Clear Roads Research and Synthesis Proposals
2022

#	Title	Est. Cost	Est. Duration	Project Summary	Presented by	Page
1	Synthesis – Use of Dashboards for AVL Systems			As technology advances, so does the methods and efficiency of winter operations. Agencies such Iowa DOT, Arizona DOT, etc., have begun utilizing dashboards for managers and legislative personnel. With the use of dashboards, the DOTs/public works could be seeing an increase in their operations LOS, while possibly reducing overall cost and usage of salt. However, states might have different matrices that are measured and different uses overall. Having a clear understanding of how public works departments and DOTs utilize dashboards can enhance the use of effectiveness of current dashboards. This can assist entities that currently do not have dashboards but want to implement process to enhance their agency/ public works.	Group 1 Kevin Duby, Arizona DOT	9
2	Synthesis – Best Practices for Application of Traction Laws & Chain Requirements			State transportation networks with severe winter weather and steep mountain passes rely on traction and chain laws to keep motorist and commercial vehicles moving and safe during snow events. These laws and requirements are implemented and enforced in a variety of different ways between states and agencies. The goal of this synthesis is to summarize the current state of traction law definitions, implementation strategies, enforcement methods, and penalties. Information from this analysis would be used to define current industry best practices.	Group 1 Jamie Yount, Colorado DOT	10

Clear Roads Research and Synthesis Proposals
2022

#	Title	Est. Cost	Est. Duration	Project Summary	Presented by	Page
3	Synthesis – Locations and Experiences Using Virtual RWIS Stations	$100,000	15 months	There are multiple companies that provide real-time weather data on a section of road using a predictive algorithm with various levels of accuracy. These companies typically charge a fee for each location that is usually less than the cost of utilities to an existing RWIS station per month. This synthesis will provide states with an inexpensive alternative to brick-and-mortar RWIS stations, which would increase the density of these stations. This in turn would provide better information about when and how to treat the roads saving labor hours, materials, and equipment costs. Understanding the general accuracy and benefit of using this service to increase the density of RWIS stations is important information for states that conduct snow and ice removal.	Group 1 Doug McBroom, Montana DOT	11
4	Development of a Centralized Winter Maintenance Research Database	$75,000 for first year $15,000/ year going forward		Field (winter maintenance) is very disjointed in that there are many groups, universities, and investigators conducting research resulting in best practices. However, we do not have a truly central place to access them all. The goal of this project is to develop and host a “free to use” central database/directory to contain, classify, and link all winter maintenance research.	Group 2, Jeremy McGuffey, Indiana DOT	12

Clear Roads Research and Synthesis Proposals
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#	Title	Est. Cost	Est. Duration	Project Summary	Presented by	Page
5	Synthesis – Post-Storm Snow Removal			The purpose of the synthesis is to gather recommended practices, policies, or training resources employed by state and other road-maintenance agencies related to how they manage post-storm snow removal. Resources can be written documents or video/animation on cleaning techniques and practices. What practices and equipment are utilized? What are the resource costs and timeframes used to clear gore areas and shoulders, which include bridge decks, median barrier walls, and guardrails? Also, what are the factors that drive each agency's policy on post-storm/beyond traveled lanes clearing?	Group 2 Scott Lucas, Ohio DOT and Justin Droste, Michigan DOT	14
6	Evaluation of DLA of Salt Brine vs. Granular Salt as Measured Through Various Performance and Safety Metrics	$125,000	18 months	Throughout the years, winter maintenance strategies have been shifting to include salt brine as part of the standard anti-icing/deicing process. Different studies have successfully shown the benefit of using salt brine, usually in terms of cost savings and environmental improvement, but public perception exists that salt brine use is less efficient and less safe for the traveling public compared to traditional use of granular salt. The goal of this project is to analyze data from prior studies and conduct a field analysis to show the differences in various performance and safety metrics between direct liquid application (DLA) of salt brine (by itself or after incorporating additives) as compared to that of granular salt.	Group 2 Emil Juni, Wisconsin DOT	15

Clear Roads Research and Synthesis Proposals
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#	Title	Est. Cost	Est. Duration	Project Summary	Presented by	Page
7	Driver's Side Salt Spreader Chute Location Savings Quantification	$40,000	6 months	The goal of this project is to quantify the savings, if any, related to the application of salt using a V-bottom or tailgate spreader with the chute located on the driver's side. This would be compared to that of a traditional spreader with the chute located on the centerline of the truck chassis on a crowned section of 2-lane road.	Group 3 Todd Miller, Missouri DOT	17
8	Zero-Velocity Spreader Savings Quantification	$40,000	6 months	The purpose of this project is to quantify the savings, if any, related to the application of salt using a zero-velocity spreader compared to a traditional spreader.	Group 3 Todd Miller, Missouri DOT	19
9	Effects of Additives in Lowering the Freezing Point	$100,000	12 months	Some solid deicing salts (Category 4 on QPL) have additives (MgCl, CaCl, etc.) and claim they are a better deicing salt because of this. However there are no definitive test results to substantiate this claim. The goal of this project is to compare the Eutectic points of various mixed salts to regular white salt to determine how much colder these products will work and if they are worth the higher costs.	Group 3 Rhett Arnell, Utah DOT	21

