

Clear Roads Problem Statements
February 2006

Page	Title	Description	Estimated Cost	Estimated Duration	Proposer
2	Agricultural Products vs. Salt Brine, Magnesium Chloride, and Calcium Chloride for Anti-Icing and De-Icing	Determine if liquid agricultural products are a better alternative to salt brine, magnesium chloride and/or calcium chloride for anti-icing and de-icing.	???	Two winters	Dennis Belter/ Mike Rivers, Indiana DOT
4	Automated Snow Route Design	Develop a user-friendly computer program to create efficient routes for anti-icing and snow and ice removal (deicing and plowing) using agency data such as GIS.	\$150,000	18 months	Dennis Belter, Indiana DOT
6	Contour adjusting wing	Investigate methods to allow snowplow wings to adjust to the contour of the shoulder independently of the front plow to minimize plow damage to the shoulder.	\$35,000	2 years	Dennis Burkheimer, Iowa DOT
7	National Snow and Ice Conference	Conduct a national winter maintenance meeting for Aurora, Clear Roads and the FHWA to share research results, solicit research needs and receive updates from each snow-belt state.	\$25,000	1 multi-day meeting in Fall 2006 or Fall 2007	Dennis Burkheimer, Iowa DOT
9	Material Application Sensor	Investigate methods to measure the output during discharge of materials to make sure the amount of material being spread matches what the spreader control indicates.	\$25,000	2 years	Dennis Burkheimer, Iowa DOT
10	Field Testing of Carbide Inserts on Underbody Plows	Field-test the longevity and effectiveness of carbide blade inserts from several manufacturers on underbody plows.	\$75,000	1 year	Tim Croze, Michigan DOT
11	Determining Effectiveness of Deicing Materials and Procedures	Determine the effectiveness of current chemicals and best practices in snow and ice removal using data from a highly instrumented test section.	\$75,000	27 months (two winters)	Linda Taylor/Curt Pape, Minnesota DOT
14	Ergonomics for Plow Driving	Research the ergonomics of driving and the control locations in the snowplow cab, as well as steering wheel position, plow and sander controls, and related components. Identify solutions for alleviating or possibly eliminating potentially serious long and short term negative health problems.	\$100,000	15 months	Linda Taylor/John Tarnowski, Minnesota DOT
16	Development of Additional Lessons for AASHTO/SICOP Computer Based Training Program	Develop additional lessons to add to the existing AASHTO/SICOP Computer Based Training Program.	\$30,000	1 year	Thomas Martinelli, Wisconsin DOT

Clear Roads Problem Statement
Pooled Fund #TPF-5(092)
Federal Fiscal Year 2007

I. PROBLEM TITLE

Agricultural Products vs. Salt Brine, Magnesium Chloride, and Calcium Chloride for Anti-Icing and De-Icing

II. RESEARCH PROBLEM STATEMENT

Manufacturers of liquid agricultural products claim effectiveness of their products at low temperatures, ease of use, easy applications, decreased corrosiveness, and effective lower cost. However, liquid agricultural products are considerably more expensive. Are the liquid agricultural manufacturer claims correct? Does the use of agricultural liquids provide a way to lower costs vs. salt brine, magnesium chloride, and calcium chloride?

III. OBJECTIVE

The objective is to see if the liquid agricultural products are a better alternative to salt brine, magnesium chloride and/or calcium chloride for anti-icing and de-icing.

IV. RESEARCH PROPOSED

Use the agricultural products in anti-icing and de-icing applications, alongside the salt brine, magnesium chloride and calcium chloride. Compare effectiveness, ease of use, corrosiveness, problems with application, and costs at different temperatures.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding: ???

Research Period: Two winters

VI. URGENCY AND PAYOFF POTENTIAL

The use of salt and other chlorides is a concern for the environment. If cost-effective, safer products are available, all transportation departments would benefit.

VIII. RELATED RESEARCH

University of Iowa

Evaluation of an Ice Ban Product as a Prewetting Agent for Snow Removal and Ice Control Operations, January 2000

http://www.virginiadot.org/vtrc/main/online_reports/pdf/00-r12%20.pdf

Introduction and Page 2

The purpose of this project was to determine if VDOT should use Ice Ban M50 for snow and ice control. Ice Ban is the registered trade name of a group of agricultural by-products patented for use as roadway deicing/anti-icing agents. Ice Ban is more expensive than traditional anti-icing and deicing chemicals. In 1997, the price for Ice Ban in Virginia was \$0.33/L (\$1.25/gal). The prices for more traditional anti-icing chemicals, converted to liquid measure, were \$0.015/L (\$0.06/gal) for NaCl, \$0.17/L (\$0.65/gal) for MgCl₂, and \$0.13/L (\$0.50/gal) for calcium chloride (CaCl₂). Based only on cost, it appears that Ice Ban cannot compete with the more traditional chemicals. However, if Ice Ban products can reduce corrosion of equipment, infrastructure damage, and the adverse environmental effects of traditional chemicals while maintaining the level of service provided by current anti-icing techniques, its use may be cost-effective.

Agricultural byproduct deicers are here to stay, January 2001

<http://www.betterroads.com/articles/brjul01a.htm>

Proof of the viability of the market is the creation of a new company formed by Minnesota Corn Processors and METSS Corporation. METSS is the developer of the new class of anti-icing materials that include First Down, effective to -34 degrees F, and All Clear, effective to -65 degrees F. Both contain no chloride salts at all, being made entirely of all-natural, organic materials. The corrosion characteristic is less than distilled water. All Clear has another advantage in boasting an indefinite shelf life. America West currently distributes both products.

Road Solutions, Inc. began distributing X-Ice this year after successful trial marketing by parent company Correlated Products, Inc. It's being used successfully in many Midwest state and local highway departments, and is made from the residue of grain and other agricultural products. It blends with magnesium chloride (called X-Ice M50) for an effective temperature to -20 degrees F, or with salt brine (X-Ice S50) down to -33 degrees F for liquid applications.

