



MnDOT 2014 Peer Exchange

***Quantifying & Communicating the Value of Research Implementation
for MnROAD Phase-II Research Projects and
Development of MnROAD's Future Research***

FINAL REPORT

June 10 - 12, 2014



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FINAL REPORT

MnDOT 2014 Peer Exchange

June 10 - 12, 2014

Executive Summary

MnDOT Research Services hosted a national peer exchange in Minneapolis, Minnesota from June 10-12, 2014, that focused on the research and implementation efforts of the MnROAD cold region pavement testing facility and laboratory. The goal of the peer exchange was to share successful strategies for implementing MnROAD research results and calculating and communicating the benefits of the research. The peer exchange participants also helped prioritize research topics to be addressed in the next phase of MnROAD projects, which is expected to begin in 2016.

To accomplish the goals of the peer exchange, representatives from MnDOT, eight other state DOTs, the Ontario Ministry of Transportation, the Federal Highway Administration, and the Transportation Research Board gathered for two and a half days of presentations, discussions, and working sessions. The group as a whole recognized MnROAD as a national and international leader in pavement research and emphasized the value of MnROAD data and research results both to MnDOT and to other states. Given shrinking agency budgets, the need to partner with other states to leverage research dollars and the MnROAD facilities is more important than ever.

Key Findings

Below are the highlights from the peer exchange discussions in the each of the topic areas addressed.

Implementing Research Results

- Implementation is important but not easy. It can take as much funding and effort as the research itself.
- Implementation must be planned and discussed from the initial research scoping meeting to the final project wrap-up meeting.
- Many agencies do not have a documented implementation process. MnDOT's implementation planning checklist (Appendix F) and the research implementation tracking form provided by Joe Mahoney (Appendix G) may be of use to others.
- Utilizing professional web and communications staff to share and promote research findings is one of the most effective ways to assist with implementation.

Calculating and Communicating Research Benefits

- Not all benefits of research can be calculated in terms of cost savings. Projects results may be useful for reinforcing the effectiveness of current practices or avoiding new products or approaches that are extremely beneficial but cannot be easily assigned dollar values. Research can help agencies better understand the tools and techniques they have available to extend pavement life (both in terms of what works and what does not).
- The calculation of benefits needs to be based on known data, such as bid prices, miles of roadways, expected life, and miles of repairs from a recent year. The validity of the calculations may be questioned if the metrics used are not clear and reliable.
- Agency methods to calculate benefits are not standardized and probably cannot be. They do have to be based on realistic values and accepted data and pass a common reality check.
- It is important to focus on telling the research story to effectively communicate research results and benefits.

MnROAD Phase-III Future Direction

- The participants discussed and prioritized national pavement research needs in the areas of asphalt, concrete, pavement preservation and tools. Eleven research statements were developed that should be addressed by MnROAD Phase III projects, other pooled fund studies or NCHRP problem statements.
- MnDOT has the support of the participants to include operational costs and marketing results as a component of the overall research project costs for MnROAD pooled fund studies.
- MnDOT will use the recommendations and research priorities from this peer exchange as a basis for a future MnROAD pooled fund study expected to be posted before January 2015.

Planned Actions for MnDOT

The discussions yielded useful guidance to MnDOT for improving research and implementation efforts. Below are the planned next steps identified by MnDOT as a result of the peer exchange.

Implementing Research Results

Actions to advance implementation efforts for completed MnROAD projects:

- *Implements of Husbandry*: MnDOT is currently working with the Local Road Research Board to hire a consultant to help implement and get the information into the hands of city and county staff.
- *PCC Diamond Grinding*: MnDOT will collaborate with local and state agencies to intensify deployment efforts based on lower life cycle-costs while monitoring long-term friction, ride-quality and rolling-resistance advantages.
- *Guide for Thin and Ultra-Thin Concrete Overlays “Whitetopping”*: With funding from the FHWA State Transportation Innovation Council (STIC), the TERRA organization has selected the CPTech Center at Iowa State University to promote the implementation of whitetopping (BCOA, bonded

concrete overlay on asphalt) as a pavement solution. This includes the development of improved technical information and participation in meetings with stakeholders and decision makers at various levels.

- *Design and Construction of Thermally Insulated Concrete Pavements*: While the original test cell related to this concept was removed in 2011 (see MnDOT research report MN/RC 2013-02), the performance of another test cell with similar design will continue to be monitored.
- *Investigation of Low Temperature Cracking in Asphalt Pavements – Phase II*: A DCT user group has been discussed and is definitely a goal. The intent is to have groups at both the technician (test procedure) and engineering (specification) levels. A new project through the FHWA STIC will be looking at procedures and specifications from neighboring states. These results will be helpful for identifying user group participants and goals.
- *Recycled Unbound Base*: MnDOT drafted an implementation plan, which will be considered by MnDOT's Technical Working Groups and Transportation Research Innovation Group.
- *Optimal Timing of Preventative Maintenance for Addressing Environmental Aging*: The final report is in draft form and should be published before the end of the year. Using the report findings, MnDOT will draft recommendations for the districts on implementing sealing on new/newer construction.

Recommendations to consider for future implementation efforts:

- Incorporate industry review and feedback on new specifications and products to ensure they are viable.
- Make sure the final selected projects for MnROAD Phase III have implementation plans with timeframes developed and incorporated into work plans and schedules.

Calculating and Communicating Research Benefits

- Share MnROAD pooled fund reports and benefits calculations with Research Services. Work with them to better market the value of the projects internally and to implement the results.
- Market the benefits and value of the projects to external agencies to encourage implementation in other states.
- Leverage the benefits information from other DOTs to promote and implement findings (i.e. Michigan success stories).

MnROAD Phase-III Future Direction

- Identify the high-interest problem statements from the peer exchange and determine which ones should be submitted for NCHRP and/or pooled fund consideration. Follow up with participating states to identify which projects will require joint funding through a pooled fund effort. Post solicitations for those projects on the TPF Pooled Fund website this fall (2014).

- All research and pooled fund projects will incorporate and support the MnROAD Phase III operations and marketing as part of the project costs.
- Using the NCAT type pooled fund model, put together a pooled fund solicitation that incorporates and supports MnROAD Phase III. This would give FHWA the ability to financially support the MnROAD facility.
- Communicate peer exchange outcome to MnROAD Subcommittees, LRRB, MnDOT working groups, TERRA, etc. to support refinement of Phase III topics.
- Leverage partnerships with industry to test new products, validate vendor claims and promote implementation.

Introduction

Background and Goals

MnROAD is a cold region pavement testing facility and laboratory located near Albertville, Minnesota. Operated by the Minnesota Department of Transportation (MnDOT), this facility celebrated its 20th anniversary during August 2014. Since 1994, MnDOT has partnered with the Minnesota Local Road Research Board (LRRB), state DOTs from around the country, the Federal Highway Administration (FHWA), industry and universities to complete projects related to pavement materials, construction techniques, performance, and maintenance.

MnROAD consists of two road segments that are divided into over 50 test cells, each representing various combinations of road-building materials and designs. The first segment is a 3.5-mile mainline interstate roadway that carries "live" traffic averaging 28,000 vehicles a day. The second segment is a 2.5-mile closed-loop, low-volume roadway that uses a 5-axle tractor-semi-trailer to simulate the conditions of a rural road. Thousands of static (environmental) and dynamic (forces applied by traffic) sensors record data on these segments for use in research conducted at MnROAD and by others around the world. For more details about MnROAD facilities, projects and data, visit the MnROAD website at www.mndot.gov/mnroad/.

