Clear Roads Research Proposals
2020

#	Title	Est. Cost	Est. Duration	Project Summary	Presented by	Page
1	Weather Forecast Evaluation Tool	$180,000	18 months	The goal of this project is to develop a program that can ingest weather forecast data from multiple sources and compare it to what actually occurred and assign the forecast a level of accuracy based on when the storm arrived, what form of precipitation fell, and how much precipitation accumulated.	Group 1 Scott Lucas, Ohio DOT	8
2	Entry-Level Commercial Driver's Training	$300,000	12 months	a) Develop Clear Road's entry level driver training (ELDT) programs for people to acquire their class B CDL, to advance from a class B to a class A CDL that meets the requirements of the new FMCSA rules. b) The curriculum must provide instruction that meets all the standards established in the FMCSA training rules to include on-road instruction, driver qualification, driver wellness, hours of service and whistleblower protection. Training must also meet state licensing agency requirements. c) Document a process for DOT's to be able to attest that they meet the specified requirements, and in the event of an FMCSA audit or investigation of the DOT, must supply documentation to verify their compliance. d) Develop a train the trainer program for the course. e) Document the process for DOT's to self-certify in the FMCSA's Training Provider Registry.	Group 1 Scott Lucas, Ohio DOT	10

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2020

#	Title	Est. Cost	Est. Duration	Project Summary	Presented by	Page
3	Salt Shed Design Template	$75,000	12 months	The goal of this project is to evaluate and design a set of standard salt sheds that could be scaled to meet the needs of a variety of sites. It is recognized that it would be difficult to design a shed that would work in every state, with every type of soil, wind load, snow load etc. However, three scales could be used for this comparison in this project: small (150- 500 ton), medium (500-4,000 ton) and large (over 4,000 ton). This project would provide a template for the member state to use as a starting point for designing and bidding these projects.	Group 2 James Morin, Washington State DOT	13
4	Snow and Ice Equipment Online Database	$75,000	12 months	The goal of this project is to create an online database of Roadway Snow and Ice Control (RSIC) equipment on the Clear Roads website that is updated on a regular basis, thus providing members with an accurate representation of equipment used by member states in a more efficient manner in terms of time, effort, and cost.	Group 2 Jeff Pifer, West Virginia DOT	15
5	Mapping Weather Severity Zones (2011-2020)	$75,000	12 months	The goal of this project is to analyze weather severity in the snow and ice states following the same methodology used for Clear Roads Project 10-02, to map weather severity across the regions and states but for the time period of 2010–2020. These results could be used to both compare the time period results and possibly identify trends.	Group 2 Tom Peters, MN DOT	17

Clear Roads Research Proposals
2020

#	Title	Est. Cost	Est. Duration	Project Summary	Presented by	Page
6	Indoor Automated Stockpile Measurement	$200,000	18 months	This project would develop a methodology and identify tools to perform indoor salt measurement using photogrammetry, LIDAR or some type of sensor. Possible solutions may include permanent installation of an array of cameras or sensors that routinely scan the stockpile, interpret the data and provide real time inventory. Or it may rely on some sort of robotic, autonomous drone or mobile technology to collect the data. As previously mentioned, this has been done with drones, however this is problematic inside sheds requiring highly skilled pilots and requires a vendor or employee to travel to each site regularly. Drone technology has not progressed to the point that flights inside a facility can truly be accomplished autonomously and requires DOT's to train and maintain numerous licensed drone pilots. The goal is this project is to identify a way to accomplish real time inventory and monitoring of the sites with minimal input from maintenance staff.	Group 2 James Morin, Washington State DOT	19
7	Quantifying the Impact that New Capital Projects Will Have on Roadway Snow and Ice Control (RSIC) Operations, Phase 2	$100,00	15 months	The goal of the project is to build upon/improve the automated method of quantifying the anticipated impact that new capital projects will have on total vehicle-hours of travel (VHTs) for the RSIC fleet. This method can be used in the early stages of project development to determine if the agency will need additional resources, such as trucks, salt, fuel, and manpower to provide RSIC after the project is completed.	Group 3 Todd Law, VTrans	21

Clear Roads Research Proposals
2020

#	Title	Est. Cost	Est. Duration	Project Summary	Presented by	Page
8	Winter Maintenance Product Proficiency Sample Program	$75,000	12 months	A Proficiency Sample Program can be utilized as a useful tool for a DOT, manufacturer/vendor, and/or third-party laboratory to monitor the quality of its services. This project would provide participating laboratories with the capability to: a) Compare individual testing results to a large pool of results from their peers. b) Verify both the testing equipment and the operator under actual testing conditions. c) Show evidence of conformance to testing procedures and protocols as set forth by specifying agencies or internal QA/QC programs. d) Receive individualized reports with performance charts to track testing results over time. Use an (optional) Extra Proficiency Sample Program (XPS) for training of technicians, testing or equipment verification, inter-laboratory studies, and for addressing accreditation issues related to proficiency sample testing.	Group 4 Jasmine Dondlinger/ Ty Barger, Nebraska DOT	23
9	Expanded Use of AVL/GPS Technology Study	$75,000	12 months	The goal of this project to find out what States are using their AVL/GPS units for, to include winter and non-winter activities. List of non-winter projects or methods that AVL/GPS technology are currently being used for to benefit DOT's.	Group 4 David Gray, New Hampshire DOT	26
10	Measuring the Costs and Detrimental Effects of Sand Use in Winter Snow and Ice Operations on the Environment	$75,000	12 months	This project would document and understand the effects of the use of sand as related to the environment and snow and ice control. The document and understand the costs and effectiveness when used as the major component in snow and ice control. To document the process of removing sand deposition on the roads, within drainage systems, ponds, and waterbodies.	Group 4 John DeCastro, Connecticut DOT	28

Clear Roads Research Proposals
2020

#	Title	Est. Cost	Est. Duration	Project Summary	Presented by	Page
11	Environmental Prioritization of Highway Segments Relative to Snow and Ice Operations Using Standard GIS Layers	$100,000	12 months	With the inability to identify environmentally sensitive corridors (beats/routes), the state is unable to assign the proper equipment and apply chemicals at the appropriate rates to avoid further environmental degradation of both surface and ground water with chloride and sodium. The goal of the project is to provide better operational planning, thus allowing states to make more informed decisions regarding application of chemicals and use of other snow fighting methods.	Group 5 Joe Thompson, New York State DOT	30
12	Application Matrix for Enhanced Salt at Higher Temperatures	$125,000	18 months	The goal of this project is to review, analyze, and verify the application rates of enhanced solid salts such as Ice Slicer and Ice Kicker at higher temperatures as a means of determining if these products are more efficient at higher temperatures. We already know they can be used at lower temperatures.	Group 5 Steve Spoor, Idaho Transportation Department	32
13	Winter Weather Trends and Material Usage	$100,000	12 months	This project will review, analyze, and present snow amounts and long-term trends over a period of 50 years. Use the information associated with the trends and correlate that information with individual state quantities and hours of staff involved with snow removal operations. States can then associate their own costs. Costs of fighting winter will vary with inflation and time, while material usage, equipment and staff hours will remain as a constant.	Group 5 Jon Fleming, Pennsylvania DOT	34
14	Understanding the NaCl Phase Diagram	$75,000	12 months	The goal of this project is to provide a better understanding of the phase diagram and how solutions beyond the eutectic point will behave on the road by providing a Clear Roads phase diagram that is clear for the snow fighting industry and has an in-depth discussion paper backing it up. In other words, to get everyone on the same page.	Group 5 Brian Burne, Maine DOT	36

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2020

#	Title	Est. Cost	Est. Duration	Project Summary	Presented by	Page
15	AWSSI Enhancements – Phase 2	$40,000	12 months	The goal of this project is to provide additional enhancements to the AWSSI tool as described below: a) Research the weather data in the 36 Clear Roads states and add one station to each state (providing that state has a location with enough data to support adding an additional station). If a state does not have the data to support an additional station, that station can be added to a different state that does have sufficient data instead. b) Update the 1980 to 2014 Averages Map. The intent of this tasking would be to bring the averages map, found at https://mrcc.illinois.edu/research/awssi/avgMap1980-2014-Brettschneider.pdf, up through the 2019-2020 winter season. c) Add the ability to download the daily seasonal data for any given station during the current season. d) Add the ability to select up to 5 specific historical seasons (user-selected), to be added to any station's current year chart.	Group 5 Brian Burne, Maine DOT	39

Clear Roads Research Proposals
2020

#	Title	Est. Cost	Est. Duration	Project Summary	Presented by	Page
16	Cost-Benefit Analysis Toolkit, Phase 3	$125,000	18 months	Clear Roads has completed two cost-benefit analysis projects – they include *08-02: Cost-Benefit Analysis Toolkit* and *11-01: Cost-Benefit Analysis Toolkit (Phase II)*. It has been seven years since the phase II Toolkit was completed and the Toolkit is in need of updates as much of the assumptions are based on old financial data and there is extraneous html code visible where it should not be. The goal of this project would be to: a) Update financial assumptions b) Clean up html code c) Expand functionality d) Provide ongoing technical support	Group 2 James Morin, Washington State DOT	42

2020 Research Proposal Form

Proposer name: Scott Lucas
Organization: Ohio Department of Transportation

Title of proposed research project: Weather Forecast Evaluation Tool

Topic Area (highlight one):
Planning/Methods Equipment Materials Training **Technology** Safety

2) **Explain the specific problem or issue to address**. Forecasting winter storms is not an exact science, but snow and ice control managers need the best information to determine their course of action. There are numerous locations to obtain weather forecast data (National Weather Service, contracted weather forecasting service, local weather services, on-staff meteorologist, etc.), but which of these options are more consistently correct in predicting the arrival of a storm (i.e. type and amount of precipitation)? Which are more consistently accurate 72, 48, 24 or 12 hours prior to the storm?

3) **What is the goal of the project?** Develop a program that can ingest weather forecast data from multiple sources and compare it to what actually occurred and assign the forecast a level of accuracy based on when the storm arrived, what form of precipitation fell, and how much precipitation accumulated.

4) **Describe the expected products/deliverables of the research.** An online program that can evaluate the level of accuracy of various weather forecasts for a specific location, duration of time, and forecast outputs before the storm.

5) **List the specific research tasks that would form the scope of work. (What steps will the researcher need to take to develop the deliverables?)**
   a) Literature Search.
   b) Define the critical information needed in a forecast for decision makers through the development data requirements using a survey of Clear Roads membership.
   c) Develop a web tool proposal that will likely also include input from CR 16-05 Weather Event Reconstruction and Analysis Tool. This tool should be modifiable so that states can adjust weighting of various storm elements based on that state's priorities.
   d) Develop the Tool.
   e) Test and deliver the tool.
   f) Production of guidance and documentation.
   g) Technical support.
   h) Final report and webinar.

6) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.** The intended audience for the product is

anyone that depends on using forecast data to make business decisions. This could also be used to evaluate paid weather forecasting services.

7) **How will they be used to impact your organization? How would they benefit DOTs? Describe how the research recommendations can be used to improve the winter maintenance operations of state transportation systems**. Having a tool that determines which forecast are the most accurate will lessen the workload on a manager in having to check multiple forecasts, some of which may have a very low level of accuracy. It could show a manager, out of the six weather forecasts they consume to make a decision, only three of them have an accuracy rate of about 70%. After the product is developed, it would be good to have a training video on how to use it and a service contract to maintain the program. The developing vendor could charge a nominal fee to perform live training to users if needed.

8) **How will you measure the success of this project?** Success of the project would be the creation of a program that could easily ingest weather forecasts and weather results as they happen of a determine area and at set timeframes and calculate the accuracy of the forecasts. The program would also need to do this on a consistence basis.

9) **Estimated funding needed:** $180,000

10) **Estimated timeline for completing the research:** Eighteen (18) months

11) **Are you aware of any similar or related research on this topic? If so, please list below.** I found the links below. The first one seems to be an internal program used by the vendor. The second was a research project done by the Royal Meteorological Society in England. It seems to look at the same issues but does not have a built process. The third is a video about assessment and verification. The fourth was a 2002 project and appears to have developed a method of evaluating the accuracy of a forecast, but not a program that will ingest and compute the results.

https://www.ecmwf.int/en/research/modelling-and-prediction/forecast-evaluation
http://empslocal.ex.ac.uk/people/staff/dbs202/publications/booksreports/mailier.pdf
https://study.com/academy/lesson/weather-forecast-assessment-verification.html
https://pdfs.semanticscholar.org/146d/5bddf53e0cbac390c1e02ebf364b98bf264a.pdf

2020 Research Proposal Form

Proposer name: Scott Lucas
Organization: Ohio Department of Transportation

Title of proposed research project: Entry-Level Commercial Driver's Training

Topic Area (highlight one):
Planning/Methods Equipment Materials **Training** Technology Safety

1) **Explain the specific problem or issue to address**.
DOT's that currently provide initial, entry level driver training (ELDT) for future CDL vehicle operators to acquire their class B CDL or go from a class B to an A will need to develop training and self-certify they meet the training requirements in the FMCSA's Training Provider Registry (TPR) by February 7, 2022. If the DOT's training departments are not registered in the FMCSA's TPR, they will not be able to provide entry-level driver training.

On December 8, 2016 the Federal Motor Carrier Safety Administration (FMCSA) published its entry-level driver training rule. The rule, the result of a negotiated rulemaking process, is based on consensus recommendations made by a committee comprised of a cross-section of motor carrier interests.

The entry level driver training rule establishes minimum training standards for drivers:

- Applying for their initial CDL,
- Upgrading their current CDL, or
- Obtaining a passenger, school bus, or hazardous materials endorsement for the first time.

An entry level driver must, prior to taking the skills test, successfully complete a prescribed program of theory and behind-the-wheel Instruction provided by a school or other entity listed on FMCSA's Training Provider Registry (TPR).

This final rule differs greatly from the current entry-level driver training rule, which prescribes instruction for drivers with less than one year of experience operation a CDL vehicle in Interstate commerce. This instruction consists of four areas or topics: driver qualification, hours of service, driver willingness, and OSHA's whistleblower protection regulations. The current rule is scheduled to expire on February 7, 2022. On that date compliance with the new requirements is required.

DOT's that provide initial CDL training for people to accruing their class B CDL or go from a class B to an A will need to self-certify that they meet the training requirements in the FMCSA's Training Provider Registry (TPR). If the DOT's training departments are not registered in the FMCSA's TPR, they will not be able to provide entry-level driver training. Once the DOT's turn in their training requirements to the TPR, FMCSA will provide an electronic interface that will receive and store entry-level driver training certification

information from the DOTs and transmit that information to the state driver licensing agency.

2) **What is the goal of the project?**
    a. Develop Clear Road's ELDT programs for people to acquire their class B CDL, to advance from a class B to a class A CDL that meets the requirements of the new FMCSA rules.
    b. The curriculum must provide instruction that meets all the standards established in the FMCSA training rules to include on-road instruction, driver qualification, driver wellness, hours of service and whistleblower protection. Training must also meet state licensing agency requirements.
    c. Document a process for DOT's to be able to attest that they meet the specified requirements, and in the event of an FMCSA audit or investigation of the DOT, must supply documentation to verify their compliance.
    d. Develop a train the trainer program for the course.
    e. Document the process for DOT's to self-certify in the FMCSA's Training Provider Registry.

3) **Describe the expected products/deliverables of the research.**
    a. Entry Level Driver Training program for CDL class B and B to A.
    b. Train the trainer program.
    c. Documented process for DOT's to self-register their program in FMCSA's Training Provider Registry.

4) **List the specific research tasks that would form the scope of work. (What steps will the researcher need to take to develop the deliverables?)**
    a. Researcher will need to gather the state licensing requirements for all states
    b. Gather training requirements from FMCSA
    c. Develop a training program that is acceptable to the TAC
    d. Develop a train the trainer program that is acceptable to the TAC
    e. Develop a process for DOT's to follow to self-certify as a training provider in the FMCSA's Training Provider Registry.

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.**
    Any public agency that provide entry level driver training to their employees to obtain a class B CDL or to advance from a class B to a class A. Once the product is developed, there will need to be some level of training on how to train, trainers on the course. Once DOTs are registered as training providers, they will be able to train their people.

6) **How will they be used to impact your organization? How would they benefit DOTs? Describe how the research recommendations can be used to improve the winter maintenance operations of state transportation systems**.
    Our organizations will be able to train our own employees on how to operate a CDL vehicle and obtain a class B or A CDL. This would allow DOTs to provide their own training and not have to contract this function out to a vendor. Development of the program to meet FMCSA's requirements as well as state and DOT requirements will create a program that is focused on operating a CDL vehicle in a highway maintenance functional roll, to included snow and ice control, more than a generic CDL vehicle operating roll.

7) **How will you measure the success of this project?**
Development of the deliverables.

8) **Estimated funding needed:** $300,000

9) **Estimated timeline for completing the research:** Twelve (12) months

10) **Are you aware of any similar or related research on this topic? If so, please list below.**
J.J. Keller & Associates, Inc. have developed a training program, but I don't believe that the current program has been approved by FMCSA. Their current product only covers requirements that sunset on February 2, 2022. The program assists in compliance with the entry-level driver training requirements in Part 380, Subpart E of the FMCSRs. It does not address the Part 383, Subpart G or the third party CDL tester requirements.

2020 Research Proposal Form

Proposer name: James Morin
Organization: WSDOT

Title of proposed research project: Salt Shed Design Template

Topic Area (highlight one):
Planning/Methods **Equipment** **Materials** Training Technology Safety

1) **Explain the specific problem or issue to address**.
Each state has their own salt shed design, in some states there are 4-5 varieties. In many cases these sheds are designed for each location given a specific budget. After viewing the salt sheds in Iowa, I realized how inadequate our sheds are. Our sheds are typically pole barns with ecology blocks placed around the inside of the poles in order to hold the salt in. Not surprisingly these facilities don't do a great job of containing salt, we often see salt leaching out through the cracks in the ecology block walls within only a couple months of installation. We need a standard design that is scalable to a variety of sizes, say from 200 to 10,000 tons in size. Ideally this design would incorporate the best practices already employed by other states such as pre-fab wall systems, cast-in-place concrete walls with variable heights, flexible roof systems, rectangular shed vs a dome, etc.

2) **What is the goal of the project?**
The goal of this project is to evaluate and design a set of standard salt sheds that could be scaled to meet the needs of a variety of sites. It is recognized that it would be difficult to design a shed that would work in every state, with every type of soil, wind load, snow load etc. However, three scales would be used for this comparison in this project; small (150-500 ton), medium (500-4,000 ton) and large (over 4,000 ton). This project would provide a template for the member state to use as a starting point for designing and bidding these projects.

3) **Describe the expected products/deliverables of the research.**
   - A simple guide for things to consider when building a salt shed, based on the experiences of member states.
   - CAD files that would be developed for a variety of sizes that can easily be modified to meet local standards. This would pull on the existing experience of states that have already taken some of these steps and incorporate their best practices into a guide.

4) **List the specific research tasks that would form the scope of work. (What steps will the researcher need to take to develop the deliverables?)**
   - Identify preferred design for storage of dry chemical that:
     - Adheres to the International Building code
     - Limits leaching to ground and adjacent resources
     - Minimizes cost per square foot construction costs

    - Minimizes lifecycle maintenance and replacement costs
    - Recognizes an economy of scale for each scale size (s,m,l) in varying regions of the country using data from private and public manufacturers
- Evaluate and recommend construction techniques such as pre-fab wall panels/soft roof structures etc.
- Develop a set of standard plans that can be easily modified to meet local size, seismic, and snow load requirements.
- Develop best practices guide for construction.

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.** Transportation entities including State, County, Cities and Airports.

6) **How will they be used to impact your organization? How would they benefit DOTs? Describe how the research recommendations can be used to improve the winter maintenance operations of state transportation systems**. Provide a proven template for construction of salt storage facilities that can be scaled to a particular site. This should reduce the cost per square foot for construction and maintenance while improving the design in an effort to limit environmental impact.

7) **How will you measure the success of this project?** We could measure the number of structures that were built using this template.

8) **Estimated funding needed:** $75,000

9) **Estimated timeline for completing the research:** Twelve (12) months

10) **Are you aware of any similar or related research on this topic? If so, please list below.** States such as Iowa, Wisconsin and Nebraska have completed some of this work independently. These might be a good place to start.

2020 Research Proposal Form

Proposer name: Jeff Pifer
Organization: West Virginia DOT

Title of proposed research project: Snow and Ice Equipment Online Database

Topic Area (highlight one):
Planning/Methods **Equipment** **Materials** Training Technology Safety

1) **Explain the specific problem or issue to address**.
Clear Roads currently keeps several sources of information related to equipment and/or material inventory and usage. Examples of this include the Product Experience Survey, the Annual Survey of State Winter Maintenance Data, the Qualified Products List, several of the Topics of Interest to the TAC, and multiple research projects that inventory equipment including, *12-05 Comparison of Materials Distribution Systems*, *14-01 Synthesis on GPS/AVL Equipment Used for Winter Maintenance*, *16-01 Utilization of AVL/GPS Technology: Case Studies*, *19-S1 Inventory and Use of Salt Spreading Systems*. The issue with these projects is that the results take the form of a static report and are not responsive to the changing states' needs and inventories. In order to update such inventories requires Clear Roads to fund projects in a less than efficient way.

2) **What is the goal of the project?**
The goal of this project is to create an online database of Roadway Snow and Ice Control (RSIC) equipment on the Clear Roads website that is updated on a regular basis, thus providing members with an accurate representation of equipment used by member states in a more efficient manner in terms of time, effort, and cost.

3) **Describe the expected products/deliverables of the research.**
A database of member states' RSIC equipment inventories on the (members-only side) Clear Roads website. Examples of RSIC equipment inventories to be maintained will likely include vehicles, plows / blades / inserts, brine makers / blenders, cameras, GPS/AVL systems, information management systems / sensors, lighting systems, material spreaders and liquid application systems, and windshield wipers. Perhaps even deicers and other chemicals.

4) **List the specific research tasks that would form the scope of work. (What steps will the researcher need to take to develop the deliverables?)**
   - Identify the RSIC equipment to be inventoried.
   - Identify the time intervals for which this equipment will be updated.
   - Survey the Clear Roads membership every year / two years, based on time interval identified in the prior step.
   - Create an online environment / tool to represent the inventories on the CRs website.
   - Populate the tool based on the results of the inventory surveys on a regular basis.

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.** RSIC managers.

6) **How will they be used to impact your organization? How would they benefit DOTs? Describe how the research recommendations can be used to improve the winter maintenance operations of state transportation systems**.
Having this resource on the Clear Roads website will provide member states access to this information on which to base decisions in their own state, without having to spend time crafting and reviewing surveys. It will also save the states time and money by not having a fund new research project every time it is time to update the status of a category of equipment.

7) **How will you measure the success of this project?**
Based on the number of webpage hits monitored by Google Analytics and based on the feedback received by member states.

8) **Estimated funding needed:** $75,000

9) **Estimated timeline for completing the research:** Twelve (12) months

10) **Are you aware of any similar or related research on this topic? If so, please list below.**
- Product Experience Survey (https://clearroads.org/product-experience-survey/)
- Annual Survey of State Winter Maintenance Data (https://clearroads.org/winter-maintenance-survey/)
- Clear Roads Qualified Products List (https://clearroads.org/qualified-product-list/)
- Topics of Interest to the TAC (https://clearroads.org/members/)
- 12-05: Comparison of Materials Distribution Systems (https://clearroads.org/project/12-05/)
- 14-01: Synthesis on GPS/AVL Equipment Used for Winter Maintenance (https://clearroads.org/project/14-01/)
- 16-01: Utilization of AVL/GPS Technology: Case Studies (https://clearroads.org/project/16-01/)
- 19-S1: Inventory and Use of Salt Spreading Systems

2020 Research Proposal Form

Proposer name: Tom Peters
Organization: Minnesota Department of Transportation

Title of proposed research project: Mapping Weather Severity Zones (2011 – 2020)

Topic Area (highlight one):
Planning/Methods Equipment Materials Training Technology Safety

1) **Explain the specific problem or issue to address**.
The winter weather data that the previous two Clear Roads projects (Clear Roads Project 10-02: *Mapping Weather Severity Zones* and Clear Roads Project 14-08: *Weather Severity Mapping Enhancement*) used to map winter severity across the U.S. was based on winter weather data now about 10 – 20 years old.

2) **What is the goal of the project?**
Analyze weather severity in the snow and ice states following the same methodology used for Clear Roads Project 10-02 to map weather severity across the regions and states but for the time period of 2010 – 2020. These results could be used to both compare the time period results and possibly identify trends.

3) **Describe the expected products/deliverables of the research.**
A series of maps that depict winter weather severity for the time period of 2010 – 2020 across the U.S. in a manner similar to the previous Clear Roads Project results.

4) **List the specific research tasks that would form the scope of work. (What steps will the researcher need to take to develop the deliverables?)**
By analyzing the updated weather severity in snow and ice states, the researchers will again use the methodology to map weather severity across the regions along with a state-focused version of each of the five weather severity maps for each of the 36 state Clear Roads members.

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.**
State and local agencies involved with winter roadway maintenance. No training is anticipated to be needed.

6) **How will they be used to impact your organization? How would they benefit DOTs? Describe how the research recommendations can be used to improve the winter maintenance operations of state transportation systems**.
In 2012, Clear Roads completed a project to develop weather severity maps of the U.S. for the time period of 2000 – 2010. The project results provided a means for state DOTs to compare their operations with other states with similar weather severity. These comparisons allowed states to identify opportunities for reducing spending or improving levels of service.

This would be a good time to revisit this methodology with updated winter weather numbers for 2010 – 2020.

7) **How will you measure the success of this project?**
Given the variabilities of weather for a typical winter season, it will be difficult to make quantified measurements. More likely, a combination of a short survey to members along with a tracking of the number of webpage visits will be the extent of any quantified measurement.

8) **Estimated funding needed:** $75,000

9) **Estimated timeline for completing the research:** Twelve (12) months

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

Clear Roads Project 10-02: Mapping Weather Severity Zones
Clear Roads Project 14-08: Weather Severity Mapping Enhancement

2020 Research Proposal Form

Proposer name: James Morin
Organization: WSDOT

Title of proposed research project: Indoor Automated Stockpile Measurement
Topic Area (highlight one):
Planning/Methods **Equipment** **Materials** Training **Technology** Safety

1) **Explain the specific problem or issue to address**.
Nationwide, State DOT's use approximately 9 million tons of salt per year. This represents an annual value of over $500 million for this commodity alone. Most if not all of this material is stored inside warehouses, sheds or barns that are mostly, if not completely enclosed. There is technology that has been effectively used to measure stockpiles with cell phones and/or drones using photogrammetry. This works quite well for outdoor stockpiles, which are generally sand or sand salt mix piles, but doesn't work particularly well in confined spaces. Currently there is not an effective way to accurately and autonomously measure our indoor salt inventory. There is a need for methods and tools to autonomously measure solid salt stockpiles in order to improve accuracy, save time and improve inventory management.

2) **What is the goal of the project?**
Develop a methodology and identify tools to perform indoor salt measurement using photogrammetry, LIDAR or some type of sensor. Possible solutions may include permanent installation of an array of cameras or sensors that routinely scan the stockpile, interpret the data and provide real time inventory. Or it may rely on some sort of robotic, autonomous drone or mobile technology to collect the data. As previously mentioned, this has been done with drones, however this is problematic inside sheds requiring highly skilled pilots and requires a vendor or employee to travel to each site regularly. Drone technology has not progressed to the point that flights inside a facility can truly be accomplished autonomously and requires DOT's to train and maintain numerous licensed drone pilots. The goal is this project is to identify a way to accomplish real time inventory and monitoring of the sites with minimal input from maintenance staff.

3) **Describe the expected products/deliverables of the research.**
   - Test and develop sensors that could be used to identify the volume of stockpiles inside of maintenance structures.
   - Establish a software package that can interpret the data collected above to provide near real time inventory data.

4) **List the specific research tasks that would form the scope of work. (What steps will the researcher need to take to develop the deliverables?)**
   - Identify sensors to be tested
   - Test sensors
   - Select preferred sensor(s) to be used

- Establish mounting protocol (if sensors are to be static mounted)
- Identify existing software or develop software to ingest above data and provide accurate inventory volumes
- Present findings and recommendations for DOT's to implement automated inventory program.

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.** Transportation entities including State, County, Cities and Airports.

6) **How will they be used to impact your organization? How would they benefit DOTs? Describe how the research recommendations can be used to improve the winter maintenance operations of state transportation systems**. Improve timing and accuracy of salt measurement and inventory. This would benefit DOTs in that it would reduce labor, increase accuracy and improve situational awareness of real time inventory which would help to reduce salt costs through the ability to make more regular orders avoiding short period ordering (7-day orders are far more expensive than 30 day orders).

7) **How will you measure the success of this project?** Accuracy of measurement devise compared to surveyed or manually measured quantities. The amount of time and cost necessary to complete measurement.

8) **Estimated funding needed:** $200,000

9) **Estimated timeline for completing the research:** Eighteen (18) months

10) **Are you aware of any similar or related research on this topic? If so, please list below.** Clear Roads initiated a synthesis in 2016, Project CR16-S2, this synthesis was completed by CTC & Associates. The findings are posted on the CR website under Synthesis CR16-S2. Following this a number of states including WA, OR and others began using this technology for outdoor stockpiles. This technology is primarily focused on cellphone and camera equipped drones.

2020 Research Proposal Form

Proposer name: Todd Law
Organization: Vermont Agency of Transportation

Title of proposed research project: Quantifying the Impact that New Capital Projects Will Have on Roadway Snow and Ice Control (RSIC) Operations, Phase 2

Topic Area (highlight one):
Planning/Methods Equipment Materials Training Technology Safety

1) **Explain the specific problem or issue to address**.
New capital projects increase the time and money required to complete Roadway Snow and Ice Control (RSIC) operations. Unfortunately, this increased RSIC burden is rarely quantified and therefore is not considered during the early stages of the capital project development process. This project will build upon CR 14-02 Quantifying the Impact That New Capital Projects Will Have on Roadway Snow and Ice Control Operations by evaluating additional capital projects. In the first project, two general types of new projects were investigated:

1) Additions of new roadway capacity such as new lanes, new shoulders, and new roadways
2) New roadway configurations such as new striping plans, new curb-cuts, new bulb-outs, etc.

2) **What is the goal of the project?**
The goal of the project is to build upon / improve the automated method of quantifying the anticipated impact that new capital projects will have on total vehicle-hours of travel (VHTs) for the RSIC fleet. This method can be used in the early stages of project development to determine if the agency will need additional resources, such as trucks, salt, fuel, and manpower to provide RSIC after the project is completed.

3) **Describe the expected products/deliverables of the research.**
- Add roadway configurations for Tool to evaluate.
- Improve / validate the Tool.
    - This could include creating an online web-based version of the Tool.
    - If so, then ongoing technical support would be recommended.

4) **List the specific research tasks that would form the scope of work. (What steps will the researcher need to take to develop the deliverables?)**

Part 1

- Review and evaluate the CR 14-02 Tool as well as other similar tools.
- Survey the Clear Roads membership to determine need and make recommendations for new roadway configurations to be added.
- Develop a mockup version of the tool for review by Clear Roads.

Part 2 (assuming Part 1 is accepted and PI is provided approval to continue)
- Create a beta version of the Tool for testing by Clear Roads membership.
- Develop instructional manual and any other associated documents.
- Finalize Tool.
- Final report and webinar.

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.**
The information gained from this project will help directors and managers of the Operations Divisions of state DOTs argue for appropriate increases in resources that are consistent with the construction of different types of new capital projects.

6) **How will they be used to impact your organization? How would they benefit DOTs? Describe how the research recommendations can be used to improve the winter maintenance operations of state transportation systems**.
The resources needed for RSIC operations may be overlooked when resources are allocated to different types of capital projects, although the Operations Division is expected to take responsibility for managing RSIC operations on any and all new capital projects. This could potentially create a budget misalignment scenario where RSIC operations do not have the resources needed to manage new capital projects. Any DOT could use the VHT burden to quantify the increased monetary costs on their specific operations, based on their specific costs for fuel, salt, labor (loaded rate), and vehicle (loaded rate). These costs can then be annualized by factoring up for the average (or maximum) number of winter-storm dispatches experienced per year, thus providing the states better data on which to base their budget planning.

7) **How will you measure the success of this project?**
Track use of the online Tool. State testimonials on the ability of the tool to assist them to more accurately prepare budgets.

8) **Estimated funding needed:** $100,000

9) **Estimated timeline for completing the research:** Fifteen (15) months

10) **Are you aware of any similar or related research on this topic? If so, please list below.**
CR 14-02: Quantifying the Impact That New Capital Projects Will Have on Roadway Snow and Ice Control Operations

2020 Research Proposal Form

Proposer name: Jasmine Dondlinger/Ty Barger
Organization: Nebraska Department of Transportation

Title of proposed research project: Winter Maintenance Product Proficiency Sample Program

Topic Area (highlight one):
Planning/Methods Equipment Materials Training Technology Safety

1) **Explain the specific problem or issue to address**.
Some DOTs perform testing of deicing chemicals in-house while others use third-party laboratories or use vendor analysis reports. There is not currently a way to accurately evaluate the quality of testing within and between laboratories for winter maintenance products. Without a way to verify a lab's proficiency in equipment and following test procedures (for deicing chemicals), the results may not be consistent or accurate; therefore, not valid. If the test results are not valid, it can be difficult or impossible to accurately evaluate the quality and value of a deicing chemical for use by a DOT.

2) **What is the goal of the project?**
A Proficiency Sample Program can be utilized as a useful tool for a DOT, manufacturer/vendor, and/or third-party laboratory to monitor the quality of its services. This project would provide participating laboratories with the capability to:

e) Compare individual testing results to a large pool of results from their peers.
f) Verify both the testing equipment and the operator under actual testing conditions.
g) Show evidence of conformance to testing procedures and protocols as set forth by specifying agencies or internal QA/QC programs.
h) Receive individualized reports with performance charts to track testing results over time.
i) Use an (optional) Extra Proficiency Sample Program (XPS) for training of technicians, testing or equipment verification, inter-laboratory studies, and for addressing accreditation issues related to proficiency sample testing.

3) **Describe the expected products/deliverables of the research.**
a) Acquire Materials – The designated organization will acquire sufficient quantities of multiple winter maintenance products in order to supply all participating laboratories with enough material to perform all required tests.
b) Program Website – Develop and maintain a program website to provide information on the program, testing instructions, report forms, and login capabilities for individual laboratories to submit data and view results.
c) Statistical Analysis – The participating laboratories will supply results to the designated organization (via the website), who will then perform statistical analysis on the aggregate data, which will include a minimum of averages, standard deviations, and ratings to the individual participating laboratories.

d) Critical Analysis – The designated organization will provide information on root cause analysis (or similar tool(s)) to assist with any corrective actions a laboratory would need to consider if a poor rating is received.
e) Proficiency Testing – The designated organization will send out sets of winter maintenance products at least annually. Since there are different categories of winter maintenance products, it may be beneficial to send out sets biannually – one set for liquids, one set for solids, and possibly a set for additives.

4) **List the specific research tasks that would form the scope of work. (What steps will the researcher need to take to develop the deliverables?)**
a) Coordinate with manufacturers of winter maintenance products in order to provide material to participating laboratories.
b) Observe Good Laboratory Practice (GLP) to ensure the integrity and consistency of all samples.
c) Create a new (or modify an existing) website to accommodate this new program.
d) Perform statistical analysis on all data results received and provide reports to individual laboratories.

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.**
The intended audience is any laboratory that performs testing on winter maintenance products, i.e., DOTs, manufacturers/vendors, third-party laboratories.

6) **How will they be used to impact your organization? How would they benefit DOTs? Describe how the research recommendations can be used to improve the winter maintenance operations of state transportation systems**.
This program would enable laboratories to evaluate the quality and consistency of their testing, as well as determine any deficiencies or problems that require a corrective action, whether it's equipment or procedural. A laboratory with a great QA/QC program in testing provides confidence in the quality of product a DOT purchases.

7) **How will you measure the success of this project?**
The establishment of an enduring Proficiency Sample Program for winter maintenance products.

8) **Estimated funding needed:** $75,000

9) **Estimated timeline for completing the research:** Twelve (12) months

10) **Are you aware of any similar or related research on this topic? If so, please list below.**
Current vendors of NDOT are interested and in support of a proficiency program such as this.

Additional information:

- AMRL Proficiency Sample Program
  - http://aashtoresource.org/psp
  - http://aashtoresource.org/psp/fees
  - http://aashtoresource.org/psp/samples-types-and-tests
  - http://aashtoresource.org/psp/schedule

    - http://aashtoresource.org/psp/faqs

- CCRL Proficiency Sample Program
    - http://www.ccrl.us/Psp/PspProgramDescriptions.html
    - http://www.ccrl.us/Psp/PSPFeeSchedule.pdf
    - http://www.ccrl.us/Psp/PSPCalendar.pdf
    - http://www.ccrl.us/DataEntry/Reports.html?NavSwitch=SumOfStats

2020 Research Proposal Form

Proposer name: David Gray
Organization: NHDOT

Title of proposed research project: Expanded Use of AVL/GPS Technology Study

Topic Area (highlight one):
Planning/Methods **Equipment** Materials Training **Technology** Safety

1) **Explain the specific problem or issue to address**.
   DOT's are trying to justify purchasing AVL's due to the unit cost and monthly fees.

2) **What is the goal of the project?**
   The goal of this project to find out what States are using their AVL/GPS units for, to include winter and non-winter activities. List of non-winter projects or methods that AVL/GPS technology are currently being used for to benefit DOT's.

3) **Describe the expected products/deliverables of the research.**
   A guide that shows the how different levels of AVL technology can be applied to different usages for DOT's. Also questions on how your State using your AVL's on the Annual Survey of State Maintenance Data.

4) **List the specific research tasks that would form the scope of work. (What steps will the researcher need to take to develop the deliverables?)**
   Literature Search. Survey to vendors on how they promote the use of their technology. Survey to State and Municipal DOT's on how they use their AVL's for winter and non-winter activities.

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.**
   Management in charge of fleets and field supervisors

6) **How will they be used to impact your organization? How would they benefit DOTs? Describe how the research recommendations can be used to improve the winter maintenance operations of state transportation systems**.
   This will help demonstrate the return on investment that AVL's can provide a DOT outside of the typical winter material tracking.

7) **How will you measure the success of this project?**
   This project will allow DOT's the ability to justify the purchasing of AVL/GPS technology, since it can be used for more than just winter material tracking.

8) **Estimated funding needed:** $75,000

9) **Estimated timeline for completing the research:** Twelve (12) months

10) **Are you aware of any similar or related research on this topic? If so, please list below.**
16-01: Utilization of AVL/GPS Technology Case Study
14-01: Synthesis on GPS AVL Equipment Used for Winter Maintenance

2020 Research Proposal Form

Proposer name: John DeCastro
Organization: CTDOT

Title of proposed research project: Measuring the Costs and Detrimental Effects of Sand Use in Winter Snow and Ice Operations on the Environment

Topic Area (highlight one):
Planning/Methods Equipment **Materials** Training Technology Safety

1) **Explain the specific problem or issue to address**.
While many states have transitioned to an all-chemical priority, some states and municipal jurisdictions within states, still use a sand / salt mixture for treating their roadway network. However, this leads to many adverse effects, including sand deposition into drainage systems and waterbodies, dust, additional work for sweeping after storm events, claims from broken windshields, etc. Sand does not dissolve and must be removed. Once collected, it must be treated as contaminated material and disposed of. In addition, the use of sand is not as effective as salt in treating roads during snow and ice events.

2) **What is the goal of the project? ,**
To document and understand the effects of the use of sand as related to the environment and snow and ice control. The document and understand the costs and effectiveness when used as the major component in snow and ice control. To document the process of removing sand deposition on the roads, within drainage systems, ponds, and waterbodies.

3) **Describe the expected products/deliverables of the research.**
The expected deliverables of this research project are to develop a report that outlines the pros and cons of sand as a material used in winter snow and ice operations, including costs associated with clean up and environmental impacts.

4) **List the specific research tasks that would form the scope of work. (What steps will the researcher need to take to develop the deliverables?)**
   - Lit search
   - Interviews
   - Case studies
   - Final report

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.**
This research is intended for states and municipalities as well as other countries with snow and ice operations. Deliverables will be a report outlining the use of sand and its effects on the environment including costs.

6) **How will they be used to impact your organization? How would they benefit DOTs? Describe how the research recommendations can be used to improve the winter maintenance operations of state transportation systems**.
Since our organization no longer uses sand in snow and ice control operations, we will only benefit by report of validation. Other towns and municipalities within the state and others outside that still utilize sand as the main component in snow and ice control, will benefit and this may justify that transition to the use of other components for snow and ice control.
7) **How will you measure the success of this project?**
Success of this project will be measured upon the determination of the detrimental effects on the use of sand as the major component in snow and ice control and a report on the costs associated with its use. Also, the bearing of this report on other towns and states that still utilize sand as the major component in snow and ice operations.

8) **Estimated funding needed:** $75,000

9) **Estimated timeline for completing the research:** Twelve (12) months

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

- 15-01 Synthesis of Material Application Methodologies for Winter Operations (https://clearroads.org/project/15-01/; see Final Report and Guidebook)
- 13-01 Snow and Ice Control Environmental Best Management Practices Manual (https://clearroads.org/project/13-01/; see Final Report and Best Practices Manual)

https://www.memun.org/DesktopModules/Bring2mind/DMX/Download.aspx?EntryId=4789&Command=Core_Download&language=en-US&PortalId=0&TabId=119

https://www.maine.gov/mdot/mlrc/docs/technical/2015-08-17-June2015FINAlversion.pdf

https://www.cargill.com/salt-vs.-sand-for-winter-road-safety

https://sicop.transportation.org/wp-content/uploads/sites/36/2017/07/Use-of-Abrasives_Nixon-2001.pdf

CLEAR ROADS
research for winter highway maintenance

2020 Research Proposal Form

Proposer name: Joe Thompson
Organization: NYSDOT (Group 5)

Title of proposed research project: Environmental Prioritization of Highway Segments Relative to Snow and Ice operations Using Standard GIS Layers

Topic Area (highlight one):
Planning/Methods Equipment Materials Training Technology Safety

1) **Explain the specific problem or issue to address**. With the inability to identify environmentally sensitive corridors (beats/routes), the state is unable to assign the proper equipment and apply chemicals at the appropriate rates to avoid further environmental degradation of both surface and ground water with chloride and sodium.

2) **What is the goal of the project?** The goal of the project is to provide better operational planning, thus allowing states to make more informed decisions regarding application of chemicals and use of other snow fighting methods.

3) **Describe the expected products/deliverables of the research.** Development of a matrix to assign environmental risk/sensitivity to highway segments and regions. This matrix will provide an ascending prioritized list of beats based on weighted environmental variables attributed to standard GIS layers.

4) **List the specific research tasks that would form the scope of work. (What steps will the researcher need to take to develop the deliverables?)**
    - Literature Search
    - Survey of states, municipal levels of government, Canadian provinces, and other foreign agencies.
    - Through the previous tasks, identify the factors and criteria and their relative impact to the environmental sensitivity of highway segments.
    - How they are weighted to be considered in developing the method/matrix i.e. : Winter severity index, 200ft buffer to open water bodies (LF-% of Beat), 0ft buffer to unconfined aquifers (LF-% of segment), # of Public/Private drinking water wells (EA), Ditch line (LF % of Beat), # of Drop inlets (EA), # of culverts (EA), # of AADT, Tree canopy - shading (LF % of Beat) etc.?
    - Develop a matrix for the prioritization/ranking of highway segments and a set of instructions / recommendations for applying the matrix to S&I operations.
    - Final Report

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.** S&I Program Managers, Resident/District Engineers.

6) **How will they be used to impact your organization? How would they benefit DOTs? Describe how the research recommendations can be used to improve the winter maintenance operations of state transportation systems**. This will reinforce good stewardship and program management, identify locations for specialized equipment for snow removal, monitor efforts, and provide a mitigation plan defending against groundwater contamination claims.

7) **How will you measure the success of this project?** Project success will be measured by providing focus to areas of greatest environmental risk resulting in fewer claims against states.

8) **Estimated funding needed:** $100,000

9) **Estimated timeline for completing the research:** Twelve (12) months

10) **Are you aware of any similar or related research on this topic?** No

2020 Research Proposal Form

Proposer name: Steve Spoor
Organization: Idaho Transportation Department

Title of proposed research project: Application Matrix for Enhanced Salt at Higher Temperatures

Topic Area (highlight one):
Planning/Methods Equipment **Materials** Training Technology Safety

1) **Explain the specific problem or issue to address**. Clear Roads Project 12-02, *Establishing Effective Salt and Anti-Icing Application Rates*, developed application matrix tables for both liquid and granular chemicals. Tables were developed for solid sodium chloride and the enhanced salt of Ice Slicer. The application rates listed in the table for temperatures of 16 degrees or higher are the same for both solid granular products. The vendor for the Ice Slicer product claims their product can be used at a lower application rate in this temperature range. Further research is needed to validate or dispute this claim by the vendor.

2) **What is the goal of the project?** To review, analyze, and verify the application rates of enhanced solid salts such as Ice Slicer and Ice Kicker at higher temperatures as a means of determining if these products are more efficient at higher temperatures. We already know they can be used at lower temperatures.

3) **Describe the expected products/deliverables of the research.** Revised application matrix tables for enhanced salts across the current temperature range of the tables as they exist in the findings of Task 2 of CR 12-02.

4) **List the specific research tasks that would form the scope of work. (What steps will the researcher need to take to develop the deliverables?)**
    - Literature search
    - Survey of states and municipalities using these products and current application rates across the full temperature range.
    - Laboratory evaluation of the products and the associated ability to melt ice compared to solid sodium chloride.
    - Field evaluation of products to backup laboratory results.
    - Updated application matrix tables specific to the products, similar to CR12-02.
    - Final Report

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.** Snow and ice program managers, supervisors, and operators.

6) **How will they be used to impact your organization? How would they benefit DOTs? Describe how the research recommendations can be used to improve the winter**

maintenance operations of state transportation systems. The products in question have a higher initial cost. If this cost can be offset by a reduced application rate, they may provide an opportunity to reduce overall costs while providing a higher level of service and reduce the total amount of salt used, reducing the impact to the environment.

7) **How will you measure the success of this project?** Specific application matrix tables for specific products allows snow and ice professionals to develop accurate cost analyses for products allowing them to purchase and utilize the most efficient product available. This has the potential to reduce overall costs, material usage, and impact to the environment.

8) **Estimated funding needed:** $125,000

9) **Estimated timeline for completing the research:** Eighteen (18) months

10) **Are you aware of any similar or related research on this topic?**
CR 12-02: Establishing Effective Salt and Anti-icing Application Rates

2020 Research Proposal Form

Proposer name: Jon Fleming
Organization: Pennsylvania Department of Transportation

Title of proposed research project: Winter Weather Trends and Material Usage

Topic Area (highlight one):
Planning/Methods Equipment **Materials** Training Technology Safety

1) **Explain the specific problem or issue to address**. With the many open discussions on climate change and the impact of a warmer climate, DOT's are still managing ordering salt quantities and budgeting on a worst-case scenario. This often leads to over committing on salt purchases and overestimating the resources necessary in staffing and equipping for winter operations.

2) **What is the goal of the project?** To review, analyze, and present snow amounts and long-term trends over a period of 50 years. Use the information associated with the trends and correlate that information with individual state quantities and hours of staff involved with snow removal operations. States can then associate their own costs. Costs of fighting winter will vary with inflation and time, while material usage, equipment and staff hours will remain as a constant.

3) **Describe the expected products/deliverables of the research.**
   - Visual representation of past trends of snowfall amounts across the nation. (Where will this come from? Can we use WERA Tool or AWSSI?)
   - Visual representation of snowfall estimates based on trend analysis of the next 10 years.
   - Business Intelligence, web-based dashboard hosted on the Clear Roads Website that winter managers can use to plug in their own costs, material usage, and equipment to forecast those needs.

4) **List the specific research tasks that would form the scope of work. (What steps will the researcher need to take to develop the deliverables?)**
   - Literature search
   - Survey of states to determine historic usage of materials, and
   - Analysis of winter weather including ice, snowfall amounts etc. for CR states.
   - Development of a Business Intelligence system accessible through HTML or web browsers.
   - Final report

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.** Snow and ice program managers and supervisors.

6) **How will they be used to impact your organization? How would they benefit DOTs? Describe how the research recommendations can be used to improve the winter maintenance operations of state transportation systems**. Managers will have a new easy to use interface tool to look at trends in winter events based on historical weather and cost data for their state. They will be better to anticipate needs over the next several years and execute scenarios of ordering less materials or balancing staffing needs based on past practices.

7) **How will you measure the success of this project?** User friendly web-based environment managers across the country can input their historic information of costs, material usage to look at future trends and needs of their department.

8) **Estimated funding needed:** $100,000

9) **Estimated timeline for completing the research:** Twelve (12) months

10) **Are you aware of any similar or related research on this topic?** No.

CLEAR ROADS
research for winter highway maintenance

2020 Research Proposal Form

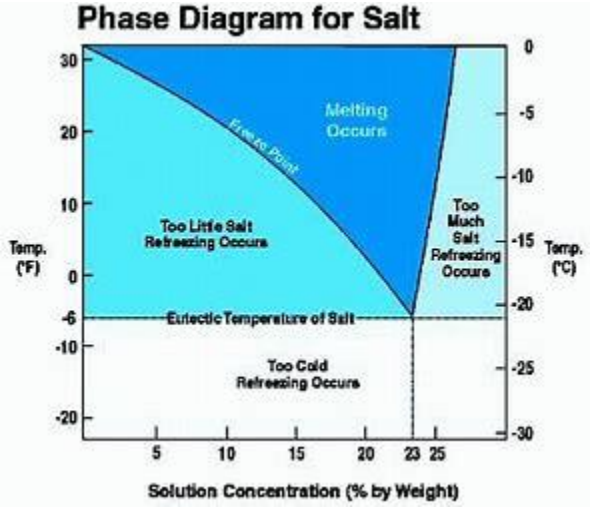
Proposer name: Brian Burne
Organization: Maine Department of Transportation

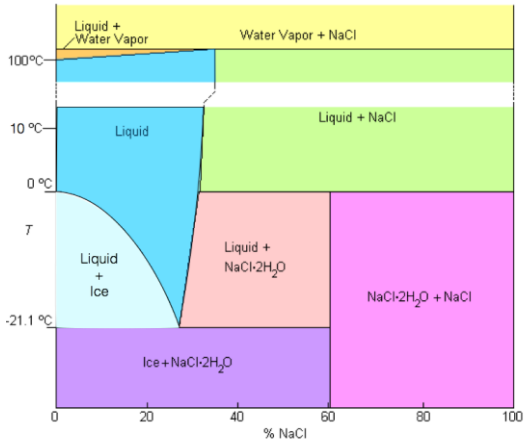
Title of proposed research project: Understanding the NaCl Phase Diagram

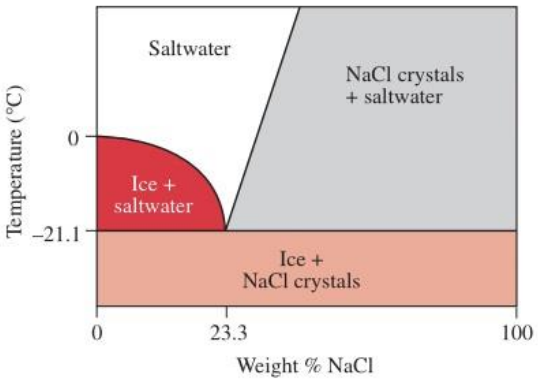
Topic Area (highlight one):
Planning/Methods Equipment Materials **Training** Technology Safety

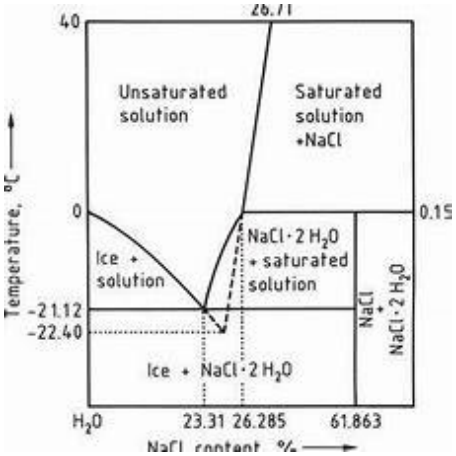
1) **Explain the specific problem or issue to address**. There are many confusing sodium chloride phase diagrams floating around the internet. Some suggesting that that solutions having salt concentrations in excess of the eutectic point can freeze at the same temperature as water with no salt. The purpose of this project would be to thoroughly explain all aspects of the phase diagram, perform lab tests with beakers of various solutions to demonstrate what occurs at different salt concentrations, and then discuss how these results relate to on-the-road performance and icing. The goal is to ensure that the entire snow fighting industry is in agreement with the science behind diagram.

2) **What is the goal of the project?** To provide a better understanding of the phase diagram and how solutions beyond the eutectic point will behave on the road by providing a Clear Roads phase diagram that is clear for the snow fighting industry and has an in-depth discussion paper backing it up.
In other words, to clear up the following and get everyone on the same page:

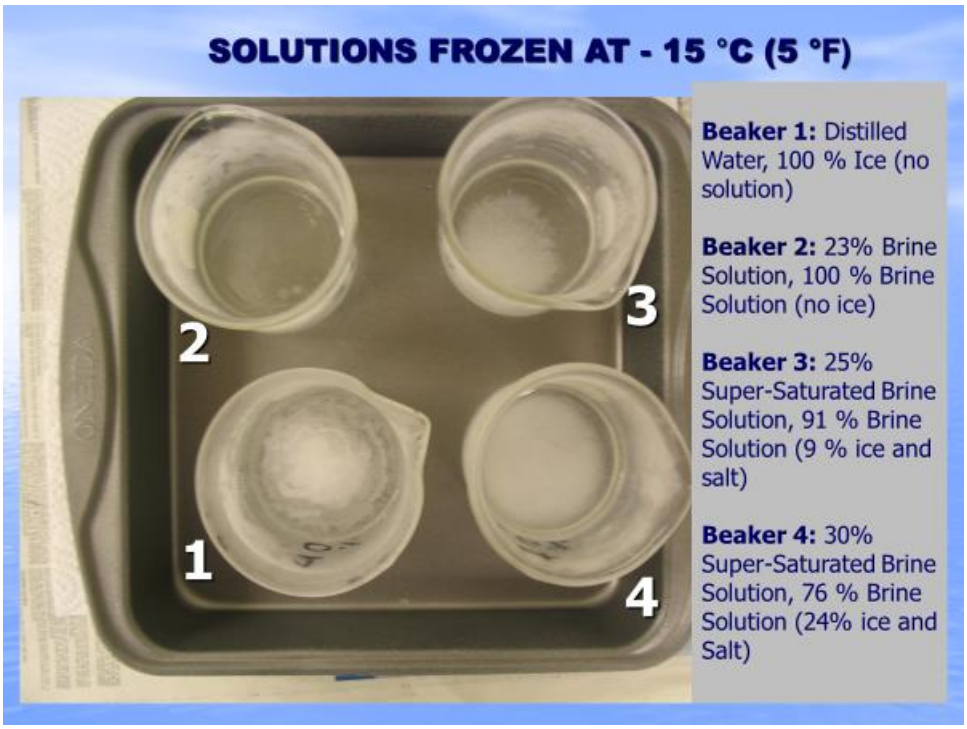








3) **Describe the expected products/deliverables of the research.** A Clear Roads NaCl phase diagram with clear explanations and discussion points, as well as photographs of lab testing, as necessary, to support the points being made, such as the following:



4) **List the specific research tasks that would form the scope of work. (What steps will the researcher need to take to develop the deliverables?)**
   - Literature search.
   - Lab testing.
   - Development of a science-backed phase diagram as well as accompanying documentation.
   - Final report.

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.** Snow and ice program managers and supervisors.

6) **How will they be used to impact your organization? How would they benefit DOTs? Describe how the research recommendations can be used to improve the winter maintenance operations of state transportation systems**. Eliminate confusion in the industry. Better understanding of how salt solutions behave under various environmental conditions.

7) **How will you measure the success of this project?** If the final product is clear and easily understood.

8) **Estimated funding needed:** $75,000.

9) **Estimated timeline for completing the research:** Twelve (12) months.

10) **Are you aware of any similar or related research on this topic?** No.

2020 Research Proposal Form

Proposer name: Brian Burne
Organization: Maine Department of Transportation

Title of proposed research project: AWSSI Enhancements – Phase 2

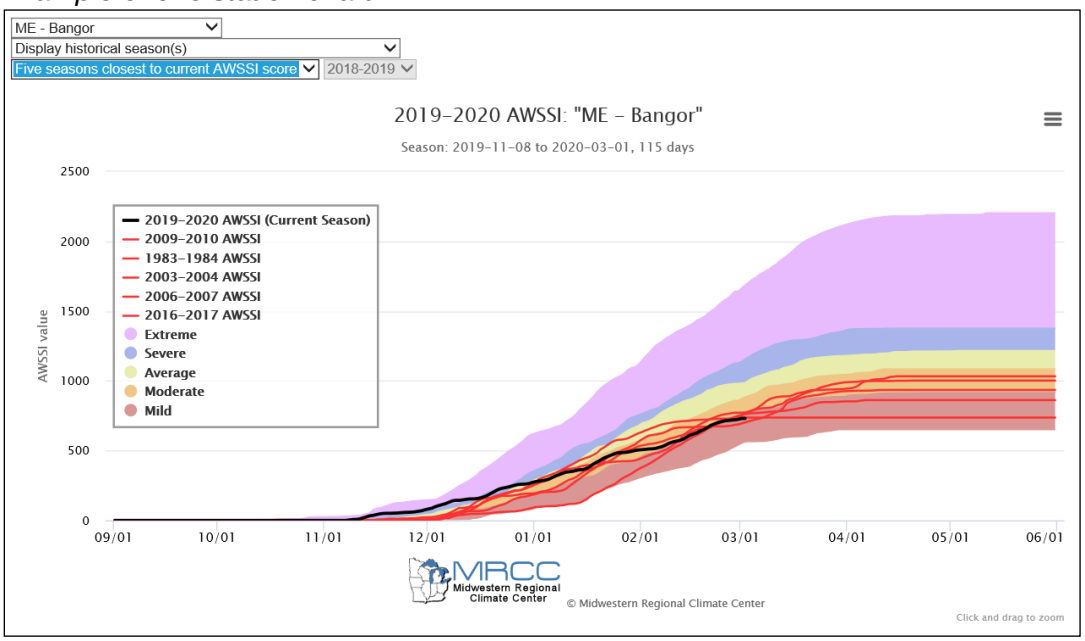
Topic Area (highlight one): (Weather)
Planning/Methods Equipment Materials Training Technology Safety

1) **Explain the specific problem or issue to address**. Project 16-02, completed in February 2019, was the first joint project between the Midwestern Regional Climate Center (MRCC) at the University of Illinois and Clear Roads to provide enhancements in support of winter road maintenance to the AWSSI which was created by MRCC. The AWSSI tool may be seen at the following link: https://mrcc.illinois.edu/research/awssi/indexAwssi.jsp

2) **What is the goal of the project?** The goal of this project is to provide additional enhancements to the AWSSI tool as described below:
   - **a)** Research the weather data in the 36 Clear Roads states and add one station to each state (providing that state has a location with enough data to support adding an additional station). If a state does not have the data to support an additional station, that station can be added to a different state that does have sufficient data instead.
   - **b)** Update the 1980 to 2014 Averages Map. The intent of this tasking would be to bring the averages map, found at https://mrcc.illinois.edu/research/awssi/avgMap1980-2014-Brettschneider.pdf, up through the 2019-2020 winter season.
   - **c)** Add the ability to download the daily seasonal data for any given station during the current season.
   - **d)** Add the ability to select up to 5 specific historical seasons (user-selected), to be added to any station's current year chart.

3) **Describe the expected products/deliverables of the research.**
Enhancements that become part of the tool that will maintained on the MRCC website at the following link: https://mrcc.illinois.edu/research/awssi/indexAwssi.jsp

Example of one station chart:



4) **List the specific research tasks that would form the scope of work. (What steps will the researcher need to take to develop the deliverables?)**
   - Station search and data validation
   - Programming

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.** Any entity that needs to quantify winter severity and make comparisons between years will benefit from this work.

6) **How will they be used to impact your organization? How would they benefit DOTs? Describe how the research recommendations can be used to improve the winter maintenance operations of state transportation systems**. The AWSSI is an independent tool that helps quantify winter severity. Granted, this tool has limitations in that it does not quantify icing, however the temperature and snowfall factors that are used as the basis of the tool have proven to provide a reasonably accurate measure that can be used to help quantify and compare winter weather nationwide. This is extremely beneficial in helping state DOT compare their expenditures and resources used from one year to the next.

7) **How will you measure the success of this project?** The enhancements will become available on the MRCC website

8) **Estimated funding needed:** $40,000

9) **Estimated timeline for completing the research:** Twelve (12) months

10) **Are you aware of any similar or related research on this topic?**
Clear Roads Project 16-02 AWSSI Enhancements in Support of Winter Road Maintenance

***Special Note When Considering This Project**: MRCC has lost several staffing members and, as of the writing of this proposal, they are working to fill those positions. If this project is approved by Clear Roads at the Spring 2020 Meeting, MRCC would like to reserve the option to verify their availability at the Fall 2020 Clear Roads Meeting. If confirmed, they would be willing to proceed with the contract towards the end of 2020. If they are unable to commit to meeting the project goals at that time, they would like the option to withdraw from the project.*

2020 Research Proposal Form

Proposer name: James Morin
Organization: Washington State DOT

Title of proposed research project: Cost-Benefit Analysis Toolkit, Phase 3

Topic Area (highlight one):
Planning/Methods Equipment Materials Training Technology Safety

1) **Explain the specific problem or issue to address**.
Clear Roads has completed two cost-benefit analysis projects – they include *08-02: Cost-Benefit Analysis Toolkit* and *11-01: Cost-Benefit Analysis Toolkit (Phase II)*. It has been seven years since the phase II Toolkit was completed and the Toolkit is in need of updates as much of the assumptions are based on old financial data and there is extraneous html code visible where it should not be. Perhaps there are new features that should be added, such as Fixed Automated Spray Technology, snow fences (both living and temporary), and agricultural-based chemicals vs. non-agricultural-based chemicals? If the Toolkit is updated, Clear Roads will need to find a consultant to continue to provide technical support as there is not one currently in place.

2) **What is the goal of the project?**
   a) Update financial assumptions;
   b) Clean up html code;
   c) Expand functionality;
   d) Provide ongoing technical support.

3) **Describe the expected products/deliverables of the research.**
An updated version of the Toolkit including any additional necessary deliverables such as a manual and training videos.

4) **List the specific research tasks that would form the scope of work. (What steps will the researcher need to take to develop the deliverables?)**
   a. Review existing Toolkit and other online tools.
   b. Survey Clear Roads membership to determine desired new features.
   c. Develop draft Tool.
   d. Create instructional manual and training materials.
   e. Finalize Toolkit.
   f. Final report and webinar.

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.**
Winter maintenance managers, DOT executives, and legislators. An instructional manual and training videos.

6) **How will they be used to impact your organization? How would they benefit DOTs? Describe how the research recommendations can be used to improve the winter maintenance operations of state transportation systems**.
The toolkit will produce reports that show local costs and benefits in easy-to-understand terms. The results from the Toolkit will inform winter maintenance supervisors charged with the responsibility to manage maintenance budgets. The results of the analyses will even inform legislators and upper managers, so that they can get a feel for the full range of winter maintenance benefits and costs.

7) **How will you measure the success of this project?**
Success stories, testimonials, and reported funds saved as reported by the results displayed by the Tool.

8) **Estimated funding needed:** $125,000

9) **Estimated timeline for completing the research:** Eighteen (18) months.

10) **Are you aware of any similar or related research on this topic? If so, please list below.**
   a. CR 08-02: Cost-Benefit Analysis Toolkit
   b. CR 11-01: Cost-Benefit Analysis Toolkit (Phase II)