Due to equipment, labor, and materials, the current snow fence process is very costly. Using living snow fences will eliminate the need to erect snow fences every year. The district will be locating, surveying, designing, planting, maintaining, and buying easements for Living Snow Fences.

### **Purpose:**

The purpose of this project is to give the district the opportunity to use a software to start and implement the Living Snow Fence Program on a statewide basis.

### **Test Procedure:**

Using new computers and software programs such as ArcView a more professional and accurate plan can be tracked, retrieved, updated, evaluated and reported as needed. Currently Mn/DOT does not have a comprehensive plan in place.

### **Results:**

The process of planting living snow fences was a success. Property and easements were purchased and plantings are in place.

### **Recommendations:**

It is recommended that this program be implemented throughout the state.

### **Status:**

Completed in 2001. Although implementation to a statewide Living Snow Fence Program is on-going.

# Dynamic GPS Performance Evaluation

**Sponsor:** Dave Gorg and Craig Shankowitz

**District/Office:**

Mn/DOT Office of Land Management  
and University of Minnesota, Intelligent Vehicles  
Lab

**Contact for further information:**

Dave Gorg (651) 296-5710

**Technical Liaison:**

John Tarnowski (651) 297-1843



**Introduction/Background:**

At the present time, no data exists which indicates the compatibility of GPS base stations and rovers. Although particular standards exist, each manufacturer appears to implement these in different ways. Knowing answers to certain questions regarding the compatibility of various receivers and base stations can be very beneficial to the implementation of GPS operations on a statewide basis in maintenance.

**Purpose:**

This research will evaluate GPS accuracy against ground truth measurement. Compatibility of base stations and rovers will also be tested and evaluated.

**Test Procedure:**

The University of Minnesota will be responsible for testing and recording accuracy and providing the results.

**Results:**

At this time the camera and associated hardware appear to operate as anticipated. Initial tests indicate that the system offers enough timing precision and sufficiently fast data recording to evaluate 10 Hz Digital Global Positioning systems.

**Recommendations:**

There are no recommendations at this time.

**Completed or on going:**

This project will continue to be tested and evaluated as long as Mn/DOT implements GPS networks.

## New Holland Disc Mower

**Sponsor:** John May

**District/Office:** D-7A Le Sueur

**Contact for further information:**  
John May (507) 665-2681

**Technical Liaison:**  
Ken Nelson (651) 282-5435



### **Introduction/Background:**

The New Holland Disc Mower is a modular design made up of a series of completely self contained individual modules and spacers bolted together. When the mower has any maintenance issues, one modular piece can be tested instead of replacing a whole mowing unit.

### **Purpose:**

The research will address the effectiveness of a modular design for the maintenance and repair of this type of equipment. The cost effectiveness of a modular design mower and the Mn/DOT standard will be evaluated.

### **Test Procedure:**

District 7 will track repair costs and down time to compare efficiency of this mower to the types that are currently being used. Driver evaluations will be tracked as well.

### **Results:**

Overall, every employee that ran this machine has positive comments.

### **Recommendations:**

This mower needs to be evaluated for another season to track the repair cost and down time.

### **Status:**

On-going until Fall of 2002.

# TRACC System

**Sponsor:** Mark Fischbach and DeWayne Jones

**District/Office:** Metro Division

**Contact for further information:**

Tom Jeso (651) 406-4734

**Technical Liaison:**

John Tarnowski (651) 297-1843



## **Introduction/Background:**

Crash attenuators are expensive to replace when damaged. The Metro Division has over 190 attenuators within its boundaries. Any reduction in cost when maintaining these systems creates a huge benefit for the Division. This new system allows for the repair of the damaged unit to take place in the shop, which in turn will reduce time, material, and overall costs of repairs.

## **Purpose:**

The purpose of this project is to compare and evaluate the maintenance and cost of the new system to the Quad Guard system that is currently in use. Two TRACC systems will be purchased.

## **Test Procedure:**

The TRACC system will be placed at the TH 52 to West I-94 interchange. Repair times will be monitored on project reports. This will allow tracking of the parts and materials needed for the repair.

## **Results:**

There are no results at this time.

## **Recommendations:**

There are no recommendations at this time.

## **Status:**

On-going until enough repairs have been made to be able to determine a cost comparison.



## ET-2000 Plus Guardrail End Treatments

**Sponsor:** DeWayne Jones

**District/Office:** Metro Division

**Contact for further information:**  
DeWayne Jones (612) 861-1655

**Technical Liaison:**  
Ken Nelson (651) 282-5435



### **Introduction/Background:**

The Metro Division is upgrading the guardrail end treatments to meet the new Federal 350 crash specifications that will be in place in the near future. The current crash attenuators that are in use are very heavy and costly to repair when hit by a motorist. These new end treatments are made out of steel posts and are capable of being replaced during the winter with much less time and material.

### **Purpose:**

The purpose is to try a new end treatment that will meet the new specifications using a lightweight system that will take less time and effort to repair.

### **Test Procedure:**

Project reports and repair costs will enable this new system to be evaluated and labor, material, and equipment to be tracked. Injury and damage reports will help determine the performance of the system. One system was purchased and placed on TH 62 Crosstown and Cedar Avenue where many crash attenuators have been hit.

### **Results:**

Since the placement of this unit there has been one reportable crash. The repair was completed with minimal effort compared to the traditional crash attenuators.

### **Recommendations:**

This system is highly recommended to be put in places where feasible.

### **Status:**

Completed in Spring of 2001.

## (GS-ED-60-50) Sidedozer

**Sponsor:** Norm Ashfeld

**District/Office:** Metro Division

**Contact for further information:**  
Norm Ashfeld (651) 582-1437

**Technical Liaison:**  
Ken Nelson (651) 282-5435



### **Introduction/Background:**

The Metro Division has numerous areas requiring drainage repair under the guardrail systems. Using current equipment cause delays and extra costs to repair these problem areas. Using a skid loader attachment called the Sidedozer, the Metro Division believes that the amount of time to repair these problem areas will be reduced significantly.

### **Purpose:**

The purpose for this research is to investigate the feasibility and cost effectiveness of the Sidedozer.

### **Test Procedure:**

Metro Division will have daily project reports and enter the data into the Operations Management System (OMS) when completing drainage repairs. These can be used to compare the current methods with that of repairs using the Sidedozer. Operators familiar with both methods will share their opinions on the use of the new equipment.

### **Results:**

The Sidedozer cleaned the dirt and debris from under the guardrails very well with labor savings of approximately  $\frac{1}{2}$  to  $\frac{3}{4}$  over hand shoveling. A lane or shoulder closure may be needed for the skid steer to operate. The material left after cleaning under the guardrail can be spread out behind the guardrail.