Clear Roads Research and Synthesis Proposals
2022

#	Title	Est. Cost	Est. Duration	Project Summary	Presented by	Page
10	pH 'waiver' for Deicing Products and the Qualified Products List	$150,000	18 months	Currently, the Clear Roads Qualified Products List (CR QPL) describes a 'waiver' request process for products that do not meet the pH requirements due to high organic compound content. The lowest pH threshold listed in the specifications document is 6.0. There is concern that CR lists certain products that do not meet the pH spec because of high organic content and the resultant formation of a 'weak' acid. The goal of this project would be to help CR determine the appropriate pH range for deicing products on the QPL. Once determined, test select categories of products – especially those with high organic content – to determine their eligibility to remain on the QPL. If the project confirms that not all 'low pH' products are equal, it will include the development of a process to determine infrastructure and environmental risk separate from pH. In other words, it will develop a process for determining whether a waiver should be provided.	Group 4 Patti Caswell, Oregon DOT	23

Clear Roads Research and Synthesis Proposals
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#	Title	Est. Cost	Est. Duration	Project Summary	Presented by	Page
11	Developing Standard Winter Maintenance Language	$100,000	12 months	Clear Roads is in a position to drive the language of winter maintenance because of the highly functional committee and leadership role for state departments of transportation. Language around winter maintenance materials and methods is inconsistent nationally (and even internationally) and CR has an opportunity to lead the way by providing definitions for commonly used terms. Some terms that come to mind include: anti-icing, deicing, pre-wet, abrasives (or sand? Or rock?). Terminology for transportation assets that are connected to winter maintenance, such as equipment and highway designations should also be considered for inclusion. The purpose of this project is to define commonly used terms and industry standard for methods where it makes sense.	Group 4 Patti Caswell, Oregon DOT	25
12	Synthesis – Corrosion and Connectors Don't Mix			The goal of this synthesis is to identify the various wing plow light setups/connectors used by CR members. The project will determine if anyone is succeeding in keeping the lights operating for an entire winter season and also identify a setup/connector that is most likely to operate for an entire snow season.	Group 4 Cliff Spoonemore, Wyoming DOT and Steve Spoor, Idaho Transportation Department	27

Clear Roads Research and Synthesis Proposals
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#	Title	Est. Cost	Est. Duration	Project Summary	Presented by	Page
13	Liquid Chloride Storage and Pump System BMPs	$75,000	12 months	Most state DOTs manage liquid chloride tanks and pump systems. The purpose of this project is to document the standard systems that are being used, including the specific components (e.g. double-wall tanks, backflow preventors, pump types, bulk connectors, containment, etc.). The project will document and share optimal system designs, as well as the management practices used to support the replacement components or other system decisions that contribute to safe, sustainable, and cost-effective liquid storage systems.	Group 5 Brian Burne and Chris Landry, Maine DOT	29
14	Vehicle Restrictions During Storm Events	$100,000	12 months	Tractor-trailers crashing during snowstorms can block highways, trap motorists, and prevent DOTs from being able to successfully clear roads and keep the traffic flowing. The purpose of this project is to identify and document the extent of the problem, potential causes, and the thresholds and considerations that influence potential restrictions for certain types of vehicles.	Group 5 Brian Burne, Maine DOT	31
15	Update to CR 14-02 Quantifying the Impact that New Capital Projects will have on Roadway Snow and Ice Control Operations	$150,000	24 months	The purpose of the project is to improve upon CR 14-02 by updating the tool and including additional capital project types in order to quantify additional resource needs because of the capital project.	Group 5, Todd Law, Vermont Agency of Transportation	33

Clear Roads Research and Synthesis Proposals
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#	Title	Est. Cost	Est. Duration	Project Summary	Presented by	Page
16	Comprehensive Guide to Prewet	$200,000	18 months	The goal of this project is to develop recommendations for pre-wetting rates and evaluate the difference between applying pre-wet in the chute v. on the chain flight or in a mix chamber. This involves a follow up on the synthesis CR 18-04 that was recently completed by WSU. The synthesis looked at prewet practices and case studies and identified needed research to identify effective and efficient materials, equipment, and procedures for pre-wet. This effort would address those needs as well as identify specifics including rates and notable results from two different pre-wetting methods.	Group 5 Patti Caswell, Oregon DOT and James Morin, Washington State DOT	35

2022 Synthesis Request Form

Requestor name: Kevin Duby
Organization: Arizona DOT (Group 1)

Title of proposed synthesis project: Use of Dashboards for AVL Systems

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

1) **Explain the specific problem or issue to address**.
   As technology advances, so does the methods and efficiency of winter operations. States such Iowa DOT, Arizona DOT, etc., have begun utilizing dashboards for managers and legislative personnel. With the use of dashboards, the DOT's / Public Works could be seeing an increase in their operations LOS, while possibly reducing overall cost and usage of salt. However, states might have different matrices that are measured and different uses overall.

   Having a clear understanding of how public works departments and DOTs utilize dashboards can enhance the use of effectiveness of current dashboards. This can assist entities that currently do not have dashboards but want to implement process to enhance their agency/ public works.

2) **What information do you want the synthesis to compile (literature, state practices, sample policies or specifications, etc.)?**
   This synthesis would seek to:
   - Understand which states are using dashboards. If states are note, then why.
   - Understand how states implement / utilize the dashboard.
   - Identify and describe any best practices in terms of use of – and enhancements to – dashboards.
   - Understand how states enhance operations and LOS.
   - Understand how states reduce cost of operations.
   - Understand how states reduce material use.
   - Determine cost of implementation.
   - Identify current programs / software.

3) **How will the synthesis report be used to improve the winter maintenance operations of state transportation systems**?
   Possible uses and benefits include:
   1) Providing agencies / public works departments the justification to create and fund dashboards.
   2) Providing ideas for how to enhance the use and effectiveness of their current dashboards.
   3) Providing winter maintenance data / information in a clear and easy to understand format for those who do not have the technical knowledge of most winter maintenance managers.
   4) Ability to enhance the effectiveness of winter operations.
   5) Potential reduction in material usage.
   6) Potential reduction in overall cost of winter maintenance operations and materials.

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

2022 Synthesis Request Form

Requestor name: Jamie Yount
Organization: Colorado DOT (Group 1)

Title of proposed synthesis project: Best Practices for Application of Traction Laws & Chain Requirements

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

1) **Explain the specific problem or issue to address**.
State transportation networks with severe winter weather and steep mountain passes rely on traction and chain laws to keep motorist and commercial vehicles moving and safe during snow events. These laws and requirements are implemented and enforced in a variety of different ways between states and agencies. The goal of this synthesis is to summarize the current state of traction law definitions, implementation strategies, enforcement methods, and penalties. Information from this analysis would be used to define current industry best practices.

2) **What information do you want the synthesis to compile (literature, state practices, sample policies or specifications, etc.)?**
The goal of this project is to compile information on the current state of the industry on traction and chain law rules and regulations, enforcement methods, compliance, and penalties for violations.

3) **How will the synthesis report be used to improve the winter maintenance operations of state transportation systems**?
This report would serve as a reference document for transportation agencies that have traction laws and those that are looking to implement traction laws in the future. Information for this report would be used to evaluate current state of practice and identify areas for future research and development.

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

2022 Synthesis Request Form

Requestor name: Doug McBroom
Organization: Montana DOT (Group 1)

Title of proposed synthesis project: Locations and Experiences Using Virtual RWIS Stations

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

1) **Explain the specific problem or issue to address**.
Road Weather Information Systems (RWIS) provide valuable weather and pavement data used to produce pavement forecasts. Pavement forecasts facilitate efficient winter maintenance operations enabling the right product to be applied at the right time and in the right location, enhancing public safety and minimizing the environmental impact. RWIS stations are expensive to build (~$100,000), forecast, operate, and maintain (~$10,000/year).

Maintenance staff know where sections of roadway are impacted differently such as areas with lake effects, shaded with trees / rock cuts, high winds etc. However, it is hard to know exactly how much the forecasts differ at these locations compared to a typical road section.

There are multiple companies that provide real-time weather data on a section of road using a predictive algorithm with various levels of accuracy. These companies typically charge a fee for each location that is usually less than the cost of utilities to an existing RWIS station per month. Understanding the general accuracy and benefit of using this service to increase the density of RWIS stations is important information for states that conduct snow and ice removal.

2) **What information do you want the synthesis to compile (literature, state practices, sample policies or specifications, etc.)?**
   - A literature review of the availability and accuracy of Virtual RWIS
   - A list of the companies that currently provide this information.
   - A description of other states pilot projects and their experiences.

3) **How will the synthesis report be used to improve the winter maintenance operations of state transportation systems**?
This synthesis will provide states with an inexpensive alternative to brick-and-mortar RWIS stations which would increase the density of these stations. This in turn would provide better information about when and how to treat the roads saving labor hours, materials, and equipment costs.

4) **Are you aware of any similar or related information on this topic? If so, please list below.**
Unaware of similar projects.

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2022 Research Proposal Form

Proposer name: Jeremy McGuffey
Organization: Indiana DOT (Group 2)

Title of proposed research project: Development of a Centralized Winter Maintenance Research Database

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

1) **Explain the specific problem or issue to address**.
Our field (winter maintenance) is very disjointed in that there are many groups, universities, and investigators conducting research resulting in best practices. However, we do not have a truly central place to access them all.

2) **What is the goal of the project?**
The goal of this project is to develop and host a "free to use" central database / directory to contain, classify, and link all winter maintenance research.

3) **Describe the expected products/deliverables of the research.**
A central database / directory to contain, classify, and link all winter maintenance research.

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 sources of winter maintenance research.
   - Gather appropriate information from these sources.
   - Create a central database / directory to contain, classify, and link all winter maintenance research.
   - Develop a method or plan for hosting this database / directory long-term as well as continued gathering of research – both on-going and completed.

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.**
Anyone who is active in winter maintenance research and those who implement that research at DOTs, local agencies, etc.

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**.
There have been times when multiple DOTs are researching the same thing at the same time without knowing it. There have also been times where DOTs begin researching a topic that has been covered extensively. This is evident alone in the number of surveys and questions that the DOTs ask each other throughout the year. The primary benefit of this central database would be to save time and money by letting DOTs see what has been researched or developed prior to starting a new project.

7) **How will you measure the success of this project?**
The project would be successful if a solution is created to centralize all winter maintenance research in one place.

8) **Estimated funding needed.** $75,000 in year 1 and $15,000 per year going forward.

9) **Estimated timeline for completing the research.** 12 months to establish the database. However, the project would be ongoing.

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

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2022 Synthesis Request Form

Requestor name: Scott Lucas and Justin Droste
Organization: Ohio DOT and Michigan DOT (Group 2)

Title of proposed synthesis project: Post-Storm Snow Removal

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

1) **Explain the specific problem or issue to address**.
During a snowstorm, the main goal is to remove the snow and ice from the roadway to keep traffic moving. In doing so, snow gets pushed to areas of the right-of-way where it accumulates. During the day when temperatures rise, the snow melts and causes water to flow across the roadway. As night falls, the water freezes and causes slick spots. The accumulated piles of snow melt and become denser. The piles refreeze and form solid blocks of ice along the roadway. The blocks of ice can form ramps on the side of bridges. Vehicles have run into the ice ramps and have been launched over the sides of bridges. Ice block obstructions in front of crash barrier and guardrail end-treatments interfere with the proper function of guardrail and can cause more damage than they were designed to prevent. Accumulated snow piles can block drainage inlets and cause flooding on the roadway. The accumulated snow and ice also take up storage room for the next storm. Accumulated snow on a gore point can cause a driver to spin out and lose control it the driver attempts to drive through the snow pile. Removing the snow and ice from these areas may require specialized equipment and many workers. The process also impacts drivers.