Cargill Salt makes a product called ClearLane with a molasses base. The liquid is used for spraying on rock salt as it's applied to roads and for prewetting to boost brine generation on the roads. It's a mixture of molasses and liquid magnesium chloride. ClearLane Treated Salt adds rock salt to the mix for a ready-to-go road deicer. Both products provide corrosion protection to user equipment.

FOCUS on anti-icing and deicing materials, August 2000

<http://www.betterroads.com/articles/prod800.htm>

Scroll to: Agricultural Mix

An environmentally safe product used for anti-icing, de-icing, and freeze proofing is M-50 Road Deicer from Mountain Products & Equipment. The patented agricultural by-product derived from processed grain or other sugar-content crops is mixed with liquid magnesium chloride to create the non-toxic, bio-degradable material. Applications for M-50 include anti-icing, deicing, stockpile treatment, prewetting, and freeze proofing. It has a freezing point of -40 degrees F and is less corrosive than distilled water. It re-activates in precipitation until diluted and prevents black ice and clear-weather frost.

IX. DATE AND SUBMITTED BY

Proposer: Mike Rivers, INDOT

Contact person:

Dennis Belter

Program Support Manager

Indiana Department of Transportation

IGCN Rm. N925

100 N. Senate Ave.

Indianapolis, IN 46202

Telephone: 317-232-5424

Fax: 317-232-5551

dbelter@indot.state.in.us

January 24, 2005

Clear Roads Problem Statement
Pooled Fund #TPF-5(092)
Federal Fiscal Year 2007

I. PROBLEM TITLE

Automated Snow Route Design

II. RESEARCH PROBLEM STATEMENT

Snow Routes are prepared to cover every road in the State jurisdiction. Current routes were prepared by hand or in some cases, a labor intensive computer aided design. Although current routes cover all roads in the State jurisdiction, it is unlikely that the routes are the most efficient. Efficient routes are needed to ensure proper use of limited resources. Several years ago a computer program was developed that required many hours of input. The intent of this project is to not require manual input other than route parameters such as starting points, maximum length, route priorities.

III. OBJECTIVE

The objective of this project is to develop a user friendly computer program to create efficient routes for anti-icing and snow and ice removal (deicing and plowing). Anti-icing routes may not cover all roads. Snow and ice removal routes shall cover all roads including all traveling lanes, turn lanes and ramps. The program should include the capability to create optional routes for optimal coverage when resources are insufficient; i.e., personnel, trucks down, etc.

IV. RESEARCH PROPOSED

A computer program shall be developed to create all anti-icing and snow and ice removal routes in a jurisdiction. Maps and written descriptions of each route would be the end result. The program would be utilized by managers at the Central Office, District and Subdistrict levels. Routes could be created on a Unit, Subdistrict, District or statewide basis. All routes will identify deadhead and service miles and consider material application rates and length of routes desired. Agency data such as GIS shall be utilized.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding: \$150,000.

Research Period: 18 months

VI. URGENCY AND PAYOFF POTENTIAL

Anti-icing and snow and ice removal routes are used for every event. By improving the efficiency of routes, use of resources will be maximized. Potential savings include fuel, equipment and labor. Elimination of one route allows fleet size of trucks to be reduced by one plus all maintenance and fuel for that truck.

VIII. RELATED RESEARCH

Purdue University developed a program, CASPER, for snow route design. It was not user friendly and required extensive labor to implement. An unsuccessful attempt to modify the program resulted in discontinuing use. Several route design programs for deliveries exist, however they do not address snow route design concerns such as; need for coverage of every road in a defined area, multiple lanes, turn lanes, ramps, intersections and turn around points. These concerns must be addressed to have a successful implementation.

Providing Intelligent Spatial Decision Support using Expert System and Web Technologies

Proceedings of the 2005 Mid-Continent Transportation Research Symposium, Ames, Iowa, August 2005.

© 2005 by Iowa State University.

<http://www.ctre.iastate.edu/PUBS/midcon2005/llavajhalaSpatial.pdf>

From Abstract: The web-based ISDSS the authors developed integrates an intelligent software component with geospatial and analytical techniques for providing real-time decision support for planning snow removal operations. The system achieves the objectives of providing intelligent decision support by including expert knowledge on snow removal operations within the system. Further, the real-time weather information accessed from the Internet, along with expert knowledge, helps in making real-time decisions based on different weather conditions. To provide ease of use, the user interface components, such as the toolbars, layers, and the map, were adapted to emulate the look and feel of standardized GIS software like ArcGIS. The current prototype has capabilities such as a user-friendly interface, powerful analytical tools for effective management and optimal allocation of resources (e.g., material, vehicles, and drivers), efficient routing, easy inventory management and analysis, an integrated real-time weather

system, and expert knowledge. This system is capable of streamlining various tasks involved in planning snow removal operations and helps cut costs by increasing the efficiency of snow removal procedures.

Caliper Announces Development of an Automated Snow Plow Routing Application for Hennepin County, January 1999

<http://www.caliper.com/Press/pr990104.htm>

Reports generated by the application include route descriptions that list highways to be serviced in a single route, the number of trucks assigned to a route, and the originating truck station for each route. Routes are also displayed in color maps and are further described in statistical reports that describe service time and deadhead time.

Web-based Implementation of Winter Maintenance Decision Support System Using GIS and Remote Sensing, May 2005

http://www.ctre.iastate.edu/mtc/reports/winter_mdss.pdf

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Researchers have also explored the possible use of decision science tools for optimizing the asset management of snow removal resources (Campbell, and Langevin 1995). For example the Snow Removal Asset Management System (SRAMS) was developed as an analytical tool to improve resource allocation in Iowa using GIS and artificial intelligence techniques (Salim, et al. 2002).

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5.2.1.2: Creating Routes

WMDSS provides two options for routing: (1) creating routes manually or (2) using the existing set of predefined routes. The predefined routes are the standard routes used by the Iowa DOT to snowplow, based on priority. These routes are color-coded and present in the WMDSS as a default layer. These existing routes prevent the need to create and save routes with every use, which thus saves time and effort for the DOT. The manual route creation tool helps add new routes as necessary. For creating a route, expert knowledge is used to determine the estimated snowplowing time, number of runs to snowplow, and the total snowplowing time. The program utilizes the expert knowledge encoded in the form of embedded business rules to obtain the results.

IX. DATE AND SUBMITTED BY

January 26, 2006
Dennis Belter
INDOT Maintenance Administration Manager
100 N. Senate Ave. Room N925
Indianapolis, IN 46204
Telephone: 317-232-5424
Cell: 317-753-6620
Fax: 317-232-5551

Clear Roads Problem Statement
Pooled Fund #TPF-5(092)
Federal Fiscal Year 2007

I. PROBLEM TITLE

Contour adjusting wing.

II. RESEARCH PROBLEM STATEMENT

Wings on the front middle or rear of snowplows are fairly common and are used to help clear shoulders during snow removal operations. Typical wing positions are controlled by the operator in the cab to remove materials from the shoulder but since the roadway and shoulders often have different contours the wing may dig into the shoulder or remove rock from the shoulder. Removal of rock from the shoulder creates problems as vehicles leaving the roadway will experience soft shoulders that will may develop into edge ruts that create safety problems for motorists. Casters and metal wheels have been used in the past to control the ride of the wing on the shoulder but are often damaged or cause problems for operators when they need to be replaced.

III. OBJECTIVE

Investigate alternative methods to allow the wing to adjust to the contours of the shoulders independently of the front plow. The method would have to minimize extra parts on the wing that would allow the wing to plow close to the shoulder without removing rock from the shoulders.

IV. RESEARCH PROPOSED

Conduct a thorough literature search of existing products used in the US and Internationally to allow the wing to adjust to the contours of the shoulder. Investigate products used in the agricultural industry that may be adapted for winter maintenance operations. Combines have head leveling devices that allow the combine head to adjust to the contours of the terrain. Purchase and test any products that appear to be adequate for this application.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding: \$35,000 -

Research Period: Two years- Year one would be an extensive literature search. Year 2 would be testing and evaluating any products that appear to work.

VI. URGENCY AND PAYOFF POTENTIAL

With reduced maintenance budgets and safety concerns for edge ruts, it's important to make sure the rock shoulders remain intact during plowing operation.

VIII. RELATED RESEARCH

Not aware of any

IX. DATE AND SUBMITTED BY

Dennis Burkheimer
Winter Operations Administrator
Iowa Department of Transportation
800 Lincoln Way, Ames, IA 50010
Phone- 515-239-1355
Fax- 515-239-1005
e-mail- dennis.burkheimer@dot.iowa.gov
Date submitted: February 14, 2006

Clear Roads Problem Statement
Pooled Fund #TPF-5(092)
Federal Fiscal Year 2007

I. PROBLEM TITLE

National Snow and Ice Conference

II. RESEARCH PROBLEM STATEMENT

Clear Roads is actively researching materials, equipment and practices related to winter maintenance operations while Aurora and the FHWA are researching a number of surface transportation weather projects. Unfortunately the information/results sometimes do not reach end users in all states or at different agency levels. The winter maintenance community needs to be more aware of the research conducted by Clear Roads, Aurora and FHWA and take a more active role in requesting research to meet winter operational needs.

III. OBJECTIVE

To conduct a National winter maintenance meeting for Aurora, Clear Roads and the FHWA to share research results, solicit research needs and receive updates from each snow-belt state. Each state would send two representatives to the meeting that are most actively involved with the areas (mainly weather and winter operations) covered by Aurora, Clear Roads and FHWA.

IV. RESEARCH PROPOSED

A national, multi-day meeting to cover a wide variety of topics related to winter maintenance operations. Surveys of research needs would be generated from the attendees and work would be started to share or coordinate winter maintenance activities. Clear Roads, Aurora and FHWA would have a portion of the meeting available to share results of the work done by their group and also solicit for new members.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding: \$25,000

Research Period: One meeting held in the fall of 2006 or 2007.

VI. URGENCY AND PAYOFF POTENTIAL

There has never been a national effort that brings together key people from each snowbelt state to discuss snow and ice operational and weather issues. A meeting like this could help provide direction for future research needs and give states the opportunity to hear how others are dealing with winter maintenance issues.

VIII. RELATED RESEARCH

6th International Symposium on Snow Removal and Ice Control Technology, 2004

http://trb.org/news/blurb_detail.asp?id=3886

TRB Electronic Circular 63: Sixth International Symposium on Snow Removal and Ice Control Technology is the compendium of papers for the June 7-9, 2004, Spokane, Washington symposium. Issues addressed at the symposium included winter weather (information, models, and data quality); winter maintenance (policy, management, and performance); customers' perspectives on winter operations; environmental stewardship; winter maintenance vehicle advancements; bridge support systems; winter pavement temperatures and road conditions; material distribution, performance and residual; and large-volume snow control.

American Public Works Association North American Snow Conference, April 30 - May 3, 2006

<http://www.apwa.net/Meetings/Snow/2006/tuesday.asp>

Keynote speakers and the always-popular Snow Conference Talk Show will be featured at general sessions on Sunday, Monday and Tuesday - plus more than 30 education sessions and roundtables addressing a variety of topics including fuel alternatives, one-pass clearing, wing plows, pavement forecasting, road weather management, public relations, salt applications, anti-icing and de-icing, AVL/GPS, winter pavement maintenance, fleet responsibilities in a disaster, new technologies, and much more!

10th Eastern Winter Road Maintenance Symposium and Equipment Expo, 2005

<http://transportation1.org/calendar/sicop/registration.aspx>

The resulting *Eastern Winter Road Maintenance Symposium and Equipment Expo* - held annually in September-is targeted at Winter Maintenance managers and other public works practitioners from cities, townships, counties, states (as well as other public agencies and private sector partners) east of the Mississippi River. Through this effort, we hope to bring the most up-to-date information on equipment, materials, and technology closer to you and your colleagues. It is also intended to serve as a companion to the American Public Works Association's *Western Snow and Ice Conference*, held annually in Colorado in late September. Through these efforts, snow/ice management forces all over the nation will be provided with ideal opportunities to gain insight as to the best practices, materials, and equipment available and to compare notes with their peers from other States with similar (as well as widely different) experiences to improve operations and the transfer of information nationwide, as well as reduce costs.

IX. DATE AND SUBMITTED BY

Dennis Burkheimer
Winter Operations Administrator
Office of Maintenance
Iowa Department of Transportation
800 Lincoln Way
Ames, IA 50010
Phone: (515) 239-1355
Fax: (515) 239-1005
E-mail: dennis.burkheimer@dot.iowa.gov

Clear Roads Problem Statement
Pooled Fund #TPF-5(092)
Federal Fiscal Year 2007

I. PROBLEM TITLE

Material Application Sensor

II. RESEARCH PROBLEM STATEMENT

Material spreaders used in winter maintenance operations are designed to measure the number of revolutions the material spreader auger. From that count the system determines the amount of material being spread on the roadway. The operator in the cab of the vehicle sets the amount of material to be spread on the roadway and the auger adjusts speeds to increase or decrease the amount of material spread on the road. If materials clog the auger, the operator may not know when materials stop flowing from the truck since the auger may still be revolving. The use of straight salt also makes it difficult for the operator to see through the rearview mirror whether the auger and spreader are dispensing the right amount of materials.

III. OBJECTIVE

Investigate methods to measure the output during discharge of materials to make sure the amount of material being spread matches what the spreader control indicates. An alarm system may need to be built in to give the operator an audible notification that the spreader is not dispensing materials or has been reduced to a certain level.

IV. RESEARCH PROPOSED

A literature search of sensors used to determine what has been tested for this type problem. The literature search should also include the agriculture industry since they have similar issues with grains. Testing of products from similar industries should then be tested on a snow plows in a variety of states.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding: \$25,000 should pay for a literature search and the purchase of several devices used to measure outputs.

Research Period: Two years- One year for a literature search followed by a winter testing period of various sensors.

VI. URGENCY AND PAYOFF POTENTIAL

As agencies move toward more straight salt applications it makes it much more difficult for operators to determine if the material spreaders is dispensing the right amount of material from the truck. They may drive several miles before the realize that the auger is not dispensing material which will result in inconsistent roadways and wasted time to rerun the route.

VIII. RELATED RESEARCH

Low Cost Sensor to Inform Operator that Cinder or Salt is Being Spread

Completed research: New Mexico State Highway and Transportation Department

<http://rip.trb.org/browse/dproject.asp?n=3342>

Abstract: There is need to alert operators if their spreader box is not spreading cinder or salt due to being low, empty or that the material has gotten wet or become frozen, clogging the spreader. One alternative is to develop a sensor with an electronic beam, another alternative would be to develop a mechanical device, gated system.

IX. DATE AND SUBMITTED BY

Dennis Burkheimer

Winter Operations Administrator

Iowa Department of Transportation

800 Lincoln Way, Ames, IA 50010

Phone- 515-239-1355

Fax- 515-239-1005

e-mail- dennis.burkheimer@dot.iowa.gov

Date submitted: February 14, 2006

Clear Roads Problem Statement
Pooled Fund #TPF-5(092)
Federal Fiscal Year 2007

I. PROBLEM TITLE

Field Testing of Carbide Inserts on Underbody Plows. (MDOT spec., Joma, Kennametal Ice series)

II. RESEARCH PROBLEM STATEMENT

Blade manufacturers continue to develop new types of blades in an attempt to address blade wear and extend the useable life of the carbide inserts. In limited tests MDOT has found that some of these new types of blades seem to be lasting longer, but a true side by side comparison of these new types of blades with our conventional specification has not been done. These new blades typically cost more than the conventional MDOT specification for carbide inserts so a comparison of longevity to cost needs to be performed in order to evaluate the cost-effectiveness of these new blades.

III. OBJECTIVE

The objective of this research is to field test the longevity and effectiveness of carbide blade inserts on underbody plows from several different manufactures.

IV. RESEARCH PROPOSED

The research would involve outfitting several trucks with new sets of carbide blades from each manufacturer that is approved by the technical advisory committee. The equipment operators would be required to record the number hours or miles that the blades were in contact with the pavement. A comparison of the longevity and the cost of each type of blade would be made.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding: \$75,000

Research Period: 1 year.

VI. URGENCY AND PAYOFF POTENTIAL

With carbide inserts prices increasing significantly over the past 3 years, research needs to be done to determine which type of insert is the best value for the money.

VIII. RELATED RESEARCH

Maine Department of Transportation Technical Memorandum: 03-11 Field Testing of Alternative Carbide Edge Snow Plow Blades.

<http://mainegov-images.informe.org/mdot/transportation-research/pdf/Report0311t.pdf>

Evaluation of Cracking in Pre-service and In-service Snow Plow Carbide Wear Surfaces

December 2003

<http://168.166.124.22/RDT/reports/Ri01023/RDT03015.pdf>

Abstract: The purpose of this study was to determine the source of defect propagation in carbide/steel snowplow blade inserts and qualify a nondestructive testing technique that will: a) locate and determine whether or not defects originating in the manufacturing process have an impact on blade service life, b) be able to monitor in-service blades to determine the rate of carbide insert and bond breakdown in the field, c) evaluate various carbide insert configurations in the field. Research, Development and Technology recommends the following and that blade life be monitored to determine if satisfactory results from these changes occur: 1) Use the nondestructive technique for receipt inspection to detect indications oriented transverse and other than transverse to the sound beam, as well as lack of bond, 2) Use front or rear mounted blades next to the carbide blade to increase the service life of the individual carbide blade, 3) With a 0° +/- roadway angle, Missouri DOT should change the shape of the carbide insert such that the inserts have a flat face, 4) try dual carbide blades on front mounted plows.

IX. DATE AND SUBMITTED BY

Tim Croze

Michigan DOT-Maintenance Support Area

6333 Old Lansing RD.

Lansing, MI 48917

Phone (517) 322.3394

Fax (517) 322.3385

crozet@michigan.gov

Clear Roads Problem Statement
Pooled Fund #TPF-5(092)
Federal Fiscal Year 2007

I. PROBLEM TITLE

Determining Effectiveness of Deicing Materials and Procedures

II. RESEARCH PROBLEM STATEMENT

Mn/DOT spends an average of 60M per year on snow removal and deicing activities. In order to meet our level of service requirements under increasing budget and environmental constraints, we need to be able to determine the “best value” for both chemical and mechanical snow/ice removal practices. Doing so will allow us to refine our current best practices to provide the public with good service at an acceptable cost while protecting the environment.

III. OBJECTIVE

The focus of this project would be information analysis to determine the effectiveness of current chemicals and best practices in snow & ice removal.

IV. RESEARCH PROPOSED

The information mentioned above would be collected from a highly instrumented test section which would show the relationship between pavement temp and conditions under various treatment scenarios. Once this relationship is established Mn/DOT will be better able to determine best value in deicing chemicals/procedures under varying conditions. Mn/DOT is proposing the Alexandria test site because it is currently equipped with RWIS, trucks are instrumented with Sail equipment, RWIS sensors updated and site has a ice detection camera.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding: An estimated cost of \$75,000 would cover collecting and analyzing the data and writing a final report.

Research Period: The test period would run for two winters or 27 months to ensure that sufficient data has been collected.

VI. URGENCY AND PAYOFF POTENTIAL

If research is successful, the results would shape our winter maintenance program and assist operators in selecting the appropriate product for the road and weather conditions. The department would benefit by increasing safety to the motoring public, reducing product usage, and minimizing impact on the environment.

In general, to gain benefits from this research, Mn/DOT will contribute all infrastructure costs on the test section. This includes RWIS information from a station with both active and passive pavement sensors; a Laser Road Surface Camera; precipitation measurement devices (liquid equivalent); a network video camera; Mobile Data Computer in Maintenance vehicle – this will allow real time tracking of vehicle position, plow up/down, chemical type and application rates; wing up/down; underbody up/down and operator entered road surface conditions.

VIII. RELATED RESEARCH

Evaluation of Equipment Options for Snow Removal and Ice Control

Research in progress: Virginia Department of Transportation

<http://rip.trb.org/browse/dproject.asp?n=11008>

From Abstract: In response to the need to implement best management practices for snow removal and ice control, while reducing equipment cost, VDOT is constructing a prototype vehicle with the capability to dispense granular and liquid chemicals directly onto the pavement during snow removal and ice control operations.

Ice Melting Performance for Ice-Control Chemicals

2005- from TRB 84th Annual Meeting Compendium of Papers CD-ROM

Abstract: Ice control chemicals, which act to depress the freezing point of water, are used extensively in winter maintenance activities to prevent the formation of the bond between snow and ice and the highway pavement or to destroy that bond when it has formed. A number of factors may impact the choice of ice

control chemicals for a given agency or in a given circumstance, as noted by Nixon and Williams (1). These factors are in essence one way in which the performance of ice control chemicals can be quantified, and as such could be incorporated into specifications to ensure selection of the best chemical(s) for a given agency to use in its winter maintenance activities. The definition of best should be a function of the given agency's needs. Performance measures for ice control chemicals are important because they are the basis for a quality control program for the acceptance of those chemicals. This paper presents a series of performance measurement tests for chemicals, and discusses the role that they can play in such a quality control program. It extends some preliminary results on simple tests (viscosity and specific gravity) presented earlier (2). This paper examines the ice melting test, the freezing point test, and the ice penetration test as applied to seven different ice control products. The ice control chemicals tested were all as supplied by various agencies, rather than being supplied directly from manufacturers. The paper evaluates the suitability of the three tests as performance measurement tools for ice control chemicals, and also assesses the manner in which they might be used in a quality control program.

Prediction of Brine Application for Pretreatment/anti-icing

2004- from TRB 83rd Annual Meeting Compendium of Papers CD-ROM

Abstract: Highway anti-icing strives to prevent the ice/pavement bond by pre-application of chemicals. An effective anti-icing program requires prediction/estimation of the amount/type/timing of chemicals needed for the expected precipitation event, while compensating for time/traffic decay of the chemical on the highway surface. Development of a sodium chloride brine anti-icing methodology was accomplished via an extensive study of brine residual decay on four pavement types. In October and November 2002, brine residual was monitored for up to three days after initial application on five sections of four-lane divided highways in Ohio. Four evenly spaced test stations within each highway section were monitored for residual as time and traffic accumulated. An instrument that dissolves salt and measures conductivity was utilized to measure available salt residual. Efficacy of the brine to prevent ice/surface bonding was estimated utilizing freeze/thaw cycles of various brines. After freezing, the bonds were held vertically as temperature was raised. The appearance of liquid below the interface indicated release. Field and laboratory data were correlated to estimate freezing temperatures for various salt residuals as a function of brine dilution represented by precipitation in depth of rainfall. Results support estimation of brine application requirements for three specific pavements based on expected precipitation and the salt residual models developed in the study. A set of graphs is included to implement the algorithm.

APWA North American Snow Conference, April 30 – May 3, 2006

Scheduled presentation: Anti-Icing Lessons Learned in Indiana

Speaker: John Habermann, Indiana LTAP, West Lafayette, IN

<http://www.apwa.net/Meetings/Snow/2006/tuesday.asp>

Many local agencies in the State of Indiana have used different types of materials for anti-icing and deicing – from salt brine to sophisticated proprietary chemicals. This presentation will discuss the pros and cons of different material options, application rates and costs, and will present photos showing each application's effectiveness.

Modeling pavement temperature for winter maintenance operations

2004: publication available for order through IngentaConnect

<http://www.ingentaconnect.com/content/nrc/cjce/2004/00000031/00000002/art00018>

From Abstract: This paper uses data collected by RWIS stations at the City of Ottawa to devise a procedure that maximizes the use of a data batch containing complete, partially complete, and unusable data and to study the relationship between the pavement surface temperature and weather variables. Statistical models were developed, where stepwise regression was first applied to eliminate those variables whose estimated coefficients are not statistically significant. The remaining variables were further examined according to their contribution to the criterion of best fit and their physical relationships to each other to eliminate multicollinearities. The models were further corrected for the autocorrelation in their error structures. The final version of the developed models may then be used as a part of the decision-making process for winter maintenance operations.

A Real-Time Scheduling Model for Winter Road Maintenance Operations

2005- from TRB 84th Annual Meeting Compendium of Papers CD-ROM

Abstract: This paper introduces a real-time scheduling model that can be used by maintenance managers to develop and evaluate alternative resources allocation plans for winter road maintenance operations.

The scheduling model takes into account a wide range of road and weather condition factors such as road network topology, road class, weather forecasts and contractual service levels, and produces a

vehicle dispatch schedule that is optimal with respect to operating costs and quality of service. The model is then used to carry out an analysis on a realistic case to illustrate the potential impact of improved information on winter maintenance operations.

Anti-icing and Pre-wetting: Improved Methods for Winter Highway Maintenance in North America
August 2005

http://www.coe.montana.edu/wti/wwwshare/Corrosion/PNS_AntiiPrewetting.pdf

The information in this paper will benefit maintenance agencies and transportation officials who seek to fully understand the benefits derived from improved winter maintenance technologies, identify areas for improvement within their own jurisdiction, and learn about related experiences from other agencies.

Referenced works include:

Colorado DOT Liquid Deicer Fact Sheet

<http://www.dot.state.co.us/TravelInfo/DeicerFactSheet.pdf>

At approximately 30 cents per gallon, CDOT's most widely used liquid anti-icers and de-icers are the least expensive alternatives to sand and salt on the market. In addition to reducing the need for the less environmentally friendly sand/salt mixture, the application of liquids helps to reduce maintenance costs by lessening the need for plowing and after-storm sweeping. Liquid de-icers (27 to 29 percent de-icer) utilized include magnesium chloride (used above 16 degrees pavement temperature) and cold temperature magnesium chloride (used below 16 degrees pavement temperature). The latter includes a corn byproduct to lower the freezing point

A Comprehensive Approach to Decision Making in Winter Maintenance

2004- from TRB 83rd Annual Meeting Compendium of Papers CD-ROM

From Abstract: The anti-icing process requires better information, especially with regard to the onset, type, intensity and duration of winter storms. The effectiveness of winter maintenance activities is critically dependent upon the quality of information upon which decisions are based, and how well that information impacts the decision making process. This paper illustrates various tools that will aid winter maintenance personnel in making better decisions based on the information that is available to them. The tools considered include data mining techniques, neural networks and expert system software. However, the decisions made are discrete. In an area where input variables change over time, continuous decision-making ensures more accuracy. Fuzzy logic is one such approach that will aid in the shift from a discrete to continuous decision-making process, and the paper discusses potential use of fuzzy logic to further improve winter maintenance decision making.

IX. DATE AND SUBMITTED BY

Curt Pape

State Program Administrator

395 John Ireland Blvd.

St. Paul, MN 55155

(651) 297-1798 (Phone)

(651) 296-6758 (Fax)

February 8th, 2006

Clear Roads Problem Statement
Pooled Fund #TPF-5(092)
Federal Fiscal Year 2007

I. PROBLEM TITLE

Ergonomics for Plow Driving

II. RESEARCH PROBLEM STATEMENT

Plow drivers are sometimes required to drive for many hours with little or no opportunity to take a break, stretch, relax for more than a few minutes, or do anything other than drive and operate the truck equipment. As a former plow driver I can testify to the painful conditions that are created when the mental stress of driving is coupled with the physical demands of the same.

III. OBJECTIVE

Ergonomics of driving and the control locations in the cab as well as steering wheel position, plow and sander controls, and related components should be studied.

IV. RESEARCH PROPOSED

A primary list relating to muscular-skeletal problems and functions should be compiled. These would be researched for solutions for alleviating or possibly eliminating potentially serious long and short term negative health problems relating to them.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding: The total estimated budget for this proposal is \$100,000.

Research Period: The total estimated time duration of this proposal is 15 months.

VI. URGENCY AND PAYOFF POTENTIAL

If research is successful, the potential benefits would benefit everyone from the drivers, to health and medical professionals, employers, and others departments and organizations.

In general, to gain the benefits from this research, a training class with statewide implementation would have to be established and utilized within Mn/DOT, and then made available to other organizations, and states.

VIII. RELATED RESEARCH

Very limited research has been conducted on the ergonomics of snowplow use. Mostly, research on workspace designs has been done, especially on those where operators are confined to a small space for long periods of time. The operators workspace is also affected by the environment located in, the lighting, the associated noise and also the layout of the area. Other issues that affect operator performance can include improper posture, twisting and reaching, and repeated forceful operations. Operator fatigue can also affect performance.

Office-Based Ergonomic System to Help 12,000 Truck Drivers, June 2005

<http://www.schneider.com/news/AtlasErgonReleaseFINAL.doc.html>

Schneider National Inc., a premier provider of transportation, logistics and related services, is working with Atlas Ergonomics to provide in-cab health and safety improvements for more than 12,000 drivers. Known for its office ergonomic innovations, Atlas is now applying its proven methods for reducing discomfort, fatigue and turnover to Schneider trucks.

We Fit the Truck to the Driver

Atlas Ergonomics- services for commercial drivers

<http://www.atlasergo.com/driversfit.htm>

Atlas turns the complex demands of proper in-cab adjustments into a simple system of pictures, colors and numbers. For each driver, Atlas identifies all appropriate settings, based on his/her physical needs. Then Atlas provides each individual a simple laminated card with correct settings, and instructions on the knob or levers used to get there. Drivers can take the card from vehicle to vehicle, ensuring safety throughout the fleet, and reducing the need for additional assistance.

Ergonomics and Driving

Occupational Health Clinics for Ontario Workers Inc.

Revised 2005

http://www.ohcow.on.ca/resources/handbooks/ergonomics_driving/Ergonomics_And_Driving.pdf

Who is at Risk? ...Truck drivers ...Anyone who drives for long periods of time on a regular basis. This pamphlet provides information concerning the ergonomic risks from driving, and provides a few simple but important safety tips to help keep drivers healthy.

Evaluation of an Alternative Seating Technology for Truck Seats

2003: publication available for order through TRIS Online

<http://trisonline.bts.gov/detail.cfm?ANNUMBER=00967157&STARTROW=41&CFID=2735777&CFTOKEN=7704574>

Abstract: In this study, the comfort of an air-inflated seat cushion designed for truck seats was compared with a common foam cushion. Using a single-axis test rig, each cushion type was evaluated under both transient and steady-state conditions over a 12-hour period (in four-hour intervals) measuring the effects of long-term sitting. The tests indicated a greater stiffening of the foam over time and higher-pressure concentrations at the bony prominences compared to the air-inflated cushion. Objective measures recommended by past studies were used to evaluate the dynamic properties of the two cushions. Two new techniques, seat pressure distribution and area pressure change, were also formulated to highlight the relative dynamics between different types of seat cushions and their effect on driver comfort. Results from the tests demonstrate that the air-inflated seat cushion provides more driving comfort by improving pressure distribution between the seat cushion and the driver.

Towards a transactional ergonomics for driver stress and fatigue

2002: publication available for order through IngentaConnect

http://www.ingentaconnect.com/search/article?title=driver+ergonomics&title_type=tka&year_from=2001&year_to=2006&database=1&pageSize=20&index=9

Abstract: This article reviews a transactional model of driver stress and fatigue, and its ergonomic application to designing vehicle systems for "stress-tolerance." Disturbances of subjective state are controlled by cognitive stress processes of appraisal and coping. Both personality factors and situational stressors may elicit maladaptive patterns of cognition that generate subjective stress symptoms, elicit potentially dangerous coping strategies, and interfere with information-processing and attention to the task at hand. Studies using a driving simulator have explored the behavioral consequences of several qualitatively different forms of "stress" that can be loosely labeled as anxiety, anger and fatigue. Implications of the model for design are reviewed, focusing on road engineering, in-car systems, and automation of vehicle functions. A transactional analysis focuses on evaluation of the cognitions produced by vehicle systems, problems of distraction and overload, and maintaining active task involvement. The article concludes with guidelines for design to minimize safety problems associated with stress and fatigue.

IX. DATE AND SUBMITTED BY

John Tarnowski

Training Specialist

395 John Ireland Blvd.

St. Paul, MN 55155

(651) 297-1343 (Phone)

(651) 296-6758 (Fax)

February 8th, 2006

Clear Roads Problem Statement
Pooled Fund #TPF-5(092)
Federal Fiscal Year 2007

I. PROBLEM TITLE

Development of Additional Lessons for AASHTO/SICOP Computer Based Training Program

II. RESEARCH PROBLEM STATEMENT

To develop additional lessons to add to the existing AASHTO/SICOP Computer Based Training Program. Refer to the attached notes from a January 17, 2006 planning meeting at which possible lessons topics were discussed.

III. OBJECTIVE

Support the development of 2-4 additional lessons that could be added to the existing AASHTO/SICOP Computer Based Training Program or the development of a separate set of lessons for a specific audience.

IV. RESEARCH PROPOSED

Development of more interactive lessons related to winter maintenance operations. These lessons would support the lessons already developed.

<http://www.pooledfund.org/projectdetails.asp?id=132&status=4>).

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding: \$30,000

Research Period: October 2006 - October 2007

VI. URGENCY AND PAYOFF POTENTIAL

These additional winter maintenance training lessons would build on the momentum established by the original seven lessons released in 2004/2005. Any payoff from this interactive type of training would relate to more efficient winter operations and lower cost per mile for winter maintenance activities.

VIII. RELATED RESEARCH

Completed AASHTO/SICOP RWIS/Anti-icing Computer Based Training Program, Lessons 1-7, 2005

IX. DATE AND SUBMITTED BY

Tom Martinelli
Winter Operations Engineer
WisDOT, Bureau of Highway Operations
P.O. Box 7986, Room 501
Madison, WI. 53707-7986
(608) 266-3745 (phone)
(608) 267-7856 (fax)
thomas.Martinelli@dot.state.wi.us

DATE: January 31, 2006

**Computer Based Training for Winter Maintenance Snow/Ice Operations
Meeting minutes from January 17, 2005 meeting in Dubuque Iowa**

Attendees:

Bret Hodne- City of West Des Moines (APWA)
Mark DeVries- McHenry County, Illinois (APWA)
Greg Parker- Johnson County, Iowa (NACE)
Tom Martinelli- Wisconsin DOT (Clear Roads)
Lee Smithson- AASHTO
Dennis Burkheimer- Iowa DOT (Clear Roads)

Purpose of meeting: The purpose of the meeting was to discuss whether there was a need for additional Computer Based Training (CBT) modules in winter maintenance snow/ice operations that could accompany the existing CBT package on Anti-Icing and RWIS. The group unanimously felt there was a need for additional training modules to accompany the current CBT package. Lee Smithson described the process used to create the current CBT training package. The group then identified the following training topics as key areas in winter maintenance snow/ice operations that would lend themselves to CBT programming:

1. Proper Plowing Techniques
2. Deicers/Materials for snow/ice removal
3. Mitigation for blowing snow
4. Equipment maintenance
5. Policy management- Supervisory course on managing a snow and ice operation

The group then spent time identifying areas within each training topic that could be covered in a new CBT module. The group recognized that there were many other topics that also should be concluded in each of these main training areas but felt this would be a good starting point.

Proper plowing techniques

1. Plow types
2. Trip types
3. Benching
4. Winging operations
5. Creating more storage on the roadside
6. Barrier walls
7. Downtown traffic
8. Parked vehicles
9. Maintaining clear zones
10. Cleaning around guardrails
11. Cleaning bridges
12. Cleaning around railroad tracks
13. Pushing snow far enough from roadway to avoid melting snow/ice from draining onto roadway and refreezing
14. Underbody plows
15. Types of wings and their use
16. Winging operations
17. Safety
18. 2-lane plowing
19. Multiple lane plowing
20. One way street plowing
21. Cul-de-sacs
22. Intersections
23. Medians
24. Calming circles
25. Roundabouts (traffic circles)
26. Controlling discharge from the plow
27. Avoiding snow clouds
28. Throwing snow over bridges

Deicers/materials

1. Characteristics and chemical properties
2. Storage
3. Alternative additives
4. Spread rates
5. Application guidelines
6. Prewetting with deicers
7. Environmental impact
8. Abrasives
9. Selection of Materials for own operations
10. Equipment used to spread materials (spreaders, hoppers, ground-speed control systems, etc.)
11. Liquid Deicers
12. Nozzles or other spraying equipment
13. Brine production
14. Anti-icing
15. Equipment Maintenance
16. Testing and quality control
17. Writing specifications for deicers
18. Safety issues with deicers
19. Application timing
20. Corrosion inhibitors
21. Anti-caking agents

Mitigation for blowing snow

1. Snow fence types
2. Living snow fences
3. Roadway Designs
4. Standing corn as a snow fence
5. Access to private property
6. Eliminating landowner fears of snow fence
7. Proper placement of snow fences
8. Snow fence designs
9. Exotic snow control techniques
10. Ron Tabler's NCHRP needs to be incorporated into the project

Equipment Maintenance

1. Specifying equipment to reduce corrosion
2. Accident procedures
3. Ergonomics
4. Safety
5. Reducing sound levels in the cab
6. Reducing vibrations and stresses
7. Trip edge
8. Casters/wheels
9. Liquid onboard tanks
10. Fuels
11. GPS/AVL
12. Pretrip checklist
13. Calibration
14. Components of a snowplow and their characteristics
15. Carbide blades
16. Steel blades
17. Rubber blades
18. Moldboard designs
19. Liability
20. Maintenance
21. Proper clean-up
22. Post trip inspections
23. Warning lights, placement and care of lighting

Winter Maintenance Management

1. Liability issues
2. Establishing service levels
3. Working with law enforcement
4. Working with elected officials
5. Performance measurements
6. Alcohol/Drug testing
7. Water run-off- Phase 2 stormwater rules and how they effect winter operations
8. Material management
9. Snow disposal
10. Operational methods (MDSS, Anti-icing, Deicing, FAST , GPS/AVL)
11. Snow Plan (policy)
12. Budget
13. Selecting appropriate deicers
14. Public relations
15. Training (In-house)
16. OSHA rules

The group then discussed how to secure funding to develop these modules and what steps need to be taken to get this project moving forward. The group decided to prioritize the main topic areas in case funding could not be secured to complete the entire training suite. The group prioritized the list based on the need to provide training to all operators and supervisors whether they are in town, county or state government. The following is the priority list for attendees to this meeting:

1. Proper Plowing techniques
2. Deicers/Materials for winter maintenance
3. Equipment maintenance
4. Snow/Ice operations (supervisory)
5. Mitigation for blowing snow

The group then discussed the next steps required to keep the process moving forward. The following are tasks or assignments for each attendee along with expected steps needed to secure funding for the CBT training suite:

- Lee Smithson-
 - Review current CBT development contract with Gantech Multimedia to determine if that contract could be extended to include the other training modules.
 - Investigate funding sources that might be appropriate for this project
 - Investigate the need for a synthesis on each of these topics before development begins
 - Report back to the group on the best model to use to secure funding for the training suite
- Greg Parker-
 - Communicate with others in NACE to promote their participation in the development of this CBT training suite for winter operations
 - Identify manuals, videos, research reports, etc. available through NACE that could be used in the CBT suite
 - Communicate with others in the Winter Maintenance Technical Services Committee to encourage their support for the development of CBT training suite
- Mark DeVries-
 - Communicate with others in APWA to promote their participation in the development of this CBT training suite for winter operations
 - Identify manuals, videos, research reports, etc. available through APWA that could be used in the CBT suite
- Bret Hodne-
 - Communicate with others in the Winter Maintenance Technical Services Committee to encourage their support for the development of CBT training suite
 - Identify manuals, videos, research reports, etc. available through APWA that could be used in the CBT suite

- Tom Martinelli-
 - Work with representatives of Clear Roads to determine what financial or in-kind contributions could be provided through that research group
 - Identify manuals, videos, research reports, etc. available through FHWA or others state DOTs that could be used in the CBT training suite

- Dennis Burkheimer-
 - Identify manuals, videos, research reports, etc. available through FHWA or others state DOTs that could be used in the CBT training suite
 - Work with others to gain support for the training suite
 - Schedule future meetings, if needed

- Group-

Identify potential “experts” that could participate on panels to develop the training modules