### **Recommendations:**

It is a good piece of equipment with the right operator. It will need a spot mirror on the front of the skid steer because it is hard for the operator to see the dozer blade due to the arm of the skid steer. This piece of equipment will save time and labor for years to come.

### **Status:**

Completed in May, 2001.

## **Equipment/Tools**

## Spray-on Box Lining and Irathane Systems

**Sponsor:** Dave Ollila  
John Tarnowski

**District/Office:** D-1B Virginia and  
Office of Maintenance

**Contact for further information:**  
Dave Ollila (218) 749-7798  
John Tarnowski (651) 297-1843

**Technical Liaison:**  
John Tarnowski (651) 297-1843



### **Introduction/Background:**

Wear on plow, wing and sander surfaces is an on-going maintenance issue each season. Surface protection in various forms including spray on materials are becoming an option to help protect equipment and increase longevity.

### **Purpose:**

The purpose of this project is to test the reduction in friction which causes wear on the plow, wing, and sander surfaces. The anti-corrosion protection that the coatings should provide on both ferrous and non-ferrous metals will be tested.

### **Test Procedure:**

Wear and corrosion on coated and non-coated surfaces will be visually inspected and monitored over several winter seasons. Fuel usage may also be evaluated and compared because of the reduction in friction resulting from plowing snow. This may be an added benefit of using these types of coatings. Operator comments will determine ease of clean-up of coated versus non-coated areas.

### **Results:**

The material appears to be holding up well in most areas. However, some chipping and cracking can be seen on the edges of wing and plow on one of the test vehicles.

### **Recommendations :**

There are no recommendations at this time.

### **Status:**

On going until Spring of 2002.

## Wire Feeder/Welder

**Sponsor:** Gale Tiedeman

**District/Office:** D-2B Roseau

**Contact for further information:**  
Gail Tiedeman (218) 463-2821

**Technical Liaison:**  
Ken Nelson (651) 282-5435



### **Introduction/Background:**

There is always a need for welding on a variety of metals in the field of maintenance. Different types of equipment such as trucks, plows, bridges, and other structures need to be repaired or modified. A new type of wire feed welder will be tried that is designed to produce less slag when in use.

### **Purpose:**

This project will address the use of a Power Mig 225 wire feeder/welder to perform repairs to mild steel, aluminum, and stainless steel. This should reduce labor time while increasing repair quality and safety. Repairs will be compared to the existing Miller welders that Mn/DOT currently purchases.

### **Test Procedure:**

The use of this welder will be compared for ease of use, operation, and quality. The amount of slag produced will be monitored for each welder.

### **Results:**

This welder performed very well in all testing areas and should be considered when purchasing a new welder.

### **Recommendations:**

The recommendation is to put it on the bid list along with the Miller welder.

### **Status:**

Completed in Fall of 2001.

## Laxo Quick Lock System

**Sponsor:** Rod Sievert

**District/Office:** D-3B St. Cloud

**Contact for further information:**  
Rod Sievert (320) 589-7347

**Technical Liaison:**  
Ken Nelson (651) 282-5435



### **Introduction/Background:**

As the cost of vehicles rise each year, the concept of using one vehicle for multiple uses becomes more feasible and more cost efficient each day. This system would allow a tandem axle truck to be used as a dump box, water tank, flat bed, or utilized as a fifth wheel tractor in a matter of minutes. The vehicle can be driven out from under one piece of equipment and back under a different one and secured. There is minimal amount of time and labor involved.

### **Purpose:**

The purpose of this research is to test the feasibility, durability, and cost effectiveness of this system in comparison to having several trucks set up for different uses.

### **Test Procedure:**

One system was purchased and the amount of time to change the bodies will be monitored and operator comments will be recorded as to ease of use. Also the possibility of a reduction in the fleet size will be looked at along with associated cost savings that this system may provide.

### **Results:**

The Laxo Quick Lock System is in place and is being tested and evaluated. The preliminary evaluation is very promising.

### **Recommendations :**

This project needs to be tracked and evaluated for future implementation. The cost of the system and installation need to be determined in order to make any recommendations.

### **Status:**

Completed in Fall of 2001.

## Brake Watch

**Sponsor:** Maurice Ellis

**District/Office:** D-3B St. Cloud

**Contact for further information:**  
Maurice Ellis (763) 295-5525

**Technical Liaison:**  
Ken Nelson (651) 282-5435



### **Introduction/Background:**

Safety is a major concern of every driver who possesses a certified drivers license. This system will help alleviate one of the concerns in respect to monitoring the brake travel distance and informing the operator when adjustment is required. The Brake Watch system enables the operator or mechanic to evaluate the brakes without having to crawl under the truck and physically measure brake travel.

### **Purpose:**

The purpose is to test the effectiveness of the warning system.

### **Test Procedure:**

The Brake Watch System will be used on three tandems. Operators and mechanics will be asked for opinions and comments on the usefulness and accuracy.

### **Results:**

The Brake Watch System worked very well and should be considered as a standard equipment on all new trucks ordered.

### **Recommendations :**

The recommendation is that all new vehicles ordered have this safety equipment installed.

### **Status:**

Completed in Summer of 2001.

# JAGZ Interlocking System

**Sponsor:** Ron Bulthious

**District/Office:** D-3B St. Cloud

**Contact for further information:**  
Ron Bulthious (320) 255-4878

**Technical Liaison:**  
Ken Nelson (651) 282-5435



## **Introduction/Background:**

Replacing cutting edges because of normal wear is a huge expense. It also poses risks to the employees because of the dangers encountered when handling and mounting the edges.

## **Purpose:**

This project will test a new interlocking type of edge that would be more cost effective and could be replaced less dangerously.

## **Test Procedure:**

These edges will be compared to existing edges on the Case loader. A variety of conditions and materials will be encountered and comments of operators will be recorded.

## **Results:**

There are no results at this time.

## **Recommendations:**

There are no recommendations at this time.

## **Status:**

On-going until there is sufficient use of the system.



## Retractaflap

**Sponsor:** Fran Bigaouette and Jim Niska

**District/Office:** Metro Division

**Contact for further information:**  
Ken Nelson (651) 282-5435

**Technical Liaison:**  
Ken Nelson (651) 282-5435



### **Introduction/Background:**

Retractaflap systems will be mounted on several snowplow vehicles to evaluate their cost effectiveness. It will be compared to existing mud flaps on snowplows, which can be torn off during unloading procedures. Using this system, employees will not have as much exposure to potentially dangerous situations by lifting mud flaps out of the way for backing operations. Damage to mud flaps due to backing operations will be eliminated because the flaps will automatically lift up when the vehicle is put in reverse.

### **Purpose:**

Mn/DOT vehicles are required by law to have serviceable mud flaps mounted on every vehicle used to haul or plow snow. During routine maintenance activities, mud flaps can sometimes be ripped off or damaged beyond repair. The Retractaflap system will automatically lift the flaps using the trucks air pressure.

### **Test Procedure:**

Four Retractaflap systems were purchased to compare to the old method of having the driver leave the cab to lift the flaps out of the way. Cost effectiveness, and safety were monitored.

### **Results:**

The Retractaflap systems performed as designed and helped to eliminate the potentially dangerous situations during backing operations but the equipment has not withstood the harsh winter environment. It has been taken off some of the test vehicles due to the corrosion caused by salt and other chemicals that are used during winter operations.

### **Recommendations:**

The Retractaflap project was not successful during the test period. The company has been contacted and now has a redesigned system that should prevent failure caused by corrosion. See the Mud Flap Jack project for similar research in this area.

**Status:** Completed in Fall of 2001.

## Mud Flap Jack

**Sponsor:** Dale Sauer and Tim Proell

**District/Office:** D-3B St. Cloud

**Contact for further information:**  
Dale Sauer (320) 255-4878

**Technical Liaison:**  
Ken Nelson (651) 282-5435



### **Introduction/Background:**

During paving operations mud flaps are damaged and in many cases torn off of the trucks because of backing up to the paver. This presents a safety problem and also a legal problem when not replaced. Mud flaps are required on Minnesota trucks according to state law. The Mud Flap Jack has an electrical wire that is connected to a switch in the cab, which the operator can turn on or off. See the Retractableflap project for previous work done in this field.

### **Purpose:**

The purpose of using the Mud Flap Jack is to eliminate or reduce the amount of mud flaps being torn off and to withstand the harsh winters. During asphalt paving operations mud flaps have to be pinned up to prevent the flaps from being torn off the truck. This can lead to possible accidents during this part of the operation. Using an automatic Mud Flap Jack can reduce the opportunity for mishap.

### **Test Procedure:**

The Mud Flap Jack will be monitored for its performance and durability. Most importantly, it will be evaluated for its use in the elimination of mud flap damage which occurs during paving operations, backing up to sand piles, and other situations.

### **Results:**

The Mud Flap Jacks have been tried through the 2001 summer season with good results but need to go through the harsh Winter environment to be able to make a recommendation as to the implementation of this product.

### **Recommendations:**

There are no recommendations at this time.

### **Status:**

On-going until Fall of 2002.

## Clear View Wiper Mirror

**Sponsor:** Roland Wagner

**District/Office:** D-6B Owatonna

**Contact for further information:**  
Roland Wagner (507) 455-5858

**Technical Liaison:**  
Ken Nelson (651) 282-5435



### **Introduction/Background:**

During winter operations the passenger side mirror on a snowplow truck is very difficult to keep clean and free of snow. With the installation of the Clear View Wiper Mirror, it can potentially eliminate the need to stop the plow truck and clean the mirror manually.

### **Purpose:**

This project will address the issue of keeping the passenger side mirror free of snow during a snow plow event.

### **Test Procedure:**

The sub-area personnel will monitor the effectiveness of the Clear View Wiper Mirror and will determine the quality of performance and dependability.

### **Results:**

The Clear View Wiper Mirror was mounted on a tandem snowplow, which operates primarily on Interstate 35. The mirror created some visibility issues by not staying attached to the mirror properly and would hang down obstructing the rear view of the driver.

### **Recommendations:**

The Clear View Wiper Mirror was not a dependable product and the recommendation is to not purchase this product.

### **Status:**

Completed in May, 2000.

## Lane Scan Mirrors

**Sponsor:** Mark Fischbach

**District/Office:** Metro Division

**Contact for further information:**

Mark Fischbach (651) 582-1429

**Technical Liaison:**

Ken Nelson (651) 282-5435



### **Introduction/Background:**

The Lane Scan Mirrors are mounted on the passenger side of the vehicle and is designed to rotate (showing the blind spot) with the touch of a toggle switch. This allows the driver to see what is on the right side of the vehicle and gives the operators better visibility when on multi lane highways. This would provide for safer driving conditions for the operators and the motorists.

### **Purpose:**

The purpose for this project is to test this new mirror and evaluate the benefits in comparison to the standard west coast mirrors that are currently in use.

### **Test Procedure:**

Three Lane Scan Mirrors systems will be mounted and evaluated in 2002. One will be mounted on a tandem and the other two mirrors will be mounted on a sweeper. Operators have to constantly change sides during sweeping. It will be used in all weather conditions and on all types of roadways. This should provide a good comparison to what is currently in use.

### **Results:**

Positive results have been recorded on the unit mounted on the tandem truck. Operators like the way they can see the blind spot especially during right hand turns. The other two sets of Lane Scan Mirrors have not been mounted.

### **Recommendations:**

There are no recommendations at this time.

### **Status:**

On-going until Fall of 2002.

## Heated Windshield Wiper Blades/ Blizzard Blades

**Sponsor:** Bob Lohburger

**District/Office:** D-7A Mankato

**Contact for further information:**

Bob Lohburger (507) 553-3721

**Technical Liaison:**

Ken Nelson (651) 282-5435



**Introduction/Background:**

During plowing and sanding operations every driver needs to stop at some time or another and clean snow and freezing precipitation off the wiper arms and blades. This not only presents a dangerous condition while driving but also while cleaning off the blades.

**Purpose:**

The purpose of this research is to eliminate the need for cleaning the wiper blades during snow and ice operations.

**Test Procedure:**

The heated blades were compared to regular winter blades. Comments on durability and use were recorded and monitored.

**Results:**

There were mixed results on this project. When the blades worked, they worked well. However, problems with the heater wires breaking kept the performance standards lower than expected.

**Recommendations:**

A stronger wire system would help alleviate problems. Also, the connectors at the blade kept disconnecting during use so a better connector should be used.

**Status:**

Completed in Spring of 2001.

# High Intensity Discharge Lighting

**Sponsor:** Randy Glaser

**District/Office:** D-7E Mankato

**Contact for further information:**  
Randy Glaser (507) 389-2848

**Technical Liaison:**  
Ken Nelson (651) 282-5435



## **Introduction/Background:**

The High Intensity Discharge (HID) lights produce four times the light of a standard headlight. The service life is estimated at ten times longer than standard lights. This would provide a safer and more visible maintenance vehicle during snow and ice operations.

## **Purpose:**

The purpose is to compare HID lights to the current lights on various pieces of equipment and under different conditions which can be encountered in the field.

## **Test Procedure:**

Operators will evaluate with hands on use under actual, varying conditions during the winter season.

## **Results:**

Operators were able to see much more clearly during snow events when using these new lights. Comments from operators were, "Unbelievable! At night it is like driving in daylight."

## **Recommendations:**

The recommendation is to install HID lights as standard equipment on new snowplow trucks. To expand the test, HID lights on sanders will be mounted to improve vehicle recognition for the motoring public during snow plowing operations.

## **Status:**

Completed in April, 2000.