Phase 1 research at MnROAD (1994-2006) focused on the structural design of concrete, bituminous and gravel pavement designs. Phase II research (2007-2015) involved the reconstruction of almost 40 test cells that supported over 20 different research projects. As MnDOT prepares to initiate Phase III research at MnROAD, focused on maintenance and rehabilitation, the agency wanted to learn how its partners have successfully quantified and communicated the value of completed MnROAD research and what research topics would be of most interest to them for future collaborative pursuit. MnDOT initiated a peer exchange to facilitate these discussions as a key step in the MnROAD planning process as shown in the following timeline.

Peer Exchange Participants

The peer exchange brought together representatives from state and international DOTs, multiple offices within MnDOT, FHWA headquarters and division offices, and the Transportation Research Board (TRB). Below is list of all participants. See Appendix B for full contact information.

Minnesota (MnDOT Staff and County Engineers)		
Tom Burnham	Bruce Holdhusen	Curt Turgeon
Shongtao Dai	Bernard Izevbekhai	Tim Stahl (Jackson County)
Glenn Engstrom	Hafiz Munir	Joel Uling
Shannon Fiecke	Alan Rindels	Dave Van Deusen
Jerry Geib	Linda Taylor	Ben Worel
Graig Gilbertson		
Visiting State and International DOTs		
Steve Bower, Michigan	Steven Krebs, Wisconsin	Magdy Mikhail, Texas
John Donahue, Missouri	Stephen Lee, Ontario	Samy Noureldin, Indiana
Joe Holland, California	Wade McClay, Maine	LaDonna Rowden, Illinois
FHWA		Peer Exchange Support
Kevin Kliethermes	Suneel Vanikar	Kim Linsenmayer, CTC & Associates
Stephen Maher	Larry Wiser	Joe Mahoney, University of Washington
Bob Orthmeyer		



Pictured left to right

Front row: Kevin Kleithermes, Ben Worel, Samy Noureldin, Magdy Mikhail, Hafiz Munir, Joel Uling
Second row: Jerry Geib, Linda Taylor, Steve Krebs, LaDonna Rowden, Shongtao Dai, Steve Bower, Dave Van Deusen
Last rows: Alan Rindels, Bob Orthmeyer, Joe Holland, Bernard Izevbekhai, Stephen Maher, Larry Wiser, Tom Burnham, Joe Mahoney, Tim Stahl, Stephen Lee, Bruce Holdhusen, Suneel Vanikar, Graig Gilbertson, Kim Linsenmayer, Wade McClay

Preparing for the Peer Exchange

In advance of the peer exchange, MnDOT asked the participants to complete three online surveys:

- Implementation and Benefits Survey – Participants were asked to share their experiences related to implementing and calculating benefits for selected MnROAD Phase II pooled fund research projects that they participated in. The results of the survey were used during the discussion sessions on research implementation and benefits.
- Research Idea Ranking Survey – Participants were asked to indicate their level of interest in a range of MnROAD research topics for the purpose of providing a preliminary topic ranking at the peer exchange.
- Discussion Groups Survey – Participants were asked to indicate their preferred research topic areas (asphalt, concrete, pavement preservation, tools) for the purpose of assigning technical discussion groups at the peer exchange.

Day 1 – Implementation and Benefits

Review of MnROAD Pooled Fund Projects

The first day of the peer exchange focused on implementation and benefits related to completed MnROAD pooled fund research projects that many of the agencies had participated in. To encourage and focus the discussion on these topics, MnDOT staff gave short presentations on the MnROAD projects listed below, reviewing each project's goal and outcomes and what steps MnDOT had taken to implement the results and quantify benefits. All of the presentations highlighting the project outcomes and implementation are available on MnDOT's website at the following link:

<http://www.dot.state.mn.us/research/PeerExchange/2014.html>.

The project summaries and final reports are available on the Transportation Pooled Fund website at the links below.



TPF-5 (148) Implements of Husbandry

<http://www.pooledfund.org/Details/Study/375>

This study investigated pavement responses to selected agricultural equipment using instrumented pavements. All tested vehicles resulted in higher subgrade stresses than the standard truck. Pavement damage is governed by axle weight, not gross vehicle weight.

TPF-5 (134) PCC Surface Characteristics – Diamond Grinding

<http://www.pooledfund.org/Details/Study/363>

This study explored the impact of pavement surface characteristics on noise, friction, texture and ride. MnDOT is using the findings to develop updated pavement specifications and an additional rehabilitation tool.

TPF-5 (129) Recycled Unbound Pavement Materials

<http://www.pooledfund.org/Details/Study/361>

Researchers monitored the properties of recycled materials during construction and throughout the pavement life to determine their effects on pavement performance. The study provided a better understanding of seasonal material behavior.

TPF-5 (165) Guide for Thin and Ultra-Thin Concrete Overlays “Whitetopping”

<http://www.pooledfund.org/Details/Study/389>

The goal of this study was to create a unified national design guide for thin and ultrathin concrete overlays of existing asphalt pavements. Using the whitetopping design, which included reduced pavement thickness and less HMA milling, MnDOT estimated expected savings of nearly \$2 million per year.

TPF-5 (149) Design and Construction of Thermally Insulated Concrete Pavements

<http://www.pooledfund.org/Details/Study/376>

The objective of this study was to perform life cycle cost analysis comparisons and develop design and construction guidelines for TICPs.

TPF-5 (132) Investigation of Low Temperature Cracking in Asphalt Pavements – Phase II

<http://www.pooledfund.org/Details/Study/395>

This study validated the Phase I laboratory test procedures, models and pavement design procedures aimed at developing a fracture mechanics-based specification for a better selection of asphalt binders.

TPF-5 (153) Optimal Timing of Preventative Maintenance for Addressing Environmental Aging

<http://www.pooledfund.org/Details/Study/380>

The objective of this study was to determine the proper timing of preventive maintenance treatments in order to optimize life cycle costs and pavement performance. The project specifically focused on environmental aging of the asphalt binder in the underlying pavement. The researchers found that to stop asphalt binder aging it is necessary to seal the pavement surface at year one.

Agency Participation in MnROAD Studies

Below is a table showing state agency participation in the Phase II MnROAD pooled fund studies discussed at the peer exchange.

Study (See below)	Husbandry	Diamond Grinding	Recycled Unbound	Whitetopping	Thermally Insulated	Low Temp Cracking	Preventative Maintenance
California			X		X		
Iowa	X					X	
Illinois	X						
Michigan			X				
Minnesota	X	X	X	X	X	X	X
Missouri				X			
Ontario						X	
Texas		X	X	X			X
Washington						X	
Wisconsin	X		X			X	
FHWA		X			X		
LRRB	X				X	X	X

Note: Indiana and Maine did not formally participate in the studies listed above for Phase-II

Representatives from FHWA and LRRB also presented on MnROAD projects, discussing the ways in which MnROAD projects had supported state and national transportation improvements.

The full group then shared their own experiences with the selected MnROAD pooled fund projects, addressing the following questions:

Implementation Approaches and Outcomes

- How have you used the results?
- What additional opportunities are there to use the results?
- What are the barriers to implementing the findings? How could they be overcome?
- What outreach products or support would help improve implementation of this project?

