Clear Roads Research Proposals
2011

Page	Title	Estimated Cost	Estimated Duration	Summary	Proposed by	Peer Exchange Reference
5	Investigating Effective Avalanche Control and Mitigation Methods	$150,000	12 months	Many DOT's and other entities (such as ski areas) must routinely trigger avalanches in order to protect the safety of the general public. Many methods are currently in use and new methods are being proposed. The goal of this project is to obtain specific scientific information as to the effectiveness, costs, and environmental impacts for each method, so each agency has the information needed to choose the correct method for their program.	Colorado DOT	
7	Material Selection for Corrosion Testing of Deicing Chemicals	$150,000	12 months	Many of the metals chosen for corrosion testing were identified decades ago and may no longer be used in automobile / truck manufacturing.The goal of this project is to determine the current metals used in automobile and truck manufacturing and which of these should be used to evaluate the corrosiveness of deicing chemicals (both liquid and solid). The project would also identify the best (most accurate, reproducible, and cost effective) testing methods to use.	Colorado DOT	2009 Peer Exchange Research Need: Best Management Practices for Reducing Corrosion
8	Determining the Toxicity of De-icing Materials	$100,000	12 months	While we are well aware of the relative corrosive properties of the various deicing chemicals, liquid and solid, in use throughout North America (MgCl2, NaCl, "beet juice" etc.), little information is available regarding the toxicity of these various compounds. This project would determine the toxicity of each deicer chemical in use throughout the snowbelt states and rank the chemicals according to toxicity. This would help states to balance their selection of deicers with consideration for the impact on the environment.	Colorado DOT	2007 Peer Exchange Research Need: Guidelines for anti-icing and deicing
9	Field Tests of Liquid Routes	TBD	12 months	The goal of this project is to perform field testing to confirm effectiveness of liquid only treatments and validate the results of the previous Clear Roads project on liquid routes.	Indiana DOT	2007 Peer Exchange Research Need:Guidelines for anti-icing and deicing
10	Improved Snowplow Design and Material Used In Construction on both Front and Underbody Plows	$150,000	18 months	This project will review past research done in plow designs and materials and investigate potential new materials and designs that may be better suited for a more pro-active approach to snow removal. This	Iowa DOT	2007 Peer Exchange Research Need: Concept Vehicle

				project will look at both front plow and under body designs		
12	Electronic Plow Route Hazard Marking	$50,000	12 months	Plow routes involve numerous hazards. Experienced operators will develop familiarity with potential hazards along their route, but replacement operators are often asked to cover routes that are unfamiliar. Some operators will prepare a log of route hazards, but this is not a is to develop a few methods to effectively, inexpensively, and electronically log plow routes hazards so that they are flagged for all operators.	Maine DOT	
13	The Effect of Plow Characteristics on Uneven Blade Wear	$100,000	18 months	The goal of this project is to quantify how plow shape can affect blade wear and identify ways to provide more consistent wear.	Maine DOT	2009 Peer Exchange Research Need: Comparative Study to Report on Blade Types, Inserts and Fasteners
14	Expanded CBT Modules (Spreader Controls)	$100,000 to $200,000	24 months	Many DOT's are experiencing high turn-over of personnel, and repetitive training draws heavily upon resources. This proposal is to recommend additional modules for the existing Computer-based Training (CBT) to cover the operation of standardized spreader controls. The training would be targeted at operators, calibrators, and supervisors.	Maine DOT	
15	Quantifying the Relationship between Road Condition and Snow and Ice Control Chemical Usage	$75,000	12 months	Pavement condition is usually assessed by states through an analysis of rutting, cracking and IRI (roughness/ride). This proposal is to create a factor that could be applied to the various aspects of the pavement condition to address the impact of snow and ice material usage.	Maine DOT	
16	Cost-benefit Analysis Toolkit: Phase II	$100,000	12 months	The Cost-benefit Analysis Toolkit Phase I created a workable tool that can be used by Clear Roads states and other agencies to calculate the cost/benefits and justify expenditures for specific new practices, equipment and operations used in winter maintenance activities. The toolkit turned out well and worked as anticipated. However, the tool still needs enhancement. Phase II will provide more flexible report outputs and easier printing for the end user. It will accommodate additional types of browsers and allow users to have multiple "new	Massachusetts DOT	2007 Peer Exchange Research Need: Cost Benefit for equipment

				scenarios" that can be saved. It will also expand to include more the maintenance tools, materials and procedures.		
18	Maintenance of Aurora's Knowledge Base for Winter Operations Research	$9,000	6 months	The funding for this project would allow Clear Roads to support Aurrora's wiki-style Knowledge Base website to include information on research for winter operations not just road weather information.	Michigan DOT	
19	Evaluation of Alternative Chemicals Field Tested in Minnesota	$5,000	18 months	The objective of this proposal is to develop a guide based on the existing evaluations of alternative chemicals done by Mn/DOT maintenance staff that can be used by all other DOTs and local agencies.	Minnesota DOT	2009 Peer Exchange Research Need: Comparative Study to Report on Blade Types, Inserts and Fasteners
20	High Friction Epoxy Aggregate Surface Treatment	$180,000	36 months	Textured seal coats for pavements have the potential to prevent dangerous road and bridge icing while minimizing the damaging effects of deicing chemicals. This project would identify and evaluate additional high friction surface products not already studied that could provide good performance on Minnesota bridges. The study will also recommend a method for qualifying future products.	Minnesota DOT	
22	Development and Implementation of a Totally Automated Spreading System	$200,000	18 months	The goal of this project is to develop a totally automated material dispensing system in order to ensure maximum benefit from the materials while minimizing environmental impacts. The system would be capable of applying the right amount of materials in the right locations at the right time, using a "smart logic" system capable of formulating output based upon multiple inputs and algorithmically calculated variables.	Pennsylvania DOT	2009 Peer Exchange Research Need: Development of a Granular Product Flow Monitor
23	Environmental Factors Causing Fatigue in Equipment Operators during Winter Operations	$100,000	13 months	During winter events, equipment operators work long, stressful hours and fatigue can be a major problem resulting in higher accident rates, lower productivity and increased health issues. This project would look at the environmental stimuli with the greatest influence on operator fatigue and recommend cost effective, realistic mitigation solutions.	Virginia DOT	2009 Peer Exchange Research Need: Optimize Ergonomics for Snow Plow Operators
25	Pacific Northwest Snowfighters (PNS)	$50,000 per year	24 months	With the impending conclusion of the Inhibitor Longevity and Deicer Performance research project sponsored by PNS, the organization will soon cease to have a Pooled Fund Project assigned to it and will	Washington DOT	