## Trailer Safety Lights

**Sponsor:** Ken Nelson

**District/Office:** Office of Maintenance

**Contact for further information:**  
Ken Nelson (651) 282-5435

**Technical Liaison:**  
Ken Nelson (651) 282-5435



### **Introduction/Background:**

Being able to see the sand discharge from the sander will be greatly enhanced when using the Trailer Safety Light System. Not only will it effectively allow the driver to see the material being discharged it will allow the motoring public to see the vehicle more clearly when a snow cloud is present.

### **Purpose:**

The purpose is to be able to see the material being discharged to sand more effectively.

### **Test Procedure:**

Maintenance Operations Research purchased 60 sets of lights to be tested alongside of our standard sander light systems. Each district received three sets of lights to install and compare against the standard systems.

### **Results:**

These lights were purchased and mounted in the Fall of 2000 and early feedback from operators support the new lights. Operators have noticed it being more visible to the motoring public. The comparison will continue for one more winter season to evaluate the durability of the lights.

### **Recommendations:**

Early recommendations are that the visibility has improved and the motoring public seems to stay farther back. The durability of this product is still being evaluated.

### **Status:**

On-going through 2001-2002 winter season.

## Cordless Impact Drivers

**Sponsor:** Bill Finnegan

**District/Office:** D-7E Mankato

**Contact for further information:**  
Bill Finnegan (507) 389-6960

**Technical Liaison:**  
Ken Nelson (651) 282-5435



### **Introduction/Background:**

Air powered tools have one drawback and that is the air hoses running across the floor of work areas. This creates an unsafe working condition.

### **Purpose:**

The purpose of this research is to evaluate the cordless impact drivers. If successful, their use will allow for a safer work area and help with job efficiency.

### **Test Procedure:**

Evaluations will be made by professional mechanics who work with tools every day while on the job. The sign crews also tested and used it on the road.

### **Results:**

The right tool for the job always makes a job easier to accomplish. The cordless impact drivers have made it safer and easier for the mechanics to perform their jobs.

### **Recommendations:**

The cordless impact drivers would work well on a statewide level.

### **Status:**

Completed in November, 2000.



## Mini Skid Loader

**Sponsor:** Larry Cooper

**District/Office:** D-7E Mankato

**Contact for further information:**  
Larry Cooper (507) 389-6959

**Technical Liaison:**  
Ken Nelson (651) 282-5435



### **Introduction/Background:**

At present a lot of bridge maintenance has to be done by manual labor. This results in more personnel and additional labor costs. This also increases the chance of work related injuries and other safety issues.

### **Purpose:**

The purpose of this project is to use a mini-load machine that would be able to get into small areas and alleviate the manual portion of bridge maintenance especially box culverts. This mini skid steer also has a jack hammer attachment that will be used to remove footings that require overhead jack hammering.

### **Test Procedure :**

Operators used this machine and evaluated it's effectiveness in reducing manual labor time and the "hands on" method that is currently used.

### **Results**

This unit has proven itself very useful to the field personnel. It is easy to lift into place and does a very good job excavating. Ease of operation is a plus. The jack hammer attachment was also used and gets a thumbs up for overhead jack hammering.

### **Recommendations:**

The mini skid loader would work well anywhere in the state.

### **Status:**

Completed in June, 2001.

## Under Body Grease Banks

**Sponsor:** Mike Sullivan and Bill Finigan

**District/Office:** D-7 Mankato

**Contact for further information:**  
Dave Ivers (507) 389-2946

**Technical Liaison:**  
John Tarnowski (651) 297-1843



### **Introduction/Background:**

During a snow and ice event the underbody scraper becomes encased in freezing precipitation making it almost impossible to maintain during use. Grease is imperative to prevent premature wear of pivot points during these crucial times.

### **Purpose:**

The underbody grease banks will keep all grease fittings in one easily accessible area. This will assure that all of the 34 zerks fittings receive lubrication. Operators will be able to access all of the zerks fittings and perform maintenance safely and effectively.

### **Test Procedure:**

The grease banks will be compared by operators to the current method of crawling under the vehicle or raising it on a hoist to access the zerks fittings. Operators and shop mechanics were polled for comments and suggestions.

### **Results:**

The surveys clearly show that operators and mechanics support the grease banks over conventional methods. The grease banks made it very easy to lubricate all of the critical points on the underbody plow components from one location.

### **Recommendations:**

It has been recommended that all plow trucks in District 7A be outfitted with the grease banks.

### **Status:**

Completed in March, 2001.

## Truck Mounted Roller

**Sponsor:** Gus Scharffbillig

**District/Office:** Metro Division

**Contact for further information:**

Gus Schaffbillig (651) 558-2150

**Technical Liaison:**

Ken Nelson (651) 282-5435



### **Introduction/Background:**

The truck mounted roller will speed up the patching process by eliminating the need for a self propelled roller which requires loading and unloading. This unit will reduce one piece of equipment needed in a paving operation.

### **Purpose:**

The purpose is to test the efficiency and durability of this truck mounted roller versus the self propelled roller that has to be loaded and unloaded for each paving job.

### **Test Procedure :**

Operators evaluated the usefulness of the Truck Mounted Roller and compared it to what is currently used. Patches were evaluated and monitored for durability and smoothness. The reduction in one person and less equipment involved in the operation is already apparent.

### **Results:**

The crew was able to increase production. The patches appeared to last longer and were smoother in nature. Also it allowed crews to move quickly from one work area to the next.

### **Recommendations:**

The Truck Mounted Roller needs the ability to move from side to side and should be mounted to a plow type frame. This would increase versatility and decrease the mounting and removal time.

### **Status:**

Completed in January, 2001.

## Collision Avoidance Monitors

**Sponsor:** Larry Thompson

**District/Office:** Central Office -  
Safety Unit

**Contact for further information:**  
Larry Thompson (651) 296-1362

**Technical Liaison:**  
John Tarnowski (651) 297-1843



### **Introduction/Background:**

Backing of large trucks creates a dangerous condition from the lack of visibility directly behind the vehicle and other blind spots that cannot be viewed in the mirrors. Many accidents could be avoided if better visibility were possible to the rear of these large vehicles.

### **Purpose:**

This project will explore the use of a rear vision camera and monitor to improve safety when backing is necessary.

### **Test Procedure:**

Operators will determine the performance of these cameras in all weather and lighting conditions.

### **Results:**

Operators were polled on the use of the camera in the MOR Test Bed Plow Truck during the 2000-2001 season. The back-up monitor camera system proved very useful under most driving conditions. During plowing operations, snow built up on the camera lens and made it difficult if not impossible to use until the precipitation was cleaned off.

### **Recommendations:**

Recommendation is to find a way to keep the camera from building up with freezing precipitation in snow and ice conditions.

### **Status:**

On-going until Spring of 2002. Through conversations with the manufacturer a "de-icer" for the camera is being constructed at this time. It will be made available for testing in a limited number during the 2001-2002 winter season.

## Electronic Hearing Protection

**Sponsor:** Jim Tessier

**District/Office:** Metro Division

**Contact for further information:**  
Jim Tessier (651) 779-5147

**Technical Liaison:**  
Ken Nelson (651) 282-5435



### **Introduction/Background:**

The PRO-TEKT electronic hearing protection allows for normal voice communications while providing 28-decible-noise protection. The existing hearing protection that is available does not provide for normal voice communication for verbal warnings and instructions.

### **Purpose:**

The purpose is to reduce hearing injuries to workers who are around noisy equipment and machinery.

### **Test Procedure:**

A survey of all mechanics, welders, and maintenance workers was taken and the performance measures were compared to the hearing protection currently used by Mn/DOT.

### **Results:**

Reports were requested from all employees that tested the PRO-TEKT hearing protectors. The general conclusions were that the ear cups did not fit properly around the ear allowing outside noise to come in that should have been eliminated. Because of the volume controls on each cup, some of the noises such as radio, traffic noises, and louder conversations were actually amplified. The employee would constantly have to adjust the volume levels.

### **Recommendations:**

Basic conclusion from all responses was that most employees felt that the units would not work in the type of environment that most are subjected to every day.

### **Status:**

Completed in May, 2001.

## On-board Truck Scale

**Sponsor:** Mark Fischbach

**District/Office:** Metro Division

**Contact for further information:**  
Mark Fischbach (651) 582-1429

**Technical Liaison:**  
Ken Nelson (651) 282-5435



### **Introduction/Background:**

Record keeping is only as good as the information that is entered into it. This system should provide a better and more accurate method of keeping track of the actual amount of material used. This can be applied any time material has to be hauled but especially during snow and ice operations.

### **Purpose:**

The purpose of this project is to test this piece of equipment for accuracy, reliability, and possibility of fleet implementation.

### **Test Procedure:**

For one year, records and weights will be tracked. The performance and reliability will be tracked by the operators. Comments and any other information from the operators will be logged and monitored.

### **Results:**

This has been installed in a single axle truck and will be used throughout the 2001-2002 winter season.

### **Recommendations:**

There are no recommendations at this time.

### **Status:**

On-going until Spring of 2002.

## Connect Under Pressure Hydraulic Couplers

**Sponsor:** John Shallow

**District/Office:** D-1A Duluth

**Contact for further information:**

John Shallow (218) 723-4960 ext. 3207

**Technical Liaison:**

John Tarnowski (651) 297-1843



**Introduction/Background:**

Difficulty connecting hydraulic hoses under pressure is a constant struggle. An unsafe condition exists when the hose end is tapped to relieve pressure which can cause fluid to be sprayed everywhere.

**Purpose:**

The purpose of this project is to test a different type of connector, which can be connected safely under pressure. Successful results would eliminate the unsafe condition found on couplers currently in use on plows and sanders.

**Test Procedure:**

The installation and use of the new couplers were compared to old ones by plow operators and other employees. The comments were recorded and reported accordingly.

**Results:**

The couplers performed well. The need to purge pressure on the hoses was eliminated for plow hookups.

**Recommendations:**

These couplers have eliminated an unsafe condition when connecting or disconnecting hydraulic hoses on plows. The district recommends that these be installed on all Mn/DOT plow trucks.

**Status:**

Completed in May, 2001.

## **Building**



## Pre-cast T-Panels for Cover All Storage Buildings

**Sponsor:** Gary Elmquist

**District/Office:** D-1B Virginia

**Contact for further information:**

Gary Elmquist (218) 749-7798

**Technical Liaison:**

John Tarnowski (651) 297-1843



**Introduction/Background:**

The cost to build a permanent storage structure escalates each year. The need for a low cost, moveable, and reusable storage facility would pay for itself by having the ability to be relocated if future plans or changes require it. This project would evaluate the efficiency, construction, and performance of pre-cast concrete panels for the storage of winter maintenance materials when used in conjunction with coverall buildings.

**Purpose:**

The primary reason for this project is to evaluate the ease of installation and cost savings in comparison to permanent foundations.

**Test Procedure:**

The actual costs of site preparation, materials, and labor will be compared to conventional methods. The T-Panel construction will be used at the International Falls Truck Station.

**Results:**

There are no results at this time.

**Recommendations:**

There are no recommendations at this time.

**Status:**

On-going until Spring of 2002.

## Wireless for Truck Stations

**Sponsor:** Gary Niemi

**District/Office:** D-3A Brainerd

**Contact for further information:**

Dan Johnson (218) 828-2547

Clarence Wroolie (218) 828-2631

**Technical Liaison:**

John Tarnowski (651) 297-1843



**Introduction/Background:**

With the introduction of the Automated Fuel Dispensing System, the cost of digging up newly paved parking lots to run cables and wiring is a huge added expense. This wireless system would drastically reduce these costs by connecting to Mn/DOT's wide area network (via frame relay) without excavating and burying cables.

**Purpose:**

This system would allow the connection of the fuel system to the wide area data network. It may also be tested and used for accessing other applications such as Building Energy Management, Maximo, M-4, and other inventory and data management systems.

**Test Procedure:**

The final costs for installing wireless technology will be compared against the installation of hard wire system installation at other locations. Reliability and ease of use will also be monitored.

**Results:**

There are no results at this time.

**Recommendations:**

There are no recommendations at this time.

**Status:**

On-going until Spring of 2002.

## **Technology Transfer/Education**

# Truck Weight Education Project

**Sponsor:** Roger Hille

**District/Office:** D-2 Bemidji

**Contact for further information:**  
Roger Hille (218) 281-6057

**Technical Liaison:**  
John Tarnowski (651) 297-1843



## **Introduction/Background:**

The majority of damage to Minnesota's highways is due to large trucks and especially "overweight" trucks. In many of the rural communities, it is not uncommon for private trucks and others to load vehicles to the maximum limit during harvest times for transporting of goods. This causes undo stress on the road pavement and aids in premature failure of the roadway.

## **Purpose:**

This project is intended to limit and reduce pavement damage by forming a partnership with the Department of Public Safety. Through this partnership, training would be provided to private trucking industries and others in regards to the Mn/DOT Weight Laws. Information would be shared as to the damage caused by overweight vehicles and the costs involved.

## **Test Procedure:**

The driver's knowledge will be tested before and after the training classes. Also the number of overweight trucks in the system will be monitored along with the dollars of infrastructure saved.

## **Results:**

There are no results at this time.

## **Recommendations:**

There are no recommendations at this time.

## **Status:**

On-going until February, 2002.

## Field Works

**Sponsor:** Mike Cirks

**District/Office:** D-8 Willmar

**Contact for further information:**  
Mike Cirks (507) 537-6146

**Technical Liaison:**  
Ken Nelson (651) 282-5435



### **Introduction/Background:**

Each year changes are made after manufacturers deliver new vehicles. This situation requires the purchase of books, manuals, and other information to allow for repairs and maintenance.

### **Purpose:**

The purpose of Field Works is to provide a service bay diagnostic tool for engines, transmissions, and brake systems. It will be used for data acquisition of all Original Equipment Manufactures (OEM) diagnostic software supporting engine, brake, and refrigeration systems. This system also allows for updates to the manuals.

### **Test Procedure:**

Technical and mechanical personnel evaluated the Field Works system. By actual hands on usage in real job settings a good evaluation of the equipment will be possible. Comments were monitored and recorded.

### **Results:**

The Field Works project was a success. The program performed as advertised.

### **Recommendations:**

Field Works has met the needs for diagnostic testing. The recommendation is that this system be implemented statewide.

### **Status:**

Completed in March, 2001.

## Snow and Ice Information Pamphlet

**Sponsor:** Norm Ashfeld

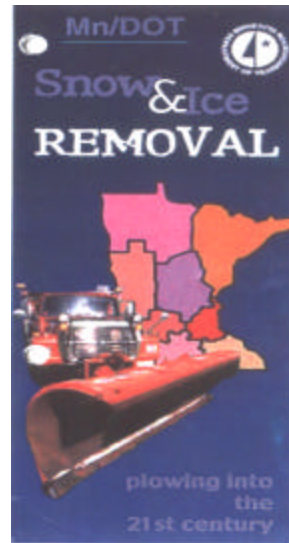
**District/Office:** Metro Division

**Contact for further information:**

Mark Fischbach (651) 582-1429

**Technical Liaison:**

John Tarnowski (651) 297-1843



### **Introduction/Background :**

Maintenance plays a very important role in Mn/DOT's strategy, "Moving Minnesota". This can be especially true in regards to snow and ice operations, which includes plowing, sanding, de-icing chemicals, and other aspects of winter maintenance. Communication of the principles of these operations is important for the motorists.

### **Purpose:**

The purpose of this project is to inform, educate, and relate contact information about Mn/DOT snow and ice control to others. Facts, figures, equipment, procedures, and other statistical information were included which will help aid in the transfer of knowledge and understanding of the snow and ice control process.

### **Test Procedure:**

This project is a marketing tool to help promote and inform Mn/DOT's snow and ice removal procedures. Therefore, there were no measurements made. Brochures were handed out to attendees at the Minnesota State Fair and other events where applicable.

### **Results:**

The most important goal of this project was to inform the public of what is involved in snow and ice control. Questions, comments, and interest expressed in regards to these procedures have made this a success.

### **Recommendations:**

It is felt that this type of information, exposure, and interaction with Mn/DOT customers should be continued in the future.

### **Status:**

Distribution has begun and will continue as necessary.

# Snow Plow Simulator Phase 1

**Sponsor:** Curt Pape

**District/Office:** Office of Maintenance

**Contact for further information:**  
Curt Pape (651) 297-1798

**Technical Liaison:**  
John Tarnowski (651) 297-1843



## **Introduction/Background:**

Up until now, the only known training simulators have been very expensive and beyond many organization's budget. The benefits of simulator training for pilots has been well documented and accepted for many years. This technology and training can also be applied to other areas and would be especially useful for plow drivers if affordable.

## **Purpose:**

The purpose of this research is to demonstrate the feasibility of the concept of creating a low cost simulator using silicone graphics to enhance performance.

## **Test Procedure:**

A demonstration of the project will be staged on a PC based computer which will verify the results to date. Costs can then be compared to an off the shelf unit.

## **Results:**

The completed demonstration showed that a low cost computer system can be used to create a simulator. Although a simple demonstration of the ability to use silicone graphics was displayed, the system worked. Phase two would be the construction of a full size simulator with a much more detail and operational ability.

## **Recommendations:**

With the successful completion of the Snow Plow Simulator Phase One, Phase Two is recommended to begin.

## **Status:**

Completed in Spring of 2001.

## Electronic Multi Meters

**Sponsor:** Kelvin Smith

**District/Office:** Office of Maintenance  
Training Center

**Contact for further information:**  
Kelvin Smith (651) 628-6841

**Technical Liaison:**  
Ken Nelson (651) 252-5435



### **Introduction/Background:**

Today's equipment has increased the need for high tech testing equipment. Multi Meter's with multi functional capability are needed to allow equipment to be tested and repaired accordingly. This new Electronic Multi Meter has many testing capabilities that will help in standardizing the training process.

### **Purpose:**

The purpose of this project is to purchase Electronic Multi Meters for each District and have training classes to ensure that all mechanics will be well schooled in the operation of the new Electronic Multi Meters.

### **Test Procedure:**

There will be 30 two-day training sessions. All Mn/DOT mechanics will be attending the sessions. The intent is to monitor the development of mechanics before and after the sessions of training.

### **Results:**

Skills and proficiency of the operator developed more quickly.

### **Recommendations:**

The recommendation is to use this training module as a foundation for designing classes and to standardize future training for mechanics.

### **Status:**

Completed in October, 1999.



# Electronic Technical Data Collection

**Sponsor:** Kelvin Smith

**District/Office:** Office of Maintenance –  
Training Center

**Contact for further information:**  
Kelvin Smith (651) 628-6841

**Technical Liaison:**  
John Tarnowski (651) 297-1843



## **Introduction/Background:**

Maintenance and repair information for vehicles is moving towards electronic data distribution. This in time will phase out paper manuals and other hard copy books. Currently there is no communication infrastructure in Mn/DOT to support this.

## **Purpose:**

The purpose of this project is to design a storage point for all technical data for as many Mn/DOT units as possible. Also the most efficient method of information delivery to the individual shops from a central location will be determined.

## **Test Procedure:**

Monitoring of the speed, accessibility, and efficiency by end users will be some of the most important determining factors as to the success of this project. Personnel will have to determine if this method is more efficient than paging through manuals and other service related books.

## **Results:**

There are no results at this time.

## **Recommendations:**

There are no recommendations at this time.

## **Status:**

On-going.

**Preview of 2002-2004  
Maintenance Research Program**

## **Preview of the 2002-2004 Maintenance Operations Research Program**

Many of the research projects listed in this report have begun but were not completed in time for the publication of this report. The project status is stated as on-going and the results will be included in the 2002-2004 Biannual Report.

In addition to the projects still being conducted in the field, numerous others will be received throughout the year. There are also projects that have been approved but due to the seasonal nature, and other various reasons, were not started. These are previewed in the following notes.

### **Winter Maintenance:**

- Test Bed Tandem – This is a continuation of the New Component Technology Test Bed. It will use a tandem truck instead of a single axle truck to install various types of new equipment. Some of the features include a full radius dump body, side mounted tanks for pre-wet liquids, and an automatic transmission fitted with a Rexroth hydraulic pump.

### **Winter Material:**

- As new anti-icing and de-icing chemicals are introduced each year, the research program will continue to evaluate the effectiveness and environmental impacts of these new chemicals.
- The Maintenance Operations Research staff is working with the Environmental Office and Materials Lab and Research in creating a guideline and procedure for testing and evaluating new chemicals.

### **Road and Bridge Maintenance:**

- Overheight Vehicle Detection System – This system uses an infrared light that is transmitted to a receiver. An alarm and a warning sign is activated if the beam is blocked.
- Hollow Deck Machine – The machine is an alternate method of chain dragging across bridge decks. The results can find deeper problems in decks that do not show up in chain dragging. It uses a sound deadening chamber and is picked up and diagnosed by a computer.

### **Traffic/Work Zone Safety:**

- Emergency Traffic Control Truck – A truck will be dedicated to carry various signs, barricades, and other traffic control equipment needed for emergency responses. This will ensure that all necessary equipment is at the site of the emergency.
- Voice Activated Message Sign – A hands free Voice Commander System will be used for striping operations to determine if it will improve traffic and employee safety. Other maintenance activities can also benefit from the system.
- Nighttime Wetline Recovery – VisiBeads will be used in Latex and Epoxy application. The evaluation will focus on improvement in reflectivity, wet line recovery, and durability of pavement markings.

- Portable Work Zone Lighting – This type of lighting will be used in maintenance and construction in high and low volume roads.

#### **Roadside Maintenance:**

- Erosion Control Equipment – A Hydro grasser will be used to better manage erosion control and restore roadside vegetation. This machine is capable of providing a slurry that blends up to 200 gallons of water and 50 gallons of seed, mulch, and fertilizer.
- Sprout Guard – This is a chemical deterrent which will prevent new growth and decrease the need for manual tree pruning.

#### **Equipment/Tools:**

- Liquid De-icing/Removal of Snow – Two miles of highway will be used as a test section for using only liquid and mechanical methods to remove and prevent snow and ice accumulation.
- Silicone Pump – This pump will be used to mechanically pump silicone into bridge joints. The project is scheduled to start July 2002.
- Stainless Steel Hopper – A hopper will be used to load salt into a brine generator building to prevent spillage. This hopper is a bottom dump model.
- Electrically Heated Dump Trailer – This heated dump trailer will be custom built and ergonomically correct with a 28 inch shoveling height.
- Recycle Mixer – The recycler-mixer creates hot mix for permanent road repairs during the winter pothole patching season. Evaluation will include the efficient use of labor and time.
- Back-Up Safety Cameras – A new type of camera has improved picture quality and vision under a variety of lighting conditions. Six of these cameras will be purchased and distributed throughout Minnesota.
- Reiter Plastic Truck Body – A different type of truck box will be used to haul summer material and used for sanding and salting in the winter. The box's versatility and resistance to damage from hauling large rocks will be tested.
- High Intensity Discharge (HID) Sander Lights – This is an on-going lighting study. The goal is to illuminate a snow plow truck during a snow cloud situation making the public more aware of plow trucks on the road.
- LED Wing Lights – Sharing the same goal as the HID Sander Lights, this type of light will be installed on the wing of a snow plow.
- UR 7000 Underhood Air Compressor – This type of equipment will be used by mechanics to increase speed and operation of repairs and maintain equipment in the field.

#### **Building:**

- Solar Heated Building – A heated building with solar panels will be constructed to store winter mix. Temperature will be monitored for its effect on keeping the material pliable and useable.

#### **Technology Transfer/Education:**

- Snow Plow Simulator Phase 2 – This is a continuation of the Snow Plow Simulator Phase 1. It will be integrated into Minnesota's statewide training program.

## **Appendix A**

## **Previous Statewide Maintenance Operations Research (MOR) Reports**

In the infancy stages of the MOR Program, the initial research focused on snow and ice field studies and projects were very limited. As the MOR Program matured and developed, it expanded into other fields of maintenance including roadside and bridges. Other offices became involved with the quality and evaluation of the projects. As projects were completed and possibly implemented, there was a need to communicate these results to the rest of the state and others.

The first MOR Report came out in 1992 and has since been published once a year. Starting this year, the MOR Report will be published every other year to coincide with the report that Mn/DOT's Office of Research Services (ORS) publishes. The ORS report is published on the years that the MOR report does not. Both offices work closely to coordinate projects that overlap in each program.

Following is a list of the project reports that have been published since 1992. Some projects had been carried over from year to year due to improvements made as results are reached. The projects listed below are in the report as it was first introduced to the program and may have conclusions in later reports. If you are interested in any of these projects, you may contact the Maintenance Operations Research Engineer.

### **1992-1993 Winter Season Report:**

- Camden Pre-wetting Field Study
- Lakeville Pre-wetting Field Study
- Plymouth Anti-icing Field Study

### **1993 Report:**

- Corrosion Research
- Road Weather Information System
- Truck Ergonomics Task Force
- Snow Fence Research
- Vehicle Conspicuity Research
- Solar Powered Culvert Deicer
- Quality Control of Premixed Sand/Salt Blender Hopper
- Laserlux Road Striping Management
- Smooth Pavement Task Force
- Remote Driven Vehicle
- Remote Slope Mower
- Zero Velocity Salt/Sand Spreader
- Timesheet Generated Interface
- Short Grass Research Plots
- Extendable Snow Plows
- Portable Interactive Weather Prediction System
- Municipal Waste Salt Water as a Pre-wetting Agent

### **1994 Report:**

- Culvert Rehabilitation
- Thermal Mapping

- Portable Interactive Weather Prediction System
- Temperature Sensors
- Snow Fence Research
- Work Zone Safety Projects
- Circuit Rider Program
- Finnish Emulsion Gravel Pavement
- Automated Call-Out System
- Timesheet Generated Interface & MMS/TIS Interface
- Barcoding
- Maintenance Research Project Tracking System
- CB Radios
- Innovative Sprayers
- Band Cleaner
- NIDO Liquid Spreader
- Wash Water Recycling System
- Salt Brine Mixing Systems
- SHRP cutting edges
- Gravel Shoulder Reclaimer

### **1995 Report:**

#### Winter Maintenance:

- Maintenance Concept Vehicle Partnership Project
- System 2000 Stationary Salt Spreader
- Automated Liquid Bridge Deck Deicer
- Brine Applicator
- Power Liquid Spreader Control Unit
- Electronic Pre-wet hang Tanks
- Integrated Tailgates Research
- Improved Snow Plow Design
- Grader End Gates
- Combined Front-Slush Plows
- Ice Buster
- Norsemeter Friction Meter
- Magnetic Pavement Taping

#### Road and Bridge Maintenance:

- Slurry Seal Patching Machine
- MicroSurfacing
- Automated Pothole Patcher
- Cascadia Enduraseal 300 Asphalt Rejuvenator
- Highlift Flatbed
- Earth Penetrating Radar Concrete Delamination Detecting System
- Lightweight Power Screed
- Retrofit Dowel Bars
- Culvert Rehabilitation Project
- Culvert Grapple Extractor (Beaver Dam Grapple)

- Stenciling Unit for Message Painting

Maintenance Management:

- Thermal Mapping
- Pavement Condition and Weather Reporting
- Interactive Travel Information Systems (Minnesota Travel Partners)
- Travel Partners Demonstration Project
- Mobile Road Weather Information Systems
- Timesheet Generated Interface & PMS/MMS/TIS Interface
- Pavement Marking Management System
- Dial in Server for Operations Management System Pilot
- Barcoding
- Paperless Field Data Collection
- Maintenance Research Project Tracking System

Roadside Maintenance:

- Herbicide Sprayer
- Flexstake Weedmats
- Remote Slope Mower
- Biological Control of Canada Thistle

General Maintenance Management:

- All Terrain Crawler Tractor; Posi-Track
- Tracks and Dozer Blade on Skidsteer Loader
- Kentrol Gate Material Control System
- Tire Experiment, Michelin

Technology Transfer:

- International Worker Exchange Program
- Finnish Emulsion Gravel Partnership Project

**1996 Report:**

Winter Maintenance:

- Heated Truck Box Using Exhaust System
- Truck Box with a Fiberglass Floor
- Snow Shield Research
- Combined Front Slush Plows
- Anti-icing using Brine from Wash Water Recycling (North Branch)
- Anti-icing using a Herbicide Sprayer Attachment, Spratronics (Metro)
- Mn/DOT – Hennepin County Anti-icing Project
- Fiber Optic Lighting Research
- Wing Plow Research (mounted at the rear of the truck)
- National Friction Measurement Study (FHWA)
- Integrated Tailgate Research
- Extendible Hood Snow Plow
- 21-Foot Snow Plow
- Cutting Edge Research



- Multiple Uses for Low-Boy Tractor
- Dual Spinner
- Elkin Spreader
- Salt Brine Mixing Systems
- Oscillating Underbody Scraper

Road and Bridge Maintenance:

- Evaluation of Radar for Snowplows
- Automatic Pothole Patcher
- Front mounted Shoulder Retriever
- Bunyan Friction Screed
- Crack Sealing
- Color Flexi Probe Inspection System
- Culvert Rehabilitation Project
- Peel-A-Way Lead Paint Removing Process for Bridges
- Lite Stripe Laser and Camera Pointer Systems

Maintenance Management:

- Automatic Low-Visibility Warning System Using Video Cameras
- ARCTIC Dispatch Center
- CD Authoring, Writing, and Sharing Project
- Automated Route Planning and Optimizing Software

Roadside Maintenance:

- Boom Sprayer Rebuild
- Hooded Ground Sprayer
- Polecat Obstacle Mower

General Maintenance Research:

- Reusable Energy Absorbing Crash Terminal
- ProPatch Head Cover, Prototype
- Bioremediation Pilot Project
- Portable Hot Water Pressure Washer
- Multi-purpose Utility Vehicle with Electrical Power tool Package
- Demo Maintenance Truck with Updated Hydraulic System

Work Zone Safety:

- Remote Driven Vehicle Unit #3
- Flashing Stop/Slow Paddle Implementation Project

Technology Transfer:

- Maintenance Expos – Fall and Spring
- Saving Salt – A Simple Solution

**1997-1998 Report:**

General Maintenance:

- Aerosol Alternative

- Drillco Sawblade
- Easy Bend
- Ford Smith Four Post Hydraulics Lift
- Multiple Uses of Hot Water Pressure Washers in Highway Maintenance
- Plasma Cutter
- Remote controller for Boom on Sign Truck
- Vacutec Leak Detector
- Video Image Scope

#### Maintenance Management:

- Blowing and Drifting Snow Control Market Research
- Evaluating Locating and Record Keeping Technology
- Fleet Management System Coordinator
- GIS Project Specialist
- Maintenance Business Planning: Measuring Quality
- From the Customer's Viewpoint
- Pavement Marking Market Research RFP
- Transmap GIS Mapping for Sign Inventory
- Striper Record Keeping/Downloading Using a Laptop Computer
- Maintenance Business Planning: Winter Operations Survey.

#### Road and Bridge Maintenance:

- Epoxy Striper Research Project
- Heated Dump Box-Tapping System
- Laser Level Plane
- Patchrite Self Propelled Pothole Patching Machine
- Silane
- Vibratory Concrete Floats

#### Roadside Maintenance:

- Box Beam Guardrail
- Contour Tree Planter
- E-Z Dig and E-Z Grader
- Funda Flex
- Power Broom/Trimmer for Light Duty Sweeping
- Weld on Wear Pads
- Wheeled Debris Blower
- Wood Chip Blower

#### Technology Transfer Partnerships:

- DNR Tandem Truck
- Truck Driving Simulator

#### Winter Maintenance:

- ALLU Screen Crusher
- Athey Force Feed Loader
- Automated Data Logger for Odin System

- Blending System for Mixing Sand and Salt
- Chemical Storage Building
- Commercial Visibility Instrument
- Continuous Friction Measurement Techniques Research
- Culvert Deicing Resistance System
- Cutting Edge Study
- Dresbach Anti-Deicer System
- Dual Auger Spinner Sander
- Dual Rear Wing Truck
- Elkin Sander
- Enclosed Salt Brine System
- Enhanced Snowplow Visibility Using Radar Technology
- Etnyre Anti-Icing Unit
- Extendable Hood Snowplow
- Heads Up Research Summary
- Henke Heavy Duty Wing
- Hydraulic Snowblower
- I-35 Fixed Bridge Deicer System
- IceBan (Liquid Deicer)
- Large Capacity Integrated Tailgates
- Nokian Tires Part One and Two
- Pick up mounted Anti-icing units
- Rebuilding Frame Work on CL-35 Snowplow
- Road Closure Gates
- Salt Conveyor
- Salt Solutions
- Snake Creek Bridge
- Stainless Steel Integrated Tailgates
- VLB Industrial Snowblower

Work Zone Safety:

- Cone Reflective Spinners
- Cone Setter/Retriever Research Trip
- Message/Arrow Brickboard
- Portable Advisory Roll-Up Sign Assemblies
- React 350 Reusable Energy Absorbing Crash Terminal
- Remotely Driven Vehicle
- Speed Control Display Systems
- Striper Crew-Programmable Light Emitting Diode Sign on Shadow Vehicle