Research Value and Benefits

- Did this project solve the problem identified? Is additional research needed?
- What was the single most useful outcome from this study?
- What improved or changed as a result of this research?
- Did this project result in cost or time savings? How did you calculate it?

Discussion Results – Implementing Research Results

Implementation Efforts by Project

TPF-5 (148) Implements of Husbandry

- Minnesota:
 - Working on a law change for permeated roadways for overweight/overwidth. Each county has its own law, and we're working on a one-stop shop given by the DOT office. It's still a long way off. Several counties turned the permit process over to the state.
 - LRRB did training for law enforcement about the pavement impacts, but the sheriff deputies still didn't enforce.
- Michigan: There isn't widespread implementation that will come out of the project, but the research gave us the tools to make the case. That's all we can do if Legislature wants to do something else. I had the best available info to make our case. I can't say enough about this research and all it did for me.
- Wisconsin: In Wisconsin the locals wanted to maintain permitting on their system.

TPF-5 (134) PCC Surface Characteristics – Diamond Grinding

- Minnesota:
 - Created a news article and two-page summary of the research.
 - An updated standard specification is now available.
 - The research provided an additional tool for rehab, along with a special provision.
 - Despite the expected benefits (increased safety, smoother roads, reduced costs), implementation is not proceeding. There's no implementation funding, it's not priority, the results are not supported within the agency, and the results are not supported by industry.
- Michigan: We switched to longitudinal tining a few years ago and don't see the need for grinding anymore. Our overlay decisions are based on other factors than noise.
- Texas: We have a specification now.
- Wisconsin: We do minimal grinding now, but we did a small section in northeast Wisconsin and monitored the performance. It has done well, and we're still watching it.
- California: We have several pilot sections out there, and we're trying to determine behavior over time while looking at costs and benefits. We have a specification.

TPF-5 (129) Recycled Unbound Pavement Materials

- Minnesota: We have a better understanding of seasonal material behavior and now have inputs for future pavement designs. We modified the MnDOT Granular Base Specification.
- Wisconsin: This study helped. We do a lot of pulverization of hot mix and end up with RAP base. We looked at some of the report and thought it reinforces what we're doing. We're still using AASHTO and are migrating toward ME – a long migration.

TPF-5 (165) Guide for Thin and Ultra-Thin Concrete Overlays “Whitetopping”

- Minnesota:
 - We did one whitetopping on the interstate four years ago that is performing well; a small number of reflective cracks did appear within the first year after construction. We now have a 4-inch job 15 miles long happening in one of our districts. We have started to adopt it as what we’re designing for whitetopping.
 - Small panel size is one of the biggest barriers. There are more joints that could fall apart in the future.
- Michigan: Follow-up rehab action was the concern in our department. We decided not to build more of these because the district feels saddled with it and has to spend money on it. We got lots of pressure from the farming communities because rehabs require a lot of work.
- Wisconsin: We’re in the same boat. We did a few ultrathins that didn’t work very well. We’re getting pressure from the concrete industry to find equal alternative to the mill-and-fill applications we do so much of because we can’t afford full construction.

TPF-5 (149) Design and Construction of Thermally Insulated Concrete Pavements

- FHWA: No implementation yet. We’ll know in the next two months with SHRP2 projects how much interest there will be. Both industries are lukewarm to it. Once we build two or three sections there will be more experience.
- Minnesota: As aggregates become more scarce this might be a good tool for the future.

TPF-5 (132) Investigation of Low Temperature Cracking in Asphalt Pavements – Phase II

- Minnesota:
 - We did pilot projects in 2013 and 2014 to mix sampling and testing from numerous MnDOT projects.
 - We’re also looking at the effects this summer as it goes through the aging process.
- Wisconsin: We’re starting to test some of our mixes with the DCT. We’re sending out mixes to different labs. We have three pilot projects with high RAP and a specification will be included in those projects.
- Minnesota (region?): We’ve tossed around the idea of tying in with user producer groups or having a DCT users group to talk about implementation. The ASTM test method doesn’t have a lot of detail and we feel it could be improved.
- Ontario: We’re noticing that when we test three years later we find a loss of weight in the PG grading. Whatever asphalt test you use it might be good to test again in the field after time passes.

TPF-5 (153) Optimal Timing of Preventative Maintenance for Addressing Environmental Aging

- Minnesota: We expect to see a strong statement in the report on the need to seal pavement surface at year 1 to stop asphalt binder aging. Not sure where MnDOT will end up for implementation recommendations. We’ve had a lot of discussions with the striping people.

Good markings last a long time, and we don't want to put down our most expensive tapes and cover them up the next spring.

Common Implementation Challenges

- Translating the research for individual agency use.
- Monitoring implementation to see the outcomes (pros and cons).
- Agency culture/resistance to change.
- Turnover in the staff responsible for implementing the results of a project.
- Getting the research results to the right person within an agency.
- Identifying and maintaining resources to support implementation activities.
- Staying informed about all completed research on a topic and what is ready for implementation.

Implementation Successes and Opportunities

- Using incentives to encourage industry to use new specifications resulting from research or to invest in equipment that will improve quality and performance.
- Identifying champions for implementation within each state.
- Developing MnROAD project implementation plans.
- Creating very short (4-page) synthesis reports of existing research and practices on selected topics.
- Setting aside funding for implementation within the project or within the research program.
- Using pilot projects or swat teams from other agencies to demonstrate the benefits of the research and how they have successfully used it.
- Documenting how specifications have changed over time to illuminate the impact of research and the progress made.
- Marketing the benefits of research within the DOT and to legislators (including current practices that are taken for granted and not recognized as resulting from research).
- Acknowledging the importance of using communications staff (non-engineers) to help distribute the research products to our customers in the most effective way. The peer exchange participants also noted that the future is the Internet, and successful practices include having updated websites and investing in staffing that can manage all future communication tools.

Joe Mahoney developed a draft form/template that could be used by the MnROAD partners to document each state's plan for implementation for each project and to track implementation progress. The goal is to know how specific state agencies (or counties) view implementation for specific studies and the impediments to implementation that they're encountering. The form/template was designed to aid implementation by examining five key implementation factors/requirements:

- Training
- Specifications
- Test Methods
- Construction Operations
- Agency Policy

Refer to Appendix G for this implementation form, along with Appendix F, which contains the current MnDOT process for implementation.

Discussion Results – Calculating and Communicating Research Benefits

Benefits Calculated by Project

TPF-5 (148) Implements of Husbandry

- Minnesota: Some have looked at damage to the produce carried by a truck as a result of pavement damage (bounce in the truck).
- Wisconsin: We have calculated the benefits and actively implemented strategies to reduce the impacts of heavy vehicles on roadways.
- California: We just finished a pilot study on vehicle interaction for calculating pavement damage.

TPF-5 (134) PCC Surface Characteristics – Diamond Grinding

- Minnesota: We did a cost-benefit analysis of completing the various rehab treatments and found significant potential savings. Savings are found primarily from the reduction in materials needed for the overlays and to build noise walls. From Life cycle cost analysis, quieter pavements mean that fewer and shorter walls can be built unless a 10dB abatement is required. One can also look at the environmental impacts of reduced noise and maintenance savings from reducing the number of walls.
- Texas: We have a specification now and may be able to save a bunch of money.
- Wisconsin: We do minimal grinding now, but we did a small section in northeast Wisconsin and monitored the performance. It has done well, and we're still watching it.
- California: We have several pilot sections, and we're trying to determine behavior over time while looking at costs and benefits. We have a specification.