				begin to function solely as an unaffiliated association of Northwest states and provinces. Without a steady and reliable source of funding to continue the core mission, PNS could lose the ability to keep the specifications and the Qualified Product List (QPL) viable as a standard for other states and provinces to rely upon. This project would provide continued funding of PNS under the auspices of Clear Roads.		
27	Snow Removal at Extreme Temperatures	$250,000	18 months	Salt works well down to about 10 degrees. It works at lower temperatures as well but not cost effectively. The goal of this project is to develop two cost effective strategies for getting the roadway to a bare/dry condition in extreme temperatures.	Wisconsin DOT	2009 Peer Exchange Research Need: Develop BMP Synthesis for Low Temperature Pavement Surface Management
28	Guidelines to provide the Minimum Maintenance Design Support System (MDSS) Data Elements	$90,000	18 months	MDSS has a wide variety of data elements related to weather, roadway and crew that can be entered in advance of running the program. To ensure a consistent result from a MDSS program, it is necessary for an established set of elements to be incorporated into the setup of the program. The purpose of this project is to establish the minimum data parameters required to operate MDSS.	Wyoming DOT	2007 Peer Exchange Research Need:Guidelines for anti-icing and deicing
30	Right of Way Snow Fence: Evaluate Alternative Types of Short Structural Fence	$100,000	18 to 24 months	The objective of this project is to discover if there are alternative snow fence types (materials) or configurations (heights or porosities) that can store snow effectively starting at the Right of Way line.	Wyoming DOT	2007 Peer Exchange Research Need: Snow Fences
32	Salinity Sensor: Determine if the Technology Can Be Developed and Evaluated	$80,000	18 months	The goal of this project is to determine if the technology is available to develop a reliable fixed RWIS salinity sensor and whether it can be adapted to a mobile platform. If it can be proven possible, the next step would be to encourage the vendor community to produce this product.	Wyoming DOT	2009 Peer Exchange Research Need: Quantify Salinity Sensor Performance

2011 Research Proposal Form

Proposer name: David C. Wieder
Organization: Colorado DOT
E-mail address: david.wieder@dot.state.co.us

Title of proposed research synthesis or project:
Investigating Effective Avalanche Control and Mitigation Methods

1) Explain the specific problem or issue.
Many DOT's and other entities (ski areas) must routinely trigger avalanches in order to protect the safety of the general public. Many methods are currently in use. Methods include LPG explosions, Mortar fire, Howitzer fire, etc. Many of these methods have been in use for decades with little or no changes. Some of these may well be the most effective, most cost effective, least environmentally harmful method available, but no current research is available to substantiate this. Many states are being pressured to try new methods with only the proposer's claims to back them up. Specific scientific information as to the effectiveness, cost effectiveness, and environmental effect for each method is needed for each agency to choose the correct method for their program.

2) List the proposed research objectives.
- Determine the effectiveness of all methods of avalanche control
- Determine the cost effectiveness of each method
- Determine the environmental effect of each method
- Make recommendations based on terrain as to the best method possible

3) List the tasks that would form the scope of work.
- Determine the effectiveness of all methods of avalanche control
- Determine the cost effectiveness of each method
- Determine the environmental effect of each method
- Make recommendations based on terrain as to the best method possible
- Write report

3) Describe the expected outcomes of the research?

- **What products would result from the project?**
  A report stating which methods of avalanche control are recommended for various topographies.

- **What audience(s) would the product(s) be intended for?**
  All mountainous snow belt DOT's, and other parties (ski areas, Forest Service…)

- **How would the results benefit DOTs?**
  Ensuring that DOT's are controlling avalanche danger in the most cost effective least environmentally harmful way.

- **How would they be used?**
  DOT's **would use this to perhaps modify their current avalanche control methods.**

4) Estimated funding needed. $__150,000___

5) Estimated timeline for completing the research.
- **Six (6) months _____**
- **Twelve (12) months X**
- **Eighteen (18) months _____**

- **Other: _____ months**

6) Are you aware of any similar or related research on this topic? If so, please list below.
None current (within the last decade) to my knowledge.

2011 Research Proposal Form

Proposer name: David C. Wieder
Organization: Colorado DOT
E-mail address: david.wieder@dot.state.co.us

Title of proposed research synthesis or project:
Material Selection for Corrosion Testing of Deicing Chemicals

1) Explain the specific problem or issue.
Many organizations test deicing chemicals for corrosive action against a bank of several metals. Many of these metals were chosen for testing decades ago, and my no longer be used in automobile / truck manufacturing

2) List the proposed research objectives.
- Determine the current metals used in automobile and truck manufacturing
- Determine which of these should be used to evaluated the corrosiveness of deicing chemicals (both liquid and solid)
- Determine the best (most accurate, reproducible, and cost effective) testing methods to use

3) List the tasks that would form the scope of work.
- Determine the metals currently used in automobile / truck manufacturing.
- Determine which of these are most critical to evaluate for corrosion from deicing chemicals
- Determine the best (most accurate, reproducible, and cost effective) test methods for corrosion of these metals for both liquid and solid deicer chemicals.
- Write report

3) Describe the expected outcomes of the research?

- **What products would result from the project?**
  A report stating which metals deicing chemicals should be tested for corroding, and the best test methods to use

- **What audience(s) would the product(s) be intended for?**
  All snowbelt DOT's, and municipalities

- **How would the results benefit DOTs?**
  Ensuring that DOT's are doing the least damage to their own fleet as well as that of the traveling public

- **How would they be used?**
  DOT's would use this to set up their testing procedures for deicing chemicals.

4) Estimated funding needed. $ 150,000

5) Estimated timeline for completing the research.
- **Six (6) months _____**
- **Twelve (12) months X**
- **Eighteen (18) months _____**
- **Other: _____ months**

6) Are you aware of any similar or related research on this topic? If so, please list below.
None current (within the last decade) to my knowledge.

2011 Research Proposal Form

Proposer name: David C. Wieder
Organization: Colorado DOT
E-mail address: david.wieder@dot.state.co.us

Title of proposed research synthesis or project:
Determining the Toxicity of De-icing materials

1) Explain the specific problem or issue.
While we are well aware of the relative corrosive properties of the various deicing chemicals, liquid and solid, in use throughout North America, ($MgCl_2$, NaCl, "beet juice" etc.) little information is available regarding the toxicity of these various compounds. Doing the best we can for mobility must be tempered by inflicting the least harm on the environment possible.

2) List the proposed research objectives.
- Determine the toxicity of each deicer chemical in use throughout the snowbelt states and rank order the chemicals according to toxicity

3) List the tasks that would form the scope of work.
- Determine which chemicals are in use
- Perform a literature search regarding the toxicity of each
- Perform any laboratory tests necessary regarding toxicity
- Write report on toxicity of the chemicals

3) Describe the expected outcomes of the research?

- **What products would result from the project?**
  A comprehensive listing of the toxicity of the various deicing chemicals

- **What audience(s) would the product(s) be intended for?**
  All snow belt DOT's, and municipalities

- **How would the results benefit DOTs?**
  By ensuring that we are doing the best we can to provide mobility while inflicting the least environmental damage possible.

- **How would they be used?**
  DOT's would be able to make informed decisions as to which deicing chemical to use based on effectiveness and toxicity.

4) Estimated funding needed. $__100,000___

5) Estimated timeline for completing the research.
- **Six (6) months _____**
- **Twelve (12) months __X__**
- **Eighteen (18) months _____**
- **Other: _____ months**

6) Are you aware of any similar or related research on this topic? If so, please list below.
None to my knowledge.

2011 Research Proposal Form

Proposer name: Dennis Belter
Organization: INDOT
E-mail address: dbelter@indot.in.gov

Title of proposed research synthesis or project:
Field Tests of Liquid Routes

1) Explain the specific problem or issue.
Clear Roads completed a project on liquid routes. The results showed promise however field testing to confirm effectiveness of liquid only treatments has not been performed.

2) List the proposed research objectives.
- Confirm effectiveness
- Provide best practices
- Confirm resources needed per original report

3) List the tasks that would form the scope of work.
Field tests of liquid routes

3) Describe the expected outcomes of the research?

- **What products would result from the project?**
  Report on effectiveness, best practices, resources required

- **What audience(s) would the product(s) be intended for?**
  Winter Maintenance Managers

- **How would the results benefit DOTs?**
  Potential cost and time savings

- **How would they be used?**
  Justification for trying liquid routes

4) Estimated funding needed. $_____

5) Estimated timeline for completing the research.

- **Six (6) months _____**
- **Twelve (12) months X**
- **Eighteen (18) months _____**
- **Other: _____ months**

6) Are you aware of any similar or related research on this topic? If so, please list below.
Identifying the Parameters for Effective Implementation of Liquid-only Plow Routes – Clear Roads project.

2011 Research Proposal Form

Proposer name: Jim Dowd
Organization: Iowa DOT
E-mail address: jim.dowd@dot.iowa.gov

Title of proposed research synthesis or project:
Improved Snowplow Design and Material Used In Construction on both Front and Underbody Plows

1) **Explain the specific problem or issue.**
New materials are continually being developed that are lighter and stronger than the materials currently used in most plows built today. Many agencies are still specifying plows that are based on 1950's needs for brute strength to clear heavy snowfalls. Many agencies are now more proactive in their operations and the need for brute strength may no longer be appropriate. Most agencies are also not waiting until snow piles up deep on the roads before they begin their plowing operations so the height of the moldboard is in question as well as the shape that would keep down the snow cloud produced by the plow and the snow coming over the moldboard and landing on the windshield causing visibility problems for the operator. In addition to redesigning the front plow it has many problems that could also be addressed by designing a new type under body plow that would provide better stability, higher plowing speeds and lighter frame work while incorporating the same advanced features researched by Clear Roads in past projects.

2) **List the proposed research objectives.** This project will provide a background on past research done in plow designs and materials. The project will investigate potential new materials and designs that may be better suited for a more pro-active approach to snow removal. This project will look at both front plow and under body designs

3) **List the tasks that would form the scope of work.**
Investigate, evaluate and test a plow design that has the following characteristics:

1. Control discharge direction and speed
2. Incorporates multiple blades (I.E. flexible edge, slush and/or scarifier blades)
3. Control snow blowing over the plow onto the truck windshield
4. Reduced weight by use of a lightweight, durable material or alternate design
5. Increased strength to withstand strong plowing forces
6. Resistant to abrasions and corrosion
7. Incorporate sound and vibration dampening methods
8. Limit interference with engine cooling system and lighting
9. Low coefficient of friction
10. Incorporate a tripping mechanism
11. Consider a design that could be used at higher plowing speeds on interstate highways, safely
12. Investigate a under body plow design that would eliminate problems experienced with a front plow and still incorporate desired features

3) Describe the expected outcomes of the research?

- **What products would result from the project?**

  Most agencies still use plows that weigh a ton or more and are more suited for plowing large amounts of snow. A redesigned plow is needed to clean the road down to a bare surface with more finesse, increase snow removal speeds and reducing fuel consumption. This project will result in a more efficient plow design and allow vendors to

offer more options in snow removal equipment and continue the work started with the multiple blade plow project.

- **What audience(s) would the product(s) be intended for?**
  All Snow Belt states should be interested in the outcome because they are all looking at better ways to remove snow and ice in a more cost effective manner.

- **How would the results benefit DOTs?**
  The outcome would result in better designed plows that can do the same work more efficiently and cost effectively.

- **How would they be used?**
  The newly designed plows would be used in the same manner as the older versions but would do a much better job of clearing snow and ice in one pass.

4) Estimated funding needed. $_150,000___

5) Estimated timeline for completing the research.

- **Six (6) months _____**
- **Twelve (12) months _____**
- **Eighteen (18) months X**
- **Other: _____ months**

6) Are you aware of any similar or related research on this topic? If so, please list below.
SHRP studies done in the early 1990's.
Multiple blade snow plow project. (Final report being written at this time and will be complete by the time this project is awarded).

2011 Research Proposal Form

Proposer name: Brian Burne
Organization: MaineDOT
E-mail address: brian.burne@maine.gov

Title of proposed research synthesis or project:
Expanded CBT Modules (Spreader Controls)

1) Explain the specific problem or issue.
Computer Based Training (CBT) provides a low-cost, standardized method to train personnel. This proposal is to recommend additional modules for training relating to the operation of standardized spreader controls. Many DOT's are experiencing high turn-over of personnel and repetitive training draws heavily upon resources. Plow contractors could also pay to use this resource.

2) List the proposed research objectives.
Develop standardized training targeted towards Plow operators, calibrators, and supervisors.

3) List the tasks that would form the scope of work.
Develop a list of the most commonly used spreader controls that should have modules.
Outline the critical training components for each group.
Program the module and incorporate it with the existing online training

3) Describe the expected outcomes of the research?

- **What products would result from the project?**
  CBT(s)

- **What audience(s) would the product(s) be intended for?**
  DOTs and Public Works Depts

- **How would the results benefit DOTs?**
  Standardized**, low-cost training**

- **How would they be used?**
  online

4) Estimated funding needed. $__100,000 to 200,000*___ (*wild guess)

5) Estimated timeline for completing the research.

- **Six (6) months _____**
- **Twelve (12) months ___**
- **Eighteen (18) months _____**
- **Other: 24 months**

6) Are you aware of any similar or related research on this topic? If so, please list below.
No.

2011 Research Proposal Form

Proposer name: Brian Burne
Organization: MaineDOT
E-mail address: brian.burne@maine.gov

Title of proposed research synthesis or project:
Quantifying the Relationship between Road Condition and Snow and Ice Control Chemical Usage

1) Explain the specific problem or issue.
We all know that rutted and misshapen roads cost more to maintain in the winter, but we need to quantify that effect in order to understand the true repercussions of deferring paving and to understand the potential increase of environmental impacts associated with a deteriorating system.

2) List the proposed research objectives.
Pavement condition is usually assessed by states through an analysis of rutting, cracking and IRI (roughness/ride). This proposal would be to create a factor that could be applied to the various aspects of the pavement condition rating to define a percentage multiplier for snow and ice material usage.