2) **What information do you want the synthesis to compile (literature, state practices, sample policies or specifications, etc.)?**
The purpose of the synthesis is to gather recommended practices, policies, or training resources employed by state and other road-maintenance agencies related to how they manage post-storm snow removal. Resources can be written documents or video / animation on cleaning techniques and practices. What practices and equipment are utilized? What are the resource costs and timeframes used to clear gore areas and shoulders, which include bridge decks, median barrier walls, and guardrails? Also, what are the factors that drive each agency's policy on post-storm / beyond traveled lanes clearing?

3) **How will the synthesis report be used to improve the winter maintenance operations of state transportation systems**?
Users will be able to review the methods and equipment used by other agencies to determine what they may utilize to improve their practices, thus preventing additional snow and ice-related crashes after the storm.

4) **Are you aware of any similar or related information on this topic? If so, please list below.**
Michigan DOT questioned the Clear Roads states to determine how each of them removed accumulated snow on bridge decks. They were able to get a few responses. Also project 14-03 provided reference animations / diagrams on clearing different interchange / intersection types (not much focus given to gores and railings with these). Iowa DOT may have some videos.

2022 Research Proposal Form

Proposer name: Emil Juni
Organization: Wisconsin DOT (Group 2)

Title of proposed research project: Evaluation of DLA of Salt Brine vs. Granular Salt as Measured Through Various Performance and Safety Metrics

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

1) **Explain the specific problem or issue to address**.
   Throughout the years, winter maintenance strategies have been shifting to include salt brine as part of the standard anti-icing/deicing process. Different studies have successfully shown the benefit of using salt brine, usually in terms of cost savings and environmental improvement, but public perception exists that salt brine use is less efficient and less safe for the traveling public compared to traditional use of granular salt.

2) **What is the goal of the project?**
   The goal of this project is to analyze data from prior studies and conduct a field analysis to show the differences in various performance and safety metrics between direct liquid application (DLA) of salt brine (by itself or after incorporating additives) as compared to that of granular salt.

3) **Describe the expected products/deliverables of the research.**
   A detailed report of the results from field testing and findings from prior studies and an infographic that clearly and concisely communicates this information.

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 review
   - Data collection (new field study + results of prior studies)
   - Data analysis
   - Report
   - Presentation + Infographics

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.**
   The primary audiences for the deliverables are winter maintenance practitioners. The result of this study will be used as source materials for:
   - Continued support for departmental buy-in
   - Program validation and justification
   - Winter maintenance best practices training
   - Additional information to improve public perception

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 benefit of the study results for the DOT is twofold. Internally, the results can be used for validation of prior work and justification of continued focus on salt brine implementation, more specifically DLA. Externally, the results of this study give the DOT access to a solid informational base of the comprehensive benefits of DLA, which can be utilized to improve public perception.

7) **How will you measure the success of this project?**
This project is a success when the result is delivered in the time expected, showing the analysis based on data collected from many different states, whether from new field data collection or summary of existing studies.

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

9) **Estimated timeline for completing the research.**
Eighteen (18) months (for one winter season of data collection)

10) **Are you aware of any similar or related research on this topic? If so, please list below.**
Many research studies related to salt brine implementation have been done, focusing on different aspects.CR 16-06 focused on informational video about what salt brine is and how it is used. CR 19-01 focused on expanding the salt brine application rate guidance (which was first mentioned in CR 12-02), and it does include some analysis of performance metrics. However, there has been no study so far that is specifically focusing on the various performance and safety aspects of DLA implementation, out of the many studies out there related to liquid anti-icing/deicing, either published under Clear Roads or other places such as TRB and other transportation or winter-related publications. Many individual states and local winter maintenance entities may have already completed internal studies regarding this topic as they started (or reviewed) their DLA program, and these are information that we would like to collect and compile with this study.

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2022 Research Proposal Form

Proposer name: Todd Miller
Organization: Missouri DOT (Group 3)

Title of proposed research project: Driver's Side Salt Spreader Chute Location Savings Quantification

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

1) **Explain the specific problem or issue to address.**
We have added the option of a chute position on the driver's side, so we would like to be able to quantify the potential savings experienced in a crowned 2-lane road section for this position.

2) **What is the goal of the project?**
Quantify the savings related to the application of salt, if any, experienced using a V-bottom or tailgate spreader with the chute located on the driver's side compared to that of a traditional spreader with the chute located on the centerline of the truck chassis on a crowned section of 2-lane road.

3) **Describe the expected products/deliverables of the research.**
   - Literature search
   - Test plan
   - Test results
   - Comparison of salt used – and any savings experienced – using a spreader with the chute located on the driver's side compared to that of a traditional spreader with the chute located on the chassis centerline, on a crowned section of 2-lane roadway.

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
   - Determine equipment to be tested
   - Develop test plan
   - Conduct testing
   - Final report

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.**
All municipalities and DOTs considering adjusting their chute location to the driver's side to quantify savings.

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.**
Savings can be quantified by adjusting the chute location.

7) **How will you measure the success of this project?**
Accurate quantification of savings.

8) **Estimated funding needed.** $40K

9) **Estimated timeline for completing the research.** 6 months

10) **Are you aware of any similar or related research on this topic? If so, please list below.**
Bounce and scatter studies may have been completed by Michigan and / or Iowa DOTs.

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2022 Research Proposal Form

Proposer name: Todd Miller
Organization: Missouri DOT (Group 3)

Title of proposed research project: Zero-Velocity Spreader Savings Quantification

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

1) **Explain the specific problem or issue to address.**
We are looking into purchasing zero velocity spreaders and would like to be able to quantify the savings for this.

2) **What is the goal of the project?**
Quantify the savings related to the application of salt, if any, experienced using a zero-velocity spreader compared to a traditional spreader.

3) **Describe the expected products/deliverables of the research.**
   - Literature search and product review
   - Test plan
   - Test results
   - Comparison of salt used – and any savings experienced – using a zero-velocity spreader to that of a traditional spreader.

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
   - Market availability / product review
   - Determine equipment to be tested
   - Develop a test plan, including bounce and scatter testing
   - Conduct testing
   - Final report

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products / deliverables.**
All municipalities and DOTs considering using a zero-velocity spreader to quantify savings.

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.**
Savings can be quantified by using a zero-velocity spreader.

7) **How will you measure the success of this project?** Accurate quantification of savings.

8) **Estimated funding needed.** $40K

9) **Estimated timeline for completing the research.** 6 months

10) **Are you aware of any similar or related research on this topic? If so, please list below.**
lowa DOT may have completed a study in the past 7 years or so.

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research for winter highway maintenance

2022 Research Proposal Form

Proposer name: Rhett Arnell
Organization: Utah Department of Transportation (Group 3)

Title of proposed research project: Effects of Additives in Lowering the Freezing Point

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

1) **Explain the specific problem or issue to address**.
Some solid deicing salts (Category 4 on QPL) have additives (MgCl, CaCl, etc.) and claim they are a better deicing salt because of this. However there are no definitive test results to substantiate this claim.

2) **What is the goal of the project?**
The goal of this project is to compare the Eutectic points of various mixed salts to regular white salt to determine how much colder these products will work and if they are worth the higher costs.

3) **Describe the expected products/deliverables of the research.**
The final deliverable would be a report/presentation that would accurately depict the effects of these additives on the deicing salts.

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?)**
1. Perform a literature search for any information on treating deicing salts and the effects on working temperatures. Perform a literature search for solid products available with additives that are currently on the market.
2. Survey of states and municipalities that use these products and their experiences
3. Prepare lab and testing protocols
4. Test various products at various additive concentrations for actual change in working eutectic temperatures.
5. Prepare a report detailing the findings of the lab tests with photos and documentation showing the effects of the additives on salt.
6. Present the findings.

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.**
Intended audience are state DOTs, municipalities, winter maintenance community of practice

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 organization is always being bombarded by vendors with claims of increased performance and better deicing results, this would allow for Users to have a resource that will help navigate these claims.

7) **How will you measure the success of this project?**
A final document that will help people make more informed choices when choosing a deicing salt.

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? If so, please list below.**
I am not aware of similar projects.

2022 Research Proposal Form

Proposer name: Patti Caswell
Organization: Oregon DOT (Group 4)

Title of proposed research project: pH 'waiver' for Deicing Products and the Qualified Products List

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

1) **Explain the specific problem or issue to address**.
Currently, the Clear Roads Qualified Products List (CR QPL) describes a 'waiver' request process for products that do not meet the pH requirements due to high organic compound content. This exemption is a carryover from the prior QPL management team; it is unclear to the current subcommittee how or whether to apply the waiver and which products currently have an exemption for not meeting the pH specification.
The main goals of the CR QPL are:
    1. Protect infrastructure and the environment by minimizing the introduction of pollution into the environment through use of appropriate criteria to evaluate products for listing.
    2. Level the playing field for manufacturers by providing consistent review and listing processes, including the development and publication of standard specifications.
    3. Treat all submittals the same by minimizing exceptions and being transparent where exceptions do occur.

    The lowest pH threshold listed in the specifications document is 6.0. In recent years, since CR has taken over management of the QPL, there have been at least a couple of products that do not meet the specification and have wanted to request a waiver for a low pH associated with organic material. CR is not making exceptions to the specifications at this time. There is concern that CR lists certain products that do not meet the pH spec because of high organic content and the resultant formation of a 'weak' acid.

2) **What is the goal of the project?**
The goal of this project would be to help CR determine the appropriate pH range for deicing products on the QPL. Once determined, test select categories of products – especially those with high organic content – to determine their eligibility to remain on the QPL. If the project confirms that not all 'low pH' products are equal, it will include the development of a process to determine infrastructure and environmental risk separate from pH. In other words, it will develop a process for determining whether a waiver should be provided.

3) **Describe the expected products/deliverables of the research.**
    1. Literature review of the impacts or effects of low pH on highway infrastructure and the environment (water quality, vegetation, animals/amphibians).
    2. Summary of findings of product testing and pH results.
    3. Set of standard testing protocols for testing pH levels of deicing products on the QPL.
    4. Summary of findings of low pH products on infrastructure and the environment.
    5. Methodology to evaluate low pH products for waiver eligibility.
    6. Project report and webinar.

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?)**
   1. Literature review for impact of organics in lowering the pH, how this organic-inducing low pH might differ from low pH based on other content (??), and impacts of low pH on highway infrastructure and the environment; how to determine if low pH is 'weak' or not and what that means; how to define 'weak', Etc.
   2. Conduct testing of deicing products containing high organic materials and review test results. Provide product name, category, and summary of pH ranges.
   3. Develop a set of testing protocols to test low pH/ high organic content products to determine potential impacts to infrastructure (steel, concrete, etc.). and water quality.
   4. Using the testing protocols developed in the previous task, determine the impact to infrastructure and environment.
   5. Provide checklist or method/process/workflow to evaluate pH for high organic content products to make sure they meet the intent of the QPL.

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.**
   The intended audience is primarily the CR QPL subcommittee and the CR TAC. However, the research will benefit QPL users (state DOTs, municipalities) by providing certainty in product safety to infrastructure and the environment.

   The QPL subcommittee is responsible for maintaining the specifications with significant changes going to the CR TAC for approval with a recommendation from the subcommittee. The subcommittee would use research project findings to describe the pH waiver purpose and process in the CR QPL specifications document. QPL users would know which products received a pH waiver and understand the impacts of the product on their infrastructure and the environment, or in other words, product risk.

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 would benefit other DOTs by including more potential deicing products on the CR QPL, which can improve product competition and therefore price.

7) **How will you measure the success of this project?**
   If we successfully figure out whether or not a pH waiver is beneficial or not. If beneficial, we will have a transparent and logical pH-waiver approval approach that ultimately maintains the integrity of the QPL.

8) **Estimated funding needed.**
   $150,000

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.**
    Nope.

2022 Research Proposal Form

Proposer name: P. Caswell
Organization: Oregon DOT (Group 4)

Title of proposed research project: Developing Standard Winter Maintenance Language

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

1) **Explain the specific problem or issue to address**.
   Clear Roads is in a position to drive the language of winter maintenance because of the highly functional committee and leadership role for state departments of transportation. Language around winter maintenance materials and methods is inconsistent nationally (and even internationally) and we have an opportunity to lead the way by providing definitions for commonly used terms. Some terms that come to mind include: anti-icing, deicing, pre-wet, abrasives (or sand? Or rock?). Terminology for transportation assets that are connected to winter maintenance, such as equipment and highway designations should also be considered for inclusion.

2) **What is the goal of the project?**
   Define commonly used terms and industry standard for methods where it makes sense.

3) **Describe the expected products/deliverables of the research.**
   Final delivery would be a Book of Winter Maintenance terms, definitions, and methods—as appropriate and applicable. Post product on the Clear Roads website under “Resources.”

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?)**
   1) Literature search for commonly used terms in winter maintenance research. Winter maintenance research and other documents (e.g., FHWA winter maintenance guide, NCHRP 207 and 277 reports use winter maintenance language. How are terms used across projects and research? Can we come up with common terms and definitions for materials and methods that meet state needs?
   2) Survey of states and municipalities re: common winter maintenance language for methods, materials.
   3) Report on the varied use of terms across research documents, state guidance, and educational materials.
   4) Draft set of common winter maintenance terms and define them.
   5) Finalize list of common winter maintenance terms and definitions.
   6) The document might be one that CR takes on updating as needed through standing agenda items for future meetings.

7) Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.
   Intended audience are state DOTs, municipalities, teaching institutes, winter maintenance community of practice and Clear Roads researchers to be used within all their project deliverables.

8) **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**.
Results will ease discussion around common winter maintenance materials and practices and avoid confusion over what different terms mean—how they are used, how they are defined, potentially variations, and the standard of practice.

9) **How will you measure the success of this project?**
Final document / web page will be published by Clear Roads. It would be awesome if the final document were adopted by AASHTO and FHWA!!! ☺

10) **Estimated funding needed**.
$100,000

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

12) **Are you aware of any similar or related research on this topic? If so, please list below.**
There are other compendiums for the community of winter maintenance around methods and materials. A short cruise of a few documents did not reveal standard definitions.

2022 Synthesis Request Form

Requestor name: Cliff Spoonemore and Steve Spoor
Organization: Wyoming DOT and Idaho TD (Group 4)

Title of proposed synthesis project: Corrosion and Connectors Don't Mix

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

1) **Explain the specific problem or issue to address**.
Wing Plow lights need electricity, and the connectors are exposed to the elements during operations. The connecting wiring harness (plug and socket) starts dry and tight. After the first 12-hour shift, the connectors begins to loosen. This allows chemicals, abrasives, and road material to enter the connection and begin to break it down. Mechanical/operator, environmental, or corrosion are all issues that can cause failure in the light system. Can - or has - the industry developed a connector that can survive the plowing environment for an entire winter season?

   The goal of this synthesis is to identify the various setups / connectors used by Clear Roads members. Determine if anyone is experiencing success in keeping the lights operating for an entire winter season. Identify a setup / connector that is most likely to operate for an entire snow season.

2) **What information do you want the synthesis to compile (literature, state practices, sample policies or specifications, etc.)?**
This synthesis will gather information related to states' experiences with connectors exposed to the winter elements (salt, wind, extremely cold temperatures, etc.) and attempt to identify…
   - Various types of connectors and include pros and cons for each.
   - Similar experiences with connectors corroding.
   - Connectors that are able to withstand an entire winter season.
     - Should look to other industries, such as DOD (Navy), Homeland Security (Coast Guard), freight, and agriculture.
   - Innovations / add-on fabrication done by individual shops to protect the connector assembly.
   - Potential experience with / or applicability of Bluetooth connections.

3) **How will the synthesis report be used to improve the winter maintenance operations of state transportation systems**?
The Information gathered will be presented in a Popular Mechanics-style document listing the connectors, including…
   - Pros and cons of each connector.
   - Purchase and installation cost.
   - Installation time.
   - Durability (how long is it expected to last based on experiences in the field.

   Potential to include a set of recommendations for innovations / add-on fabrication known to extend the life of the connectors.

These documents will provide clear and concise information for winter operations managers to use when making decisions regarding procurement and / or protection of the equipment.

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

2022 Research Proposal Form

Proposer name: Brian Burne / Chris Landry
Organization: Maine DOT (Group 5)

Title of proposed research project: Liquid Chloride Storage and Pump System BMPs

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

1) **Explain the specific problem or issue to address**.
Most state DOTs manage liquid chloride tanks and pump systems. The purpose of this project is to document the standard systems that are being used, including the specific components (e.g. Double-wall tanks, backflow preventors, pump types, bulk connectors, containment, etc.) and to document management practices used to support the replacement of components or other system decisions.

2) **What is the goal of the project?**
The goal of this project is to document and share optimal system designs and management practices that contribute to safe, sustainable, and cost-effective liquid storage systems.

3) **Describe the expected products/deliverables of the research.**
Pictures and descriptions of typical set-ups currently in use at various DOTs and public works facilities. Each set-up will list the primary components and the pros/cons associated with each set-up. In conclusion, the report and close-out video will summarize the system components and management practices that demonstrated the most potential benefits for a DOT or public works entity and will assist in the optimal design, or design considerations, for new systems.

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?)**
   - Poll states and public works entities for system information.
   - Isolate roughly a dozen diverse types of systems, from different parts of the country, to gather specific design, management, and system component details. Selection should involve a mixture of “budget” systems, “middle-of-the-road” systems, and “Cadillac” systems.
   - Work directly with a point person from each selected location to capture and analyze the specific design, cost, management, and system component details.
   - Develop a consistent report format for documenting the details of each system, including a detailed discussion of all pros/cons.
   - Capture all systems into the report and develop overall conclusions and recommendations.
   - Develop a final video discussion the research, findings, and recommendations.

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.**
DOTs and public works organizations. The deliverables are intended to help all parties better understand system design and management considerations when utilizing liquid materials for snow and ice control.

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**.
MaineDOT has liquid chloride systems that have worked well overall but have demonstrated some potential flaws. The assumption is that each state is doing its own thing in this regard and there may be better ideas that could be shared to help agencies improve their systems or practices.

7) **How will you measure the success of this project?**
Success will be measured by the number of good ideas that are captured and shared through this project.

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

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

10) **Are you aware of any similar or related research on this topic? If so, please list below.**
PA and CT DOT, among others, have implemented specific measures.

2022 Research Proposal Form

Proposer name: Brian Burne
Organization: Maine DOT (Group 5)

Title of proposed research project: Vehicle Restrictions During Storm Events

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

1) **Explain the specific problem or issue to address**.
Tractor-trailers crashing during snowstorms, which in turn block highways, trap motorists, and prevent DOTs from being able to successfully clear roads and keep the traffic flowing.

2) **What is the goal of the project?**
To identify and document the extent of the problem, potential causes, and the thresholds and considerations that influence potential restrictions for certain types of vehicles.

3) **Describe the expected products/deliverables of the research.**
Improved awareness of where, and under what conditions, significant problems have occurred. A decision-making tool to assist DOTs and transportation agencies with implementing reasonable and consistent restriction measures during certain types of snow events.

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 significant weather events where tractor-trailer crashes have trapped motorists
   - Identify the weather conditions that were in effect at the time of the crashes
   - Poll states for any decision points that are currently in place for restricting travel by vehicle type
   - Poll major transportation companies for any decision points that are currently in place for restricting travel by certain vehicle types
   - Research economic impact considerations associated with restricting commercial vehicle travel
   - Summarize conditions where restrictions may improve overall highway safety and considerations for implementing such restrictions

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.**
DOTs and State governments in general, as well as trucking organizations. The deliverables are intended to help all parties better understand when the risk factors are highest and what steps can be taken to mitigate those risks by implementing reasonable restrictions.

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 tool should identify very specific weather thresholds and both highways and vehicle considerations that should influence transportation weather forecasting and pre-storm decision-

making. It should help agencies better identify reasonable restrictions that should be in place for certain types of highways experiencing specific types of events.

7) **How will you measure the success of this project?**
Success will be measured by the level of awareness and implementation of consistent and reasonable measures that demonstrably decrease the number and magnitude of highway closures caused by tractor-trailer crashes during storm events.

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

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

10) **Are you aware of any similar or related research on this topic? If so, please list below.**
PA and CT DOT, among others, have implemented specific measures.

2022 Research Proposal Form

Proposer name: Todd Law
Organization: Vermont AOT (Group 5)

Title of proposed research project: Update to CR 14-02 Quantifying the Impact that New Capital Projects will have on Roadway Snow and Ice Control Operations

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

1) **Explain the specific problem or issue to address**.
   This would be an update to the previous project to include additional capital project types in the analysis which would be included in the tool for quantifying additional resource needs. It would also review and potentially update the tool if possible.

2) **What is the goal of the project?**
   To improve upon the previous project by updating the tool and including additional capital project types into the tool to quantify additional resource needs because of the capital project.

3) **Describe the expected products/deliverables of the research.**
   Updated tool which would include additional case studies to provide additional project types into the tool.

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?)**
   - Review of the previous case studies, existing tool and a survey of upcoming projects that could be included into the tool for pre- and post-field data collection to include into the updated tool.
   - Data collection.
   - Data modeling.
   - Tool update/ upgrade for new configurations and potential upgraded functionality or other improvements that might be possible.

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.**
   Transportation professionals who are interested in determining the need for additional resources with the changes to configurations or additional assets that are included in 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**.
   To ensure the tool is updated and is continued to be used, it needs to be somewhat inclusive of the configurations that are probable for roadways. It also needs to be fresh and efficient so that the audience finds value in the results from utilizing the tool.

7) **How will you measure the success of this project?**
Adding new configurations to the tool and ensuring that any updates to the tools are performed. Ultimately, the success would be that the tools is or continues to be used frequently for a determination of additional resource needs due to capital projects.

8) **Estimated funding needed.**
$150,000

9) **Estimated timeline for completing the research.**
24 months

10) **Are you aware of any similar or related research on this topic? If so, please list below.**
No, this is an update to the previous project CR14-02 completed in 2017.

CLEAR ROADS
research for winter highway maintenance

2022 Research Proposal Form

Proposer name: James Morin / Patti Caswell
Organization: Washington State and Oregon DOTs (Group 5)

Title of proposed research project: Comprehensive Guide to Prewet

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

1) **Explain the specific problem or issue to address**.
   - **Methods:** Pre-Wet is widely used in the snow and ice industry to achieve three goals:
     1. Reduce bounce and scatter
     2. Activate Salt
     3. Inhibit corrosion

     Research is needed that will help agencies identify appropriate rates to meet the above purposes. Research has been done that addresses speed and application rates in a general sense, however the research that we are aware of does not provide ideal or target rates to achieve pre-wet goals. The proposed research would determine the optimum rate that should be applied at a given solid rate (gallons/ton) in different spreader configurations for each purpose. Further it would define the benefit received for each given rate. For example: At 10 gallons/ton all three purposes are accomplished with a loss of 10% of salt, at 20 gallons/ton the salt loss is reduced to 5% loss etc. for each of the three purposes at different rates.
   - **Equipment:** Pre-wet liquid delivery systems are designed in many ways and incorporated into a variety of spreader configurations. Some systems apply liquid at the spinner while others apply liquid at the flight chain or along the auger inside a mix chamber. Some systems rely on electric pumps; others use hydraulic pumps, other factors include nozzle selection, optimum pressure, screen size, hose diameter and flow meter design. This research will use two delivery systems and will note pump type, flow rate, hose diameter, flow meter and screen size when describing the results. This project does not include an in-depth analysis of various material spreader systems.
   - **Materials:** A variety of liquids are used for pre-wet including MgCl, CaCl and Inhibited Brine. This research would use one product from category 1 of the CR QPL to pre-wet materials and evaluate the benefits to items 1-3 above.

2) **What is the goal of the project?**
   The goal of this project is to develop recommendations for pre-wetting rates and evaluate the difference between applying pre-wet in the chute v. on the chain flight or in a mix chamber. This involves a follow up on the synthesis CR 18-04 that was recently completed by WSU. The synthesis looked at prewet practices and case studies and identified needed research to identify effective and efficient materials, equipment, and procedures for pre-wet. This effort would address those needs as well as identify specifics including rates and notable results from two different pre-wetting methods.

   The following quote is from CR 18-04:
   While pre-wetting practices are used by many agencies, the most effective and efficient materials, equipment, and procedures have not been extensively studied. Recent advances in chemical

products and equipment and an increase in public expectations further the need for a comprehensive look at pre-wetting.

The effectiveness of pre-wetting can vary based on weather and road conditions, and few agencies have conducted testing or rigorous field trials to compare the effectiveness of different materials, methods, equipment, and application rates. Even within a single agency, pre-wetting procedures can vary across districts or regions. Citing safety, costs and environmental concerns, Clear Roads agencies wanted an overview of the most effective pre-wetting methods, materials, and practices.

3) **Describe the expected products/deliverables of the research.**
A comprehensive guide to pre-wet would be developed that would address everything necessary for a program to incorporate prewet into their snow and ice equipment. Specifically, the guide would:

   a) Provide optimal rates for meeting pre-wet goals as well as quantify benefit of different rates (10gpt vs 20 gpt for each goal) in addition to speed and other deliver factors such as spinner/non spinner application methods.

   b) Evaluation of at least 2 and up to 4 different delivery systems on basic road salt. Discussion of different pros and cons of delivery systems in meeting pre-wet goals.

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?)**
   1. Literature review
   2. Review the CR synthesis report on pre-wetting.
   3. Identify different pre-wetting locations on the truck to test
   4. Develop test procedures (for each of the project goals)
   5. Test a variety of pre-wetting rates and measure benefit for each pre-wet goal
   6. Evaluate application locations
   7. System will use two 'hoses' (one from each saddle tank) and nozzles (as specified by the TAC), except on the pre-mix chamber system.
   8. List characteristics of each system used including: flow rate, flow constriction, screen size, flow meters, mix chambers etc.
   9. Develop application rate and system considerations and recommendations.

5) **Who is the intended audience for the products/deliverables? Identify training needed and describe the use of products/deliverables.**
DOTs, public works agencies, anyone involved in snow and ice control.

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**.
Better designed pre-wet systems will result in more efficient and effective delivery of solid deicer products. This has the potential to minimize impacts (less salt/sand in the ditches), reduce waste, and provide better roads for our customers at a reduced cost.

7) **How will you measure the success of this project?**
Success will be measured by changes in the way prewet systems are implemented.

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.**
This project will build on the recent synthesis CR18-04 by conducting research that fills the gaps identified by that project.