TPF-5 (129) Recycled Unbound Pavement Materials

- Minnesota:
 - We did calculate some benefits based on the number of miles we build with class 7 recycled materials and the costs for each type of base (virgin or recycled). We calculated \$900,000 in savings.
 - We write it into the proposal. We see savings up front in the bid prices.

TPF-5 (165) Guide for Thin and Ultra-Thin Concrete Overlays “Whitetopping”

- Minnesota: We calculated \$1,966,741 per year in savings as a result of reduced pavement thickness and less HMA milling.

TPF-5 (149) Design and Construction of Thermally Insulated Concrete Pavements

- Minnesota: We did a calculation with a contractor at MnROAD and found that having to ship in new aggregates from further away it was a wash to avoid the cost of trucking and using the recycled materials.

TPF-5 (132) Investigation of Low Temperature Cracking in Asphalt Pavements – Phase II

- Minnesota:
 - We looked at maintenance savings, crack reduction (saving in crack seal), and a modest performance increase.
 - Estimated overlay savings – 10% extra life from them with cost per mile for resurfacing saved.
 - New construction savings from a 20% increase in life results in savings.
 - Estimated almost \$2M in savings overall.

TPF-5 (153) Optimal Timing of Preventative Maintenance for Addressing Environmental Aging

- Minnesota:
 - The savings calculations are a big unknown. We have to wait 15 years to see how it performs. It won't improve the ride, but it will seal the surface and might seal microcracks that appear around year 5.
 - Sealing right away could be included in the original contract, which reduces administrative costs in contracting. You might also save money on paint stripes if you put the seal down right away.

Suggested Approaches to Calculating Benefits

- Lifecycle cost analysis based on construction unit rate.
- Energy savings or reductions in greenhouse gas emissions.
- Cost benefit of avoidance (not doing something).
- Travel delays as tied to household impact.
- Savings in maintenance costs.
- Reduced noise from quieter pavements (environmental cost)
- Savings in materials costs.
- Savings from extending pavement service life.

Comments About Calculating Benefits

- The savings need to be put into perspective, the metrics used clearly communicated, and the dollar amounts not inflated so as to not mislead and to maintain credibility.
- Many benefits are qualitative in nature, making it hard to tie to dollar amounts.
- There's value simply in having a public agency carry out the research as opposed to having an industry say their products perform well.
- Research results can provide the data needed to make a strong case for a new approach to the legislature.

- MnROAD data is available for use by other agencies and has supported numerous research efforts outside of Minnesota.

Comments About Communicating Benefits

- Michigan is putting together success stories on pooled funds and how they've been beneficial to the state and what has been implemented.
- Minnesota both contracts out and develops two-page technical summaries in-house to effectively communicate to a general audience.
- Online formats are often preferred. Two-page summaries should be adapted for easy viewing online or on smart phones.
- Short videos are increasingly being used to effectively communicate research results.

Day 2 – MnROAD Phase III Planning

MnROAD Tour

The second day began with a presentation on MnROAD and the test cells that will be available for research in Phase III. The group then toured the MnROAD facilities, observing the various types of pavements, design approaches and surface treatments.



Discussion of Project Ideas

The peer exchange participants were asked to help develop the research agenda for Phase III of MnROAD research by prioritizing and developing research project ideas. MnDOT expects to lead 10-15 research projects in which test cells will be developed, constructed, and instrumented starting in 2016. MnDOT indicated that the research projects selected should take into account available funding and daily operations costs, and will involve balancing product-oriented versus long-range goals and national versus local needs.

The participants broke up into four subgroups (asphalt, concrete, pavement preservation, and tools) to review and discuss the preliminary rankings of project ideas from the online survey. Refer to Appendix C for the lists of all research ideas included in the survey by topic area. Each subgroup selected their top ideas (no more than five) that they felt should be pursued in the near future and would be a good fit for MnROAD. They presented these priority topics to the full group for feedback and then worked again in subgroups to develop them into preliminary problem statements for further consideration. Below are the subgroup participants.

Discussion Subgroup Participants

	Asphalt	Concrete	Pavement Preservation	Tools
Leader	Shongtao Dai	Bernard Izevbekhai	Jerry Geib	Dave Van Deusen
Documentation	Kim Linsenmayer	Tom Burnham	Stephen Maher	Bob Orthmeyer
Members	Stephen Lee	Steven Krebs	Tim Stahl	LaDonna Rowden
	Joe Holland	Suneel Vanikar	Samy Noureldin	Larry Wiser
	Wade McClay	John Donahue	Magdy Mikhail	
	Graig Gilbertson		Steve Bower	
Rovers	Joe Mahoney			
	Ben Worel			

Discussion Results – MnROAD Phase III Priority Research Ideas

Below are the titles of the priority research project ideas selected by the topic area subgroups during the peer exchange. Next to each title are the states that expressed potential interest in funding or supporting the projects. Note that only a few of the projects were discussed in this detail on the last day of the exchange. Also, Steven Krebs from Wisconsin had to leave the exchange early and was not able to indicate which projects would be of interest to Wisconsin.

Asphalt

1. Longitudinal joint construction performance (Illinois, Maine, California, and Minnesota interested)
2. Pavement performance of using foam manifolds in warm mix asphalt
3. Performance of pavements with high RAP (Wisconsin and industry strongly supports this effort from past conversations)

Concrete

1. Sustainable Preservation of Thin Concrete Pavements and Overlays (Minnesota, Missouri, Texas, Illinois, and Michigan interested)
2. Sustainable Practices for Concrete Pavement (Minnesota and Missouri interested, California may be interested in a collaborative effort on a similar project)
3. Sustainable Solutions to Joint Deterioration

Pavement Preservation

1. Optimal timing for placement of chip seal on HMA (Indiana, Texas, California, Michigan, Washington, and FHWA interested)
2. Design, construction, and evaluation, of Thin HMA overlays in cold climates (less than 1" thick) (Illinois, Minnesota, Indiana, Texas, Washington, and Maine interested)

Tools

1. Develop user interface for MnROAD database
2. Next generation systems for measuring and evaluating surface characteristics (Indiana, Illinois, Texas, Maine, FHWA, and Ontario interested)

Refer to Appendix D for the preliminary draft problem statements developed for these priority topics during the peer exchange and then updated once after the event. The group leaders will add more detail to the problem statements based on feedback provided and will send them out to participants for additional comments and revisions. Also refer to Appendix E for a status update (as of September 24, 2014) of the top priorities MnROAD has been developing since the peer exchange for the development of future research efforts of MnROAD.

Day 3 – Wrap Up

During the final morning of the peer exchange, representatives from each of the subgroups presented at least one of their priority problem statements for feedback from the full group. The participants discussed which research topics they would be most likely to support financially and how to modify the problem statements to fit their individual agency needs. The full group also revisited the discussion of implementation opportunities and challenges and approaches to quantifying research benefits.



Recommendations and Next Steps for MnDOT

The peer exchange discussions yielded useful guidance to MnDOT for improving efforts in the three key areas addressed during the peer exchange: implementation of research results, calculating and communicating benefits of research, and planning for MnROAD Phase III projects. Below are the action items developed by MnDOT following the peer exchange.

Implementing Research Results

Actions to advance implementation efforts for completed MnROAD projects:

- *Implements of Husbandry*: MnDOT is currently working with the Local Road Research Board to hire a consultant to help implement and get the information into the hands of city and county staff.
- *PCC Diamond Grinding*: MnDOT will collaborate with local and state agencies to intensify deployment efforts based on lower life cycle-costs while monitoring long-term friction, ride-quality and rolling-resistance advantages.
- *Guide for Thin and Ultra-Thin Concrete Overlays “Whitetopping”*: With funding from the FHWA State Transportation Innovation Council (STIC), the TERRA organization has selected the CPTech Center at Iowa State University to promote the implementation of whitetopping (BCOA, bonded concrete overlay on asphalt) as a pavement solution. This includes the development of improved technical information and participation in meetings with stakeholders and decision makers at various levels.

- *Design and Construction of Thermally Insulated Concrete Pavements*: While the original test cell related to this concept was removed in 2011 (see MnDOT research report MN/RC 2013-02), the performance of another test cell with similar design will continue to be monitored.
- *Investigation of Low Temperature Cracking in Asphalt Pavements – Phase II*: A DCT user group has been discussed and is definitely a goal. The intent is to have groups at both the technician (test procedure) and engineering (specification) levels. A new project through the FHWA STIC will be looking at procedures and specifications from neighboring states. These results will be helpful for identifying user group participants and goals.
- *Recycled Unbound Base*: MnDOT drafted an implementation plan, which will be considered by MnDOT's Technical Working Groups and Transportation Research Innovation Group.
- *Optimal Timing of Preventative Maintenance for Addressing Environmental Aging*: The final report is in draft form and should be published before the end of the year. Using the report findings, MnDOT will draft recommendations for the districts on implementing sealing on new/newer construction.

Recommendations to consider for future implementation efforts:

- Incorporate industry review and feedback on new specifications and products to ensure they are viable.
- Make sure the final selected projects for MnROAD Phase III have implementation plans with timeframes developed and incorporated into work plans and schedules.

Calculating and Communicating Research Benefits

- Share MnROAD pooled fund reports and benefits calculations with Research Services. Work with them to better market the value of the projects internally and to implement the results.
- Market the benefits and value of the projects to external agencies to encourage implementation in other states.
- Leverage the benefits information from other DOTs to promote and implement findings (i.e. Michigan success stories).

MnROAD Phase-III Future Direction

- Identify the high-interest problem statements from the peer exchange and determine which ones should be submitted for NCHRP and/or pooled fund consideration. Follow up with participating states to identify which projects will require joint funding through a pooled fund effort. Post solicitations for those projects on the TPF Pooled Fund website this fall (2014).
- All research and pooled fund projects will incorporate and support the MnROAD Phase III operations and marketing as part of the project costs.

- Using the NCAT type pooled fund model, put together a pooled fund solicitation that incorporates and supports MnROAD Phase III. This would give FHWA the ability to financially support the MnROAD facility.
- Communicate peer exchange outcome to MnROAD Subcommittees, LRRB, MnDOT working groups, TERRA, etc. to support refinement of Phase III topics.
- Leverage partnerships with industry to test new products, validate vendor claims and promote implementation.

Participant Takeaways

At the end of the peer exchange, each participant had an opportunity to briefly share a highlight or takeaway they had from the peer exchange.

LaDonna Rowden (Illinois)

I am so glad that there is still this focused effort on sharing with other states. We need to support that. There are others working in same direction as us and we can stretch our dollars with MnROAD.

Samy Nouredin (Indiana)

This has been good exposure for other state DOTs. I'm aware that we share similar problems and am feeling that we need to improve and advance and change. I learned a lot from the gathering and heard a lot of ideas on what direction we can take in Indiana.

Magdy Mikhail (Texas)

I enjoyed the meeting. We all share the same challenges. One of my takeaways: We're still struggling with quantifying the benefits of research. We all agree it's valuable, but it's difficult to quantify. There is no clear process for implementation.

Jerry Geib (MnDOT)

Good ideas shared here, and it's good to get them on paper and move forward.

Bernard Izevbekhai (MnDOT)

Implementation is a big issue. This gave us a chance to channel our focus and see that we don't exist in a vacuum. The discussions on Wednesday were so good.

Shongtao Dai (MnDOT)

I learned a lot from all of the states and see that not everyone has same research issue.

Stephen Lee (Ontario)

We have common challenges. The biggest bang for our buck is to have research like this to mitigate the risks before we implement.

Bob Orthmeyer (FHWA)

I see MnROAD as a national/international treasure. It was good to hear other people say what comes out that they can use. We need to keep it as a viable operation.

Alan Rindels (MnDOT)

We need to include implementation in the problem statement.

Wade McClay (Maine)

It was great to hear different points of view. I'm taking a lot back.

John Donahue (Missouri)

I appreciated the outreach to other states.

Steven Maher (TRB)

I've learned that with regard to the end product of research that the implementation is very important but not easy. There are some interesting ways of doing it, and I'll keep studying it and sharing it. It's important to focus on communications at the end of the research and knowledge management within DOTs to capture and make the research accessible.

Joe Holland (California)

There really are common problems. I enjoyed the different ideas that I can go back to California with for dealing with research and implementation. Collaborative research is a takeaway as budgets get tighter.

Steve Bower (Michigan)

I see our budgets being taxed more and more and that means you have to partner with others. Also, this has reinforced the importance of communication and the need to tell your story. Know what you and others are doing.

Suneel Vanikar (FHWA)

This was my first peer exchange. I enjoyed the collaboration and discussions. I wish others would use this process when it's needed to get buy-in from many individuals. I like the emphasis on implementation. The problem statements developed here are interesting, and FHWA would be interested in a number of them depending on funding. It's good to get insight into what you're thinking.

Dave VanDeusen (MnDOT)

It's good to catch up and hear what's been going on elsewhere. We've got a good head start on Phase III.

Tom Burnham (MnDOT)

It's encouraging to see continuing interest in MnROAD. It started out as a MnDOT facility, and it has become national/international. It's very gratifying.

Larry Wiser (FHWA)

Identify champions early and involve them early. Close the loop at the end.

Linda Taylor (MnDOT)

MnROAD is nationally and internationally recognized as a leader and the work is readily adopted and used by other states, but we struggle to the results implements internally. MnDOT needs to do a better job marketing our research results internally. MnROAD does amazing work and we need to continue to support this facility.

Ben Worel (MnDOT)

I found the peer exchange helpful in the development of MnROAD's Phase III efforts both related to study and test cell development. The focus needs to be on agency critical needs, have a product and implementation plan that's obtainable, and make an impact on the future for our customers. Many of the ideas and thoughts from this peer exchange will be incorporated into our common practices.

Joe Mahoney (University of Washington)

The discussion by the state and federal representatives was quite informative. Shared problems and collaboration to develop and implement solutions was the major focus of the meeting. Further, it is clear that the state DOTs represented largely have common issues—however it was also clear that some of the research results are likely to be implemented in some states but not others. And...for pavement research it is good to keep some perspective about implementation timing—a good rule-of-thumb is that it takes 10 years from problem identification to early implementation. If one can do better than 10 years, all good. Pooled fund studies appear to shorten this cycle.