3) List the tasks that would form the scope of work.

- Research the pavement condition parameters to find what is the most prevalent among states.
- Define the ones that make the most sense to use as a factor for defining the relationship to snow and ice control material usage.
- Define a level-of-service standard to be used to assess the results (e.g. time to bare pavement)
- Conduct controlled field trials to establish a draft relationship
- Work with states to "tweak" the draft as necessary

3) Describe the expected outcomes of the research?

- **What products would result from the project?**
  Report and method to calculate costs

- **What audience(s) would the product(s) be intended for?**
  DOTs and Public Works Depts

- **How would the results benefit DOTs?**
  We could apply a cost factor to deferred work and anticipate rising costs based upon Work Plan accomplishment.

- **How would they be used?**
  See above.

4) Estimated funding needed. $__$75,000*____ (*wild guess)

5) Estimated timeline for completing the research.

- **Six (6) months _____**
- **Twelve (12) months __X__**
- **Eighteen (18) months _____**
- **Other: _____ months**

6) Are you aware of any similar or related research on this topic? If so, please list below.
No.

2011 Research Proposal Form

Proposer name: Brian Burne
Organization: MaineDOT
E-mail address: brian.burne@maine.gov

Title of proposed research synthesis or project:
Electronic Plow Route Hazard Marking

1) Explain the specific problem or issue.
Plow routes involve numerous hazards and numerous operators. While experienced operators will develop familiarity of potential hazards along their route, replacement operators are often asked to cover routes that are unfamiliar to them. Some operators will prepare a log of route hazards, but in many cases, this may not occur. With the widespread availability of GPS and routing devices (such as smart phones, Garmins and Tom-Toms), can a relatively inexpensive process, possibly using points of interest (POIs) or other similar marking method, be implemented to electronically log plow route hazards that can be flagged on-the-fly to new/replacement operators.

2) List the proposed research objectives.
Provide a few methods to effectively, inexpensively, and electronically log plow routes so that plow route hazards will be flagged for plow operators.

3) List the tasks that would form the scope of work.
Electronic device research, develop proposed scenarios, test those scenarios, develop a guide that provides a couple standardized options and instructs how to use them.

3) Describe the expected outcomes of the research?

- **What products would result from the project?**
  Defined process & guide.

- **What audience(s) would the product(s) be intended for?**
  DOTs & Public Works

- **How would the results benefit DOTs?**
  Better communication, less equipment damage

- **How would they be used?**
  Standard part of operations

4) Estimated funding needed. $_50,000_

5) Estimated timeline for completing the research.

- **Six (6) months _____**
- **Twelve (12) months X**
- **Eighteen (18) months _____**
- **Other: _____ months**

6) Are you aware of any similar or related research on this topic? If so, please list below.
No.

2011 Research Proposal Form

Proposer name: Brian Burne
Organization: MaineDOT
E-mail address: brian.burne@maine.gov

Title of proposed research synthesis or project:
Effect of Plow Characteristics on Uneven Blade Wear

1) Explain the specific problem or issue. Certain types of plows will wear blades unevenly beyond what is caused by misshapen roads. Some of this is may be created by a difference in weight from one end of the plow to another, but can aerodynamics and the manner in which the snow moves across the plow's surface also contribute to this effect? As plowing speeds increase, could airfoils be used to equalize down pressure to create more consistent blade wear?

2) List the proposed research objectives. Quantify how plow shape can affect blade wear and identify ways to provide more consistent wear.

3) List the tasks that would form the scope of work. Speak to several states to identify various plow shapes and to quantify the observed blade wear consistency of each style.
Identify the factors that may affect the blade wear characteristics
Identify possible ways to offset the uneven wear
Propose specific field tests for the types of plows with the most inconsistent wear

3) Describe the expected outcomes of the research?

- **What products would result from the project?**
  Overview/discussion paper of how plow shape affects blade wear. Proposed field tests

- **What audience(s) would the product(s) be intended for?**
  DOTs & Public Works

- **How would the results benefit DOTs?**
  Better plow design, less uneven blade wear

- **How would they be used?**
  Plow specification improvements;

4) Estimated funding needed. $_100,000_

5) Estimated timeline for completing the research.

- **Six (6) months _____**
- **Twelve (12) months ____**
- **Eighteen (18) months X**
- **Other: _____ months**

6) Are you aware of any similar or related research on this topic? If so, please list below.
No.

2011 Research Proposal Form

Proposer name: Paul G Brown
Organization: MassDOT
E-mail address: Paul.Brown@State.ma.us

Title of proposed research synthesis or project:
Cost-benefit Analysis Tookit: Phase II

1) Explain the specific problem or issue.
The Cost-benefit Analysis Toolkit Phase I created a workable tool can be used by Clear Roads states and other agencies to calculate the cost/benefits and justify expenditures for specific new practices, equipment and operations used in winter maintenance activities. The tool kit turned out well and worked as anticipated. However, the tool still needs enhancement to include other maintenance practices and equipment. The next version will also need to provide prettier printing capabilities. For example, the end report needs to be in a format that can be more easily manipulated for presentation to managers. The tool will also need to run on more versions of internet browsers as many members were not able to use it, because DOTs are not always on the latest versions of software and do not always give their staff the freedom to choose a specific browser. It should also include the capability of saving multiple scenarios.

2) List the proposed research objectives.
Phase II will provide more flexible report outputs and easier printing for the end user. It will accommodate more different types of browsers. It will allow the user to have multiple "new scenarios" and save each one to allow for review at another time. It will also expand to include more the maintenance tools, materials or procedures.

3) List the tasks that would form the scope of work.
Poll the Clear Road Members to capture the next ten tools to include in the tool kit. Survey the Clear Roads Members for feedback on the current toolkit and to identify their needs in terms of report output and printing capabilities. Develop the tool to expand capabilities to address the needs identified in the polls and surveys.

3) Describe the expected outcomes of the research?

- **What products would result from the project?**
  The toolkit would be expanded and improved to make it more user-friendly and more comprehensive.

- **What audience(s) would the product(s) be intended for?**
  States, Cities, towns and Counties

- **How would the results benefit DOTs?**
  A realistic verification of tools and practices to justify expenditures or inclusion of new technology

- **How would they be used?**
  It would be an invaluable tool for determining priorities in winter maintenance and justification of expenditures

4) Estimated funding needed. $_100,000_____

5) Estimated timeline for completing the research.

- **Six (6) months _____**
- **Twelve (12) months X**
- **Eighteen (18) months _____**

- **Other: _____ months**

6) Are you aware of any similar or related research on this topic? If so, please list below.
Development of a Toolkit for Cost-benefit Analysis of Specific Winter Maintenance Practices, Equipment and Operations

2011 Research Proposal Form

Proposer name: Tim Croze
Organization: Michigan Department of Transportation
E-mail address: crozet@michigan.gov

Title of proposed research synthesis or project:
Maintenance of Aurora's Knowledge Base for Winter Operations Research.

1) Explain the specific problem or issue.
There are hundreds and maybe thousands of research reports that have been performed by state and local agencies, universities and private research labs on the topic of winter operations. It would be beneficial to have a place one could go to find all research related to winter operations.

The funding would allow Clear Roads to partner with Aurora on this project and provide the necessary financial backing to support the wiki-site and include research and information on winter operations not just road weather information.

2) List the proposed research objectives.
Update and maintain the website to store winter operations related research in an easy to use and is searchable and easy to update.

3) List the tasks that would form the scope of work.
3) Describe the expected outcomes of the research?

- **What products would result from the project?**
  A website that is easy to navigate, read, and update.

- **What audience(s) would the product(s) be intended for?**
  Anyone involved in the maintenance and operation of roads, runways, or parking lots in winter weather states.

- **How would the results benefit DOTs?**
  It will save time and effort when trying to locate research on winter maintenance topics. It may also reduce or eliminate redundant research.

- **How would they be used?**

4) Estimated funding needed. $ 9,000

5) Estimated timeline for completing the research.

- **Six (6) months** x
- **Twelve (12) months** _
- **Eighteen (18) months** _____
- **Other:** _____ **months**

6) Are you aware of any similar or related research on this topic? If so, please list below.

2011 Research Proposal Form

Proposer name: Farideh Amiri
Organization: Minnesota Department of Transportation
E-mail address: Farideh.amiri@state.mn.us

Title of proposed research synthesis or project:
Evaluation of Alternative Chemicals Field Tested in Minnesota

1) Explain the specific problem or issue.
Clearing winter roads to bare pavement require applying chemicals to melt snow and ice from the roads and adding salt for traction. Since chemicals are expensive and may have negative environmental, we need to know how well they work, when to use them and in what quantity (when, where and how). Mn/DOT had the opportunity to field test different chemicals for the last three years. These field tests are done by Mn/DOT district staff and done in verity of ways. This proposal is to hire a consultant to interview district maintenance operators, collect data and evaluation information and prepare a guide to assist all DOT's maintenance staff to use for when they need to know when, where and who to use alternative chemicals.

2) List the proposed research objectives.
The objective of this proposal is to develop a guide base on the existing evaluations of alternative chemicals done by Mn/DOT maintenance staff that can be used by all other DOTs and local agencies.

3) List the tasks that would form the scope of work.
- Survey of Mn/DOT maintenance staff and collect their evaluation done on the alternative winter chemicals
- Field observation of testing current chemicals in the field
- Write a report/guide to reflect the survey of when, where and how to use the available alternative chemicals

3) Describe the expected outcomes of the research?

- **What products would result from the project?**
  A guide to assist all DOTs and local agencies to use when they are using alternative chemicals

- **What audience(s) would the product(s) be intended for?**
  DOTs and local agencies

- **How would the results benefit DOTs?**
  By using the evaluation to get to the bare pavement and cleaning winter roads with lower cost and less environmental impacts

- **How would they be used?**
  By applying the results

4) Estimated funding needed. $5,000.00

5) Estimated timeline for completing the research.
- **Six (6) months _____**
- **Twelve (12) months _____**
- **Eighteen (18) months X**
- **Other: _____ months**

6) Are you aware of any similar or related research on this topic? If so, please list below.

2011 Research Proposal Form

Proposer name: Farideh Amiri
Organization: Minnesota Department of Transportation
E-mail address: Farideh.amiri@state.mn.us

Title of proposed research synthesis or project:
High Friction Epoxy Aggregate Surface Treatment

1) Explain the specific problem or issue.
Since the 1990s, Mn/DOT has been using anti-icing chemicals to help prevent frost and ice from building up on its roads and bridges. Unfortunately, chloride ions from deicing salts corrode the steel bars that reinforce bridge decks, causing premature deterioration. The anti-icing chemicals can also damage the environment, including surrounding soil, vegetation and water. Mn/DOT is continuously looking for innovative methods to keep the travelling public safe on Minnesota's 30,000 lane miles of state highway and it is the first priority of Mn/DOT's snow and ice removal operations.

Consequently, Mn/DOT is interested in methods that prevent dangerous road and bridge icing while minimizing the damaging effects of deicing chemicals. One possible method is using polymeric chip seal (PCS) and ultra bounded wear courses (UTBWC) materials. This is accomplished by the additional texture the cover aggregate adds to the pavement. A seal coat increases the pavement texture and increases the surface friction properties.

This proposal will expand the existing studies done by Mn/DOT and University of Minnesota, Duluth (UMD). Initially, the evaluation included SafeLane Product on Mitchell bridges in Duluth for three years. The current evaluation includes three more products on four more bridges statewide. The objectives of this investigation are to identify other high friction surface products that will provide good performance on Minnesota bridges and to recommend a method for qualifying future products. This proposal has two parts: Part1) Hire a consultant 1) To conduct a survey and collect data from other DOTs and local agencies and collect feedbacks from Mn/DOT bridge and Traffic safety staff; 2) Find any new and innovative materials and installation vehicles on the market and hire the vendor to furnish and apply epoxy and high friction aggregate on the recommended bridges and ramps by Traffic and Bridge staff; 3)Write an evaluation and recommendations base on the survey data, direct field comparison of all the products and the results of the evaluation done by UMD. Part 2) Hire UMD to continue evaluating the new products recommend in part one.

2) List the proposed research objectives.
Primary concerns focus on the following performance characteristics:
1) Materials quality and performance quality of materials in a given system, including both the sealing material (e.g. polymer in a PCS system) and the aggregate component;
2) Skid resistance afforded by the overlay system, evaluated by friction measurement over the first few years of service life;
3) Improved safety provided by higher friction as manifested in accident reduction at the application sites;
4) Effectiveness of the sealing component to reduce or eliminate chloride ingress into the deck as a consequence of the use of deicing chemicals;
5) Examination of issues relating to moisture trapping at the seal coat/concrete interface which may cause premature degradation of the concrete and
6) Cost/Benefit considerations as related to the above.

3) List the tasks that would form the scope of work.
<u>Part One</u>

1) Hire a consultant to conduct a survey and collect data from other DOTs and local agencies and collect feedbacks from Mn/DOT bridge and Traffic safety staff;
2) The consultant should also find any new and innovative materials and installation vehicles on the market and hire the vendor to furnish and apply epoxy and high friction aggregate on the recommended bridges and ramps by Traffic and Bridge staff;
3) Write an evaluation and recommendations base on the survey data, direct field comparison of all the products and the results of the evaluation done by UMD

Part Two
Hire UMD to continue evaluating the new products recommend in part one.

3) Describe the expected outcomes of the research?

- **What products would result from the project?**
  A final report that will evaluate different high friction materials, advanced installation equipments, benefits, costs and recommendation that can be used by all DOTs and local agencies.

- **What audience(s) would the product(s) be intended for?**
  All DOTs maintenance operations and bridges, local agencies and international audiences interested to improve snow and ice removal operations without damaging infrastructures.

- **How would the results benefit DOTs?**
  Apply the results

- **How would they be used?**
  Apply the results

4) Estimated funding needed. $180,000.00
Hire Consultant: $90,000.00 (including purchase of new material for $3.00/SF)
Hire UMD: $90,000.00

5) Estimated timeline for completing the research.

- **Six (6) months _____**
- **Twelve (12) months _____**
- **Eighteen (18) months _____**
- **Other: 36 months**

6) Are you aware of any similar or related research on this topic? If so, please list below.
Evaluation of the SafeLane Overlay System for crash Reduction on Bridge Decks

2011 Research Proposal Form

Proposer name: W. James Smith, Chief Equipment Division, Bureau of Maintenance & Operations

Organization: Pennsylvania Department of Transportation
E-mail address: walsmith@state.pa.us

Title of proposed research synthesis or project:
Development and Implementation of a Totally Automated Spreading System

1) Explain the specific problem or issue.
At the present time we rely on operator controlled dispensing of materials. The operator may or may not be making sound choices as it relates to when where and how much materials to apply. In an effort to maximize the benefit and minimize the use of materials and impact to the environment, a totally automated system could be developed and used.

2) List the proposed research objectives.
Develop a system capable of applying the proper amount of materials in the correct locations at the proper time. A "smart logic" system capable of formulating output based upon multiple "hard" inputs and algorithmically calculated variables.

3) List the tasks that would form the scope of work.
1) Identify functional requirements 2) Identify inputs (i.e. Temps – actual and projected [ambient/road surface]), weather data [expected temp increase/decrease, dew point, wind speed - direction, etc., roadway classification/ADT, relationship of truck to roadway (uphill, downhill, horizontal/vertical curves, etc).

3) Describe the expected outcomes of the research?

- **What products would result from the project?**
  A "smart" control system capable of making the correct decision regarding materials disbursement timing and rate. Perhaps an add-on to MDSS.

- **What audience(s) would the product(s) be intended for?**
  DOT, Municipal and other Maintenance Organizations

- **How would the results benefit DOTs?**
  Improved efficiency and effectiveness at a lower cost along with the environmental benefits relating to the use of less material. A consistent level of service.

- **How would they be used?**
  Installed in place of the existing materials controls.

4) Estimated funding needed. $ 200,000.00

5) Estimated timeline for completing the research.

- **Six (6) months _____**
- **Twelve (12) months _____**
- **Eighteen (18) months _X___**
- **Other: _____ months**

6) Are you aware of any similar or related research on this topic? If so, please list below.
No but recommend a literature search prior to proceeding.

2011 Research Proposal Form

Proposer name: Allen Williams, VDOT
Organization: Virginia Department of Transportation
E-mail address: Allen.Williams@vdot.virginia.gov

Title of proposed research project:
Factors causing equipment operator fatigue during winter operations

1) Explain the specific problem or issue.
During snow removal operations, equipment operators are exposed to a number of negative stimuli which can increase their level of fatigue. Operators work long, stressful hours during times of heavy snow fall. Fatigue can be a major problem for operators and can result in higher accident rates, lower productivity and increased health issues.

2) List the proposed research tasks.

- Identify the environmental stimulus an equipment operator experiences while operating snow removal equipment;
- Conduct humanistic studies to determine which environmental stimuli have the greatest influence on operator fatigue during winter operations;
- Identify ways the environmental stimuli with the greatest influence on operator fatigue can be mitigated;
- Recommend cost effective, realistic mitigation solutions for fatigue causing environmental stimulus.

3) Describe the expected outcomes of the research?

- **What products would result from the project?**
  A series of cost effective, realistic recommendations for reducing or eliminating fatigue causing environmental stimulus impacting equipment operators during winter operations.

- **What audience(s) would the product(s) be intended for?**
  State DOT maintenance managers, equipment manufactures, equipment specification writers and equipment operators

- **How would the results benefit DOTs?**
  Improved safety and risk management

- **How would they be used?**
  Reducing equipment operator fatigue during winter operations would improve the safety of operations, reduce employee absences and improve operator efficiency. The recommendations from the study could be used to make improvements whether it is to equipment, policies or operational functions to reduce the fatigue of equipment operators.

4) Estimated funding needed. $ 100,000.00

5) Estimated timeline for completing the research.

- **Six (6) months _____**
- **Twelve (12) months _____**
- **Eighteen (18) months _____**
- **Other:** 13 **months**

Literature review: 2 months
Operator interviews: 3 months
Humanistic studies: 6 months

Project write and recommendations: 2 months

6) Are you aware of any related research on this topic? If so, please list below.
Some in-cab vehicle studies for drowsy driver behavior and accident potential of driver behavior – Virginia Tech Transportation Institute

2011 Research Proposal Form

Proposer name: Monty Mills
Organization: WSDOT
E-mail address: millsm@wsdot.wa.gov

Title of proposed research synthesis or project:
Pacific Northwest Snowfighters (PNS)

1) Explain the specific problem or issue.
PNS is widely recognized as the premier deicer material research, testing, and product approval entity in North America. Many states and provinces rely on the PNS Qualified Products List (QPL) and the PNS Product Specifications as standards for accepting products for bid on their contracts. Additionally, PNS is the clearinghouse for questions regarding deicer characteristics, and a primary sponsor of research into deicer performance.

With the impending conclusion of the Inhibitor Longevity and Deicer Performance research project sponsored by PNS, the organization will soon no longer have a Pooled Fund Project assigned to it, and will begin to function solely as an unaffiliated association of Northwest states and provinces. Without a steady and reliable source of funding to continue the core mission, PNS could lose the ability to keep the specifications and the Qualified Product List (QPL) viable as a standard for other states and provinces to rely upon.

2) List the proposed research objectives.
The objective of this research is to support the continued work and knowledge of PNS in the realm of deicer performance and characteristics. As a Pooled Fund effort, under the auspices of Clear Roads, research can be championed to identify environmentally benign alternatives to chlorides, best practices for deicer applications, innovations in corrosion inhibitor products, deicer enhancement products, and many other aspects of deicer technology. As a sub-set of Clear Roads, PNS can also continue to produce updates to the QPL, field questions on deicer products, and provide deicer testing specifications via an independent web site, or a link within the Clear Roads site.

3) List the tasks that would form the scope of work.
- Prepare and/or review deicer material research problem statements.
- Determine timelines and budgets of approved research.
- Review proposals and recommend research entities to the larger group.
- Serve as the Technical Advisory Committee on deicer research.
- Review research updates and prepare status reports for the larger group.
- Troubleshoot research challenges and work closely with research entities.
- Review draft final reports and address shortcomings or inconsistencies.
- Provide comments to larger group on the research outcome, and recommend approval or rejection of final reports.
- Evaluate the need for further research and provide recommendations.

3) Describe the expected outcomes of the research?
- **What products would result from the project?**
  - Continuous analysis of needs within the realm of deicer research.
  - Knowledgeable review of ongoing deicer research.
  - Identification of research entities equipped to perform deicer research, and their relative capabilities.
  - Analysis of “best fit” products for any given region or climate.
  - Continuously updated QPL and testing specifications.
  - Central clearinghouse for deicer related questions and concerns.

- Website updates and maintenance.

- What audience(s) would the product(s) be intended for?
- All users of deicer products.

- How would the results benefit DOTs?
Through the research analysis, testing, and comparison of deicer products so that DOT managers can make educated decisions on which products are most suited to their specific needs.

- How would they be used?
To determine best-fit products for any given climate or geographical location, assess product specific environmental impacts, compare performance, and provide specific product characteristics and blends.

4) Estimated funding needed.
$50,000 per year to support product testing and approval, and Website maintenance.

5) Estimated timeline for completing the research.
- **Six (6) months _____**
- **Twelve (12) months _____**
- **Eighteen (18) months _____**
- **Other: 24 months**

6) Are you aware of any similar or related research on this topic? If so, please list below. No.

2011 Research Proposal Form

Proposer name: Mike Sproul
Organization: WisDOT
E-mail address: Michael.sproul@dot.wi.gov

Title of proposed research synthesis or project:
Snow Removal at Extreme Temperatures

1) Explain the specific problem or issue.
Salt works well down to about 10 degrees. It will work at lower temperatures but not cost effectively. When the temperature gets really low we tend to just plow or rely on abrasives or dump on the salt. But in more urban areas with high traffic volumes abrasives are ineffective. Thus the end result is the over usage of salt, equipment, and manpower.

2) List the proposed research objectives.
Develop two cost effective strategies for getting the roadway to a bare/dry condition in extreme temperatures.

3) List the tasks that would form the scope of work.
Literature research
Survey of states and countries
Identify de-icing agents and equipment that works at extreme temperatures.
Develop 2-3 strategies for cost effective snow removal at extreme temperatures.
B/C analysis
Field Testing
Develop a purchasing plan of necessary equipment, materials that will be necessary to incorporate these strategies into a states toolbox
Organize strategies so that they can be integration into MDSS

3) Describe the expected outcomes of the research?

- **What products would result from the project?**
  A report

- **What audience(s) would the product(s) be intended for?**
  All maintenance authorities

- **How would the results benefit DOTs?**
  Hopefully it will save us money on salt in those areas that are currently trying to burn off the snow without considering costs.

- **How would they be used?**
  We'll be able to choose a strategy that works for us then incorporate that strategy into MDSS on the section that require dry pavement.

4) Estimated funding needed. $250,000

5) Estimated timeline for completing the research.

- **Six (6) months _____**
- **Twelve (12) months _____**
- **Eighteen (18) months X**
- **Other: _____ months**

6) Are you aware of any similar or related research on this topic? If so, please list below.
Nope.

2011 Research Proposal Form

Proposer name: Cliff Spoonemore
Organization: WYDOT
E-mail address: cliff.spoonemore@dot.state.wy.us

Title of proposed research synthesis or project: Guidelines to provide the Minimum Maintenance Design Support System (MDSS) Data Elements – this is from 2009 PEER Exchange

1) **Explain the specific problem or issue**.
MDSS has a wide variety of weather, roadway and crew elements that can be input in advance of running the program. To ensure a consistent result from a MDSS program it is necessary for an established set of elements be incorporated into the setup of the program. The purpose of this project would be to establish the minimum data parameters required to operate MDSS.

2) **List the proposed research objectives**.
Break down the front end input data sets for weather, roadway and the tools the crew uses to fight a snow and ice event, and establish the minimum known points for MDSS to produce an accurate strategy to treat the roadway during the event.

3) **List the tasks that would form the scope of work**.
There are at least 3 known vendors of MDSS, DTN Meterologics, NCAR, and Meridian Environmental, and they will need to be consulted as to the makeup of their version of MDSS. With this knowledge there may be 3 sets of minimum data requirements for MDSS. The MDSS input data would have to be broken down to determine what data is critical and what data is considered useful to produce an accurate treatment strategy. This input data is both for the roadway condition and the crews' ability to place the treatment on the roadway. Evaluate the necessity of what weather elements required from a weather provider (service) and outside input such as RWIS.

4) Describe the expected outcomes of the research? There are remote roadway sections that can benefit from using MDSS, but they don't have access to a complete data set like those of major urban roadways. This same roadway section may have access to a weather report, known roadway surface, and crews' toolbox to treat the roadway during an event, is that enough? The result of this research should answer that very question.

- **What products would result from the project?**
Develop a written guideline for each MDSS provider that explains what and why each data element is needed.

- **What audience(s) would the product(s) be intended for?**
Users that have to input these minimum elements, this could be mid level managers to crew foreman.

- **How would the results benefit DOTs?**
Knowing why each element is needs will determine the effort to which the supplier will determine the accuracy of the input. To avoid garbage in, garbage out, by giving an explanation that satisfies the end user.

- **How would they be used?**
That would be established by the vendors MDSS program system.

4) Estimated funding needed. $ 90,000

5) Estimated timeline for completing the research.

- **Six (6) months _____**
- **Twelve (12) months _____**
- **Eighteen (18) months X**

(May need at least one winter to confirm if MDSS is operating the same way with the minimum data sets, as compared to a full data set.)

- **Other: _____ months**

6) Are you aware of any similar or related research on this topic? If so, please list below.
There may be by each vendor. This is the reason for checking with each vendor of MDSS. The vendor may not explain what minimum elements are needed to operate MDSS. They will give a list of elements that the program will accept to run within their program.

2011 Research Proposal Form

Proposer name: Clifford Spoonemore
Organization: Wyoming DOT
E-mail address: cliff.spoonemore@dot.state.wy.us

Title of proposed research synthesis or project:
Right of Way Snow Fence: Evaluate Alternative Types of Short Structural Fence

1) Explain the specific problem or issue.
Large structural or living snow fence has been installed along side our Roadway Systems to capture far snow and protect trouble areas such as large cuts or overhead/underpass structures. Structural and living snow fence has proven effective and they have been studied in the past for efficiency and cost benefit.

Experts such as Dr. Ronald Tabler of Tabler and Associates have complete extensive research on snow fence. Dr Tabler recommends shorter fence place on the Right of Way to fight near snow. Near snow is defined as the snow that falls and becomes the source of blowing snow between the structural or living snow fence and the Roadway. Most often the near snow effect is handled using short 4' high wooden fence system that has many names such as corn cribbing, lath fence, and several others depending on your local terminology.

The need to fight near snow is common in both rich crop lands of the Midwest and East as those areas in the West with wide open spaces. The issue is the landowners are not willing to allow agencies to construct snow fences on their property and take the land out of production. Agencies need an alternative snow fence that can be attached at the Right of Way and provide snow storage.

Short Right of Way snow fence has a big negative in that it will fill up quickly and no further snow is stored during the winter. There will need to be a warming spell during the winter to melt off some of the snow stored to make it effective once again.

2) List the proposed research objectives.
This project would be to discover if there are alternative snow fence types (materials) or configurations (heights or porosities) that can store snow effectively starting at the Right of Way line. A cost benefit analysis is also needed to ensure the agency is spending its funds prudently.

A secondary benefit for this research is to explore placing these new alternatives on interchange ramps to protect overpasses/underpass from plugging with snow around abutments or bents. Many times extra equipment is required to clear the snow so that traffic can once again flow unrestricted.

3) List the tasks that would form the scope of work.
The objectives for this project are:

- Complete a literature search of research conducted on fence systems used by others agencies or countries.
- Develop new or improve existing snow fence systems to fight near snow by taking advantage of existing knowledge of porosity, bottom gap, height, skew angle and blow cast distance.
- Develop test methods to measure goals or expected results. Define expectations from field tests. Define control standard to compare new snow fence to. Define expectation with field personnel when snow fence is full, and at what time during the snow season this will or has occurred.
- Provide construction design details and specifications for snow fence systems developed.
- Complete field testing in both Plains and Mountainous terrain states in several situations, such as protecting cuts, overpass/underpass interchanges, icing conditions on

superelevated curves and bridge end protection by W-Beam guardrail or other areas where drifting occurs on the roadway.

- Provide cost benefit analysis for Right of Way snow fence to fight near snow problems.
-

A pre-research meeting with Clear Roads Project TAC is required, quarterly reports, 50% meeting with CR project TAC, draft report and comments (by CR and other experts called by CR), final report and comments. Prepare and make a presentation of report at the Clear Roads TAC meeting.

3) Describe the expected outcomes of the research?

- **What products would result from the project?**
  New technology developed to fight snow starting at the Right of Way. This research will provide maintenance forces with new tools to fight snow without encroaching on adjacent landowners property.

- **What audience(s) would the product(s) be intended for?**

- **How would the results benefit DOTs?**
  Snow storage has been proven to be more cost effective than snow removal.

- **How would they be used?**
  Using new or improved snow fence will make it possible for maintenance to install snow fence where it is needed and within the control of agencies.

4) Estimated funding needed. $_100,000____

5) Estimated timeline for completing the research.

- **Six (6) months _____**
- **Twelve (12) months _____**
- **Eighteen (18) months _____**
- **Other: 18-24 months**

6) Are you aware of any similar or related research on this topic? If so, please list below.
NCHRP Project 20-7(147) “Controlling Blowing and Drifting Snow with Snow

2011 Research Proposal Form

Proposer name: Cliff Spoonemore and Tina Greenfield (on behalf of Aurora)
Organization: WYDOT and IDOT
E-mail address: cliff.spoonemore@dot.state.wy.us and tina.greenfield@dot.iowa.gov

Title of proposed research synthesis or project:
Salinity Sensor: Determine if the technology can be developed and evaluated

1) Explain the specific problem or issue.
Winter maintenance professionals must ensure that an appropriate amount of deicing chemical remains on the road. Enough chemical must be present to prevent bonding of snow and ice to the pavement and to prevent slush from refreezing on the pavement. Care must be taken to avoid the cost of over-application, which includes the cost of chemical and labor to apply roadway treatment, as well as the unnecessary cost to the environment and corrosion to highway infrastructure and vehicles.

At the 2007 and 2009 National Winter Maintenance Peer Exchange attendees identified the lack of reliable fixed (RWIS via Aurora) and vehicle-mounted salinity sensors (via Clear Roads) as a significant operational problem (group rank placed 9 out of 27). While salinity sensors of various forms have been on the market for some years, they are said to not be reliable enough to assist in winter maintenance decision making. The 2005 NCHRP 6-15 study "Testing and Calibration Methods for RWIS Sensors" concluded that most of the available sensors were able to provide reasonable freeze point data in the laboratory environment.

Development and evaluation of new sensors is a potentially difficult and expensive endeavor for vendors. Furthermore, it may be difficult for an agency wishing to purchase some new salinity sensor technology to determine whether the new sensor is as good as claimed, especially when the technology is new enough that few other agencies have any long-term experience with it.

2) List the proposed research objectives.
There would be two main objectives in this project. First to determine if the technology is available to develop a reliable fixed RWIS salinity sensor and whether it can be adapted to a mobile platform. Second by determining the availability of reliable technology this research may spur the vendor community into action to produce this product.

Aurora has committed $50,000 to this concept in the past; Clear Roads did not back the concept in 2009. The time may be now for Clear Roads to put forth funding to investigate the availability of this concept. Because of no action being taken in the past Aurora has reduced its commitment to $5,000 just to keep the concept on the shelf. If Clear Roads selects this project for study, Aurora will seek authorization from its members to reinstate the original funding level.

3) List the tasks that would form the scope of work.
- Conduct a literature search to determine if the technology to develop a reliable sensor is available.
- Evaluate the existing sensors to benchmark the common pitfalls to help future developers explore alternative technologies or methods to bridge the common faults in existing sensor design. The evaluation should include pitfalls and solutions for both mobile and fixed sensors.
- Conduct lab testing to determine if a reliable salinity sensor that addresses the known pitfalls can be created to measure the chloride level in chemicals used to treat roadway surfaces.

- Create a report that lists the issues that would need to be overcome in developing a marketable salinity sensor by the vending community and suggests ways to resolve the issues identified.

4) Describe the expected outcomes of the research? This project's first steps are to prove to the vending community that a need exists for a reliable salinity sensor and that it is possible to develop a reliable one.

- What products would result from the project?
A complete literature search is needed to make the initial determination if further research and development is required to create a salinity sensor.

The information necessary to create the technology to develop a reliable salinity sensor.

- What audience(s) would the product(s) be intended for?
As a DOT community we would know if our desire for a salinity sensor was possible or an impossible dream.

Vendors would know that the maintenance community is serious about the need and creation of a salinity sensor.

- How would the results benefit DOTs?
If technology is available or can be created to develop a salinity sensor then DOT's can push on vendors to create a reliable salinity sensor.

- How would they be used?
When ordering replacement sensors for their existing RWIS or new RWIS units DOT'S can voice the need for a salinity sensor and that they would purchase such a sensor if the vendor could provide such a sensor. Using the results of this report DOT's could show the vendors that technology is available and are waiting for them to create the sensor that would assist the DOT's in using chemicals treatments on their roadway systems.

5) Estimated funding needed. $_10,000 for Literature Search + $70,000 for lab research of technology, for a total of $80,000__

6) Estimated timeline for completing the research.
- **Six (6) months** __X___ for literature search
- **Twelve (12) months** __X___ for the lab research
- **Eighteen (18) months__X__ Total**
- **Other: _____ months**

7) Are you aware of any similar or related research on this topic? If so, please list below.
2005 NCHRP 6-15 study "Testing and Calibration Methods for RWIS Sensors"