Appendix A – Peer Exchange Agenda

MnDOT 2014 Peer Exchange June 10-12, 2014

Quantifying & Communicating the Value of Research Implementation for MnROAD Phase-II
Research Projects and Development of MnROAD’s Future Research

Monday – June 9, 2014

(Participants arrive in Minneapolis – shuttle to hotel – lunch/dinner on your own)

Hotel: Holiday Inn Airport - 1201 West 94th Street Bloomington, Minnesota 55431
(Hotel provides free shuttle and free breakfast)

Tuesday – June 10, 2014 (hotel)

7:30	Continental Breakfast (Open to all including non-hotel guests – outside of room)	
8:30	Welcome and Introductions House Keeping Items Overview of this peer exchange and desired outcomes Review of the past MnDOT “Value of Research” Peer Exchange	Worel Taylor
9:00	MnROAD Project Overview General Survey Responses to Implementation and Benefits	Worel
9:30	FHWA Projects - Implementation and Benefits from MnROAD	FHWA
10:00	Break	
10:30	Agency Implementation and Benefits of Research TPF-5 (148) Implements of Husbandry	Dai
11:00	Agency Implementation and Benefits of Research TPF-5 (134) PCC Surface Characteristics – Diamond Grinding	Izevbekhai
11:30	Agency Implementation and Benefits of Research TPF-5 (129) Recycled Unbound Pavement Materials	Worel
12:00	Lunch – Provided	
1:00	Agency Implementation and Benefits (15 presentation + 15 discussion) TPF-5 (165) Development of Design Guide for Thin and Ultra Thin Concrete Overlays of existing Asphalt “Whitetopping”	Burnham
1:30	Agency Implementation and Benefits (15 presentation + 15 discussion) TPF-5 (149) Design and Construction of Thermally Insulated Concrete Pavements	Burnham
2:00	Agency Implementation and Benefits (15 presentation + 15 discussion) TPF-5 (132) Investigation of Low Temperature Cracking in Asphalt Pavements	Van Deusen
2:30	Agency Implementation and Benefits (10 presentation + 5 discussion) TPF-5 (153) Optimal Timing of Preventative Maintenance for Addressing Environmental Aging in HMA Pavements (still ongoing study)	Geib
2:45	Break	
3:15	Minnesota Local Road Research Board - Implementation and Benefits from MnROAD	Stahl
3:45	Group Discussion on implementation of research and quantifying the benefits Summarize the findings for both implementation and benefits – takeaways	Mahoney Group
5:00	Adjourn (Dinner on your own)	

Wednesday – June 11, 2014 (MnROAD)

7:30	Continental Breakfast (Open to all including non-hotel guests – outside of room)				
8:30	Meet in Hotel Lobby – Travel to MnROAD				
9:30	Welcome – Overview of Tuesday and objectives for today				Mahoney
9:45	MnROAD Phase-III Research Ideas / Available MnROAD test cells (Go over survey sent to participants before the meeting and discuss)				Worel
10:15	Break				
10:45	MnROAD Tour				
12:00	Lunch – Provided				
12:30	Subgroups to work on ranking of ideas and collaboration (top 3 ideas)				Subgroups
	Concrete	Asphalt	Prevent Maintenance	Tools	
1:45	Break				
2:00	Subgroup update of the top ideas to the group (Why they pick the 3 ideas & discussion)				Subgroup Leaders
3:00	Subgroups to work on ideas and collaboration (top 3 ideas)				Subgroups
	Concrete	Asphalt	Prevent Maintenance	Tools	
4:00	Subgroup presentations on written problem statements / Feedback from Group				Subgroup Leaders
5:30	Leave MnROAD				
6:00	Group Dinner –				

Subgroups Areas

- **Concrete**
 - Focusing on new, rehabilitation, rehabilitation of asphalt or concrete roadways, and foundations (bases) related to concrete
- **Asphalt**
 - Focusing on new, rehabilitation, rehabilitation of asphalt or concrete roadways, and foundations (bases) related to asphalt
- **Preventative Maintenance**
 - Focusing on extending the life of both concrete and asphalt roadways.
- **Tools**
 - Focusing on non-destructive testing, surface profilers, noise, and other type of studies.

Thursday – June 12, 2014 (hotel)

7:00	Continental Breakfast (Open to all including non-hotel guests – outside of room)	
8:00	Welcome – Overview of the past two days and objectives for today	Mahoney
8:15	Implementation and Benefits – Summary and Next Steps <ul style="list-style-type: none">• Revisit discussion outcomes / highlights.• Takeaways – What will you use in your agency?• What changes are needed to optimize the outcomes and implementation of 2016 projects?	Mahoney Worel
10:00	Break	
10:30	2016 Study Ideas – Summary and Next Steps <ul style="list-style-type: none">• Interest in pursuing the top-ranked projects?• Partner funding availability (timing and amount).• Costs involved (construction, research, operations). Which expenses can/should the pooled fund cover?	Mahoney Worel
11:30	Final Reflections	Mahoney Worel
12:00	Lunch – Provided	
1:00	Adjourn (flights scheduled for the afternoon – hotel 5 miles from airport)	

Appendix B – Peer Exchange Participant Contact Information

Organization		Participant
MnDOT	Road Research	Ben Worel ben.worel@state.mn.us Tom Burnham tom.burnham@state.mn.us Bernard Izevbekhai bernard.izevbekhai@state.mn.us Shongtao Dai shongtao.dai@state.mn.us Jerry Geib jerry.geib@state.mn.us
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Technical Assistance		Joe Mahoney jmahoney@uw.edu Kim Linsenmayer kim.linsenmayer@ctcandassociates.com

Appendix C – MnROAD Research Ideas

The following list of potential study topics was shared with the peer exchange participants to help them develop/prioritize the current national research needs that should be addressed in MnROAD Phase III efforts. These topics were developed from local and national input to date before the peer exchange meeting. The list has been updated since the meeting.

Study	Focus Area	Material	Comment
Cross-Slope effect on pavement performance	Design	Asphalt and Concrete	Mixture ETG Interest - Drainage
Use of Foamed Concrete for light weigh fills	Design	Asphalt and Concrete	http://www.cellularconcreteinc.com/
Use of Lightweight Aggregates	Design	Asphalt and Concrete	One interesting item on the list is the use of a small amount of lightweight aggregate in place of sand because of the "internal curing" results they are getting. They are building bridge decks as well as the freeways in the south using this method. They tell me that the Feds will pay the difference in the cost regarding the use of this on bridge decks and highways because of the advantage of internal curing http://www.cellularconcreteinc.com/Lightweight_Distributing.html
Stormwater Best Practices Management Evaluation	Environmental Secondary Study	Asphalt and Concrete	Need input from cities - use existing test cells to setup monitoring
Rolling Resistance / models – validation	Monitoring Secondary Study	Asphalt and Concrete	Secondary Study - Use existing test sections and other studies as needed
Permeable Pavements (New Construction)	Pervious	Asphalt and Concrete	MnROAD test cells have outperformed many of our expectations for the past 6 winters with very little freeze thaw issues. What could be done to improve upon the designs used in 2008?
Permeable Pavements (Rehabilitation)	Pervious	Asphalt and Concrete	Study related to the grinding and placing overlays on existing MnROAD test sections
Pervious Paver Blocks	Pervious	Asphalt and Concrete	Parking lot installation in 2014 at MnROAD - possible 2016 idea
Pre-Cast Pervious Concrete (4'x4')	Pervious	Asphalt and Concrete	Parking lot installation in 2011 at MnROAD - good performance - possible 2016 idea
Road Widening Effectiveness	Rehabilitation	Asphalt and Concrete	Tough to do at MnROAD but might be able to use the ALF for testing at the University of Minnesota
Fiberglass Reinforcement Grids for Asphalt & Concrete Mix Applications for Rehabilitation	Rehabilitation - Overlays	Asphalt and Concrete	Fiberglass Reinforcement Grids for Asphalt & Concrete Mix Applications for Rehabilitation http://www.transmetalite.com/fibre_glass_grid.html
Cross Walks LED Use?	Safety Secondary Study	Asphalt and Concrete	
Cross Walks Options for city streets	Safety Secondary Study	Asphalt and Concrete	City question - could be a paint, epoxy, colored concrete done in the transitions - Traffic / no Traffic Industry interested - can do one cell or use the transitions - could be done for new surfaces or rehabilitation of existing older surfaces. Meetings held with industry.

Study	Focus Area	Material	Comment
Rumble Strip Alternatives	Safety Secondary Study	Asphalt and Concrete	Interest for MnDOT, Cities and Counties, and other states. Safety and noise related issues to figure out. Political issues also. Mumble and Quiet rumble strips
Cost Effective Roadway Shoulders	Secondary Study	Asphalt and Concrete	Alternatives to HMA or PCC shoulders MnDOT District support
Tool Innovations using smart phones - New Technology	Testing	Asphalt and Concrete	Utilize new technologies/sensors to help decision makers – cell phone example - Digital inspection using electronic devices (tablets, etc.)
General Comment not sure where to put	General	General	Since we are in a Preservation mode, and MnROAD is quite new, I think we need to somehow model the poor condition of our subgrades and bases (try to make it perform like is 50+ years old). It might mean milling notches thru the asphalt (where deteriorated transverse joints would be) and placing loose material back in there prior to overlay (black or white), and then see if any of things we've been discussing actually work (thin whitetopping, chip sealing first year of 3" overlay, etc). Bottom line, MnROAD is new with a nice uniform subgrade, albeit clay, and that's not the case on lots of our roads. Let's try to replicate what we have out on our Trunk Highway system, and see what preservation treatments work.
Optimal Timing of Preventive Maintenance for Addressing Environmental Aging in HMA Pavements (Phase-II?)	Aging	HMA	Evaluate aging based on monitoring methods developed at the University. Piggy-backing the Optimal timing project which includes environmental (climatic) modeling, mixture and binder testing to determine when maintenance activities should be done. Tie to 12 states with MPPP. Test cells or even the driveway or pole barn loop also? Monitoring of the PG grade changes over time. Forensic opportunities. Micro cracking performance. Bill Buttlar interested in collaboration.
Curb and Gutter Section	City Streets	HMA	Build city street with curb and "bathtub" hill along the roadways to look at cracking and water movement related to sealing. Possible idea for understanding city and county roadways - Need input; what effect on edge joint?; drainage; cost/benefit - Construction group also suggest curb material studies with ARM
Tack Coat / Prime Coat Study	Construction	HMA	Develop implementation package and spec for bond strengths, tack coats, and do field tests/demonstrations with new tack products including tackless tack coats - also prime coats on top of the granular base.
Lightly Surface Roadways	Design	HMA	MnROAD has built two cells in 1999 and 2000 along with the county road outside of MnROAD. No LTC with the use of these materials. Cells 28 (big base) -29 (geo barrier) -30 (granular base) + Overlay?? Built with 4" thickness.
Longitudinal joint construction	Design	HMA	
Micro Milling	Maintenance	HMA	What effect does this leveling aid in ride and performance (use alone, chip seal, micro, overlay on top)
Asphalt Binder Study	Mix Design	HMA	Other agencies uses better rock gradations and more AC (i.e. SMA) type of pavement with no transverse cracking. Study to demonstrate effect - verification 1 - low ac - high ac mixes 2 - Low VMA mixes 3 - Simple Performance Testing (E* - lab testing, method of practice 4 - Coarse vs Fine mix 5 - Can you add more AC and not use the lower grade temp asphalt? 6 - SMA Use 7 - 6%+ polymer modified asphalt - low voids

Study	Focus Area	Material	Comment
Binder Replacement (Bio Asphalt Binders)	Mix Design	HMA	Chris Williams - Iowa State Eddie Johnson Can 50% of binder replacement possible?
Cold Mix Asphalt Paving	Mix Design	HMA	Shoulders? Emulsion based
Effects of Limestone on HMA performance	Mix Design	HMA	Mike Sheehan
Effects of rejuvenators on asphalt pavement life	Mix Design	HMA	Mixture ETG interest - Binder Ratio
FHWA Accelerated Load Facility Test Section - RAP or Shingles	Mix Design	HMA	
High Strength Asphalt Layers	Mix Design	HMA	Innophos thoughts on giving layers additional strength. Might be good to compare this with the 5" WMA sections at MnROAD depending on their performance. LVR might also be a good test for a thin pavement. Could also include fiber reinforced asphalt - http://www.forta-fi.com/ - Claims 50% increase in life and a 35% reduction in thickness
Methods to increase density in Asphalt Mixes	Mix Design	HMA	Mixture ETG interest - explore different technologies to increase density 1 - Adjust the nominal aggregate size (5X) to layer thickness to maximize density. 2 - Shuttle buggies, other methods 3 - Storage in Silos 4 - Haul Distances Effects
Nova Chip / Thin Bonded Wearing Coarse (TBWC)	Mix Design	HMA	Nova Chip on both HMA and PCC roadways
Rubber Modified Asphalt Layers	Mix Design	HMA	Rubber Pavement Association (ideas) recycling - HVS testing shows less thickness required (50% less claims) - ASU Researcher also shows AR has a very high crack reflective resistance to it - Mixture ETG suggested addition of Rubber with WMA technology
Shell Thiopave Modification	Mix Design	HMA	Shell notes it has improved its product and is looking for a demonstration to show the benefits of its modification. MnDOT is not interested due to potential issues for future rehabilitation.
Shingle Test Cell	Mix Design	HMA	Mixture ETG interest
Warm Mix Asphalt (LTPP Sections)	Mix Design	HMA	Chemical - Foaming + other cells being requested for LTPP needs - Could do at MnROAD.
High Recycled Asphalt Pavement (RAP) mixes	RAP	HMA	Develop performance measures of high RAP mixes - WI using 50% replacement - high need for research - Can we go 75% with warm mix additives? Arizona Chemical - Scott Harry (Sylvaroad additive)
Full Depth Reclamation (FDR)	Rehabilitation	HMA	Full Depth Reclamation (FDR) with various stabilizing additives. Could use cells 33-35 LVR also see UofMN Study - % AC, Fines, ME Inputs, Foamed, construction issues, effects on top down cracking and low temperature cracking; new study by Skok, Loken, & Labuz. TRB subcommittee

Study	Focus Area	Material	Comment
Asphalt overlays of asphalt pavements	Rehabilitation	HMA	Repairs of Top Down and LTC. Investigate Owens-Corning TruePave, mill cracks, ISSAC, TTI Overlay tester. Maybe use one cell and do 5 types of repairs. Bill Buttlar study. Cidex Fibers - 6D solutions
Asphalt overlays of concrete pavements	Rehabilitation	HMA	<p>see past proposal for old westbound - SPS 6 types of repairs 4" HMA on minimum repairs of PCC 4" HMA on Crack and Seat PCC 8" HMA on Crack and Seat PCC 8" HMA on Rubblization of PCC 4" WMA on Rubblization of PCC 4" WMA on minimum repairs of PCC 2" HMA on minimum repairs of PCC Fabrics?</p> <p>Repairs of Top Down and LTC. Investigate Owens-Corning TruePave, mill cracks, ISSAC, TTI Overlay tester. Maybe use one cell and do 5 types of repairs. Bill Buttlar study. Cidex Fibers - 6D solutions</p> <p>JT Anderson – D2 has built BOCs with a permeable drainage layer as the first lift and have had improved performance. Something we might try at MnROAD. How thick does the PAB need to be, and then how thick does the HMA overlay need to be to support the loads. I was thinking this might be a good idea for WB 94, but the traffic probably wouldn't be on there enough to show us what we need?? (and after reading point 2 below, I think we would have to manipulate the concrete of the MnROAD sections some to put them in a poor condition, since poor concrete is what we usually overlay)</p>
Cold In-Place Recycling	Rehabilitation	HMA	Not a good fit at MnROAD due to the length of the test cells
Underseals for HMA Overlays	Rehabilitation	HMA	Texas Underseal Carolina Underseal (Chip seal then HMA overlay)
High Friction Treatments	Safety	HMA	
HMA performance testing	Secondary Study	HMA	HMA performance testing regarding fatigue and thermal cracking, including WMA as part of the work done in 2016
HMA Construction Tools and Testing	Testing	HMA	DCT mix test/spec Step frequency GPR for asphalt density Inra-red paving Bar - How to implementation package Intelligent Compaction Vacuum recovery of emulsion residue Test
Flexible microsurfacing	HMA Pavement Preservation	Pavement Preservation	Develop guidebook for flexible microsurfacing
Reactive maintenance techniques	Maintenance	Pavement Preservation	Depends on distresses present - might be able to do before 2016. Not enough areas currently and historically MnROAD does not have enough locations to do this type of testing - could do it on 70th street near MnROAD - also in 2014 or 2015 if any HMA issues need repair. Develop best manufacturing practices, trainings, specs, performance on reactive maintenance techniques including mastic pothole repair

Study	Focus Area	Material	Comment
Development of Protocols and Procedures for Selecting, Monitoring and Reporting on Pavement Preservation Treatments for Performance Evaluation	Pavement Preservation	Pavement Preservation	MPPP research need statement
Pavement Preservation	Pavement Preservation	Pavement Preservation	Needs details on what - Explore collaborations with Michigan State UTC - need more details than pavement preservation
Preventive Maintenance for joint deterioration	Pavement Preservation	Pavement Preservation	Larry Sutter - what can be done with joints during construction to seal the concrete mix for longer durability
Concrete Joint Cut Depths and widths	Design	PCC	(T/3 or T/4)
Concrete Joint Spacing Increase past 15 feet	Design	PCC	Michael Beer – Joint spacing on new PCC pavement. Can it be increased from 15 feet?
Dowel Bar Misalignment	Design	PCC	
Dowel Bar Numbers	Design	PCC	Performance issues with fewer dowels or placement alternatives - what is the minimal need?
Minimize curling and warping of concrete pavements	Design	PCC	What can be done to achieve flat PCC panels?
Precast concrete pavement panels	Design	PCC	Not a good fit for MnROAD FHWA - Sam Tyson - Could be new or as a OBOL
Roller compacted concrete	Design	PCC	Shoulders built on the mainline - what else can this material be used for? Composite PCC with HMA overlay?
PCC Sealant Alternatives	Maintenance	PCC	(not traditional joint sealant)
Concrete Mix Designs using Recycled materials	Mix Design	PCC	Use of Back Rock and other material to reduce the dependency on virgin materials. MnROAD has already done some of this
Evaluation of fly ash class, class C vs. class F for equal performance	Mix Design	PCC	Not a good fit for MnROAD
Fiber Reinforced Concrete	Mix Design	PCC	Possible pooled fund study - use to pull past MnROAD data from test cells built for analysis. Could also relate to dowel bar needs or number of dowel bars. We started this in 2013 at MnROAD.
Concrete overlays of asphalt roadways - Whitetopping	Rehabilitation	PCC	How thick does the concrete need to be before dowels are no longer necessary? Panel Size? Intentionally misalign some dowel baskets (tip, skew, miss saw cuts, etc)
Concrete overlays of Concrete pavements	Rehabilitation	PCC	
CPR – full and partial depth patches, mix types, dowel grouts, etc.	Rehabilitation	PCC	Possible Pre-2016 idea if we have distress needing repair

Study	Focus Area	Material	Comment
UBOL innerlayer evaluation	Rehabilitation	PCC	May have enough data now without new cells
Concrete Construction Tools	Testing	PCC	Will be incorporated into MnROAD phase-III - possible study Concrete maturity meters - new workability test for concrete - MIT Scan Testing - Resistivity meter - Super air meter - T2 for pavement thickness
Aggregate Base Research	Design	Unbound	Aggregate industry wants input into designs - Look into gradations and cost effectiveness "natural availability" Class-5 field verification / Alternatives Stable/Drainable Bases Best gradations for PCC and HMA
Recycled Unbound Pavement Materials	Design	Unbound	SD - crushed/asphalt concrete base. MN Class 7 base. With and without virgin materials. M-E design issues - seasonal variation. Jason Harrington is key contact at FHWA.
Required Granular (Frost Protection)	Frost Protection	Unbound	Possible improvements to a computerized design taking into account the existing materials (Sweden Allowable Heave Program)
Unbound Soil/Subgrade Stabilization	Stabilization	Unbound	Chemical - Geotextile Stabilization - Implementation package for soil/subgrade stabilization (design considerations, stabilizer guidance, construction specs, benefit/cost, etc.) - What additional credit can be given to that layer? Might already have a lot to look into already at MnROAD.
Unbound Intelligent Compaction	Testing	Unbound	Bases and Subgrades

Appendix D – 2014 Peer Exchange Priority Research Problem Statements

These problem statements were developed at the peer exchange and updated by the leaders of each group after the meeting.

ASPHALT PROJECTS

I. PROBLEM TITLE

Longitudinal joint construction performance

II. RESEARCH PROBLEM STATEMENT

States are seeing premature longitudinal joint failure, which is allowing water infiltration into both the pavement and the subbase.

III. OBJECTIVE

Study the performance of different joint techniques. What is the impact on lifecycle?

IV. RESEARCH PROPOSED

- Literature review
- Construct one control section and then 5 or 6 additional sections using different joint techniques. Core the new sections and measure the density. Look at which techniques outperform the others and identify the density associated with those techniques.
- Determine the performance/density correlation and develop an engineering limit/spec for density.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

This would be a secondary study to another MnROAD project that involves the same materials for all test sections. Estimated \$100,000 for this study.

VI. URGENCY AND PAYOFF POTENTIAL

High priority. MnROAD will serve as a primary evaluation facility. Payoff will be longer life pavement and reduced maintenance costs.

VII. RELATED RESEARCH

MnDOT Maryland joint compaction method has been implemented. Evaluate the pavement performance for the pavements that used this construction technique.

VIII. PERSON(S) DEVELOPING THE PROBLEM

MnROAD Peer Exchange

IX. PROCESS USED TO DEVELOP PROBLEM STATEMENT

Peer exchange brainstorm session

X. DATE AND SUBMITTED BY

June 11, 2014

- I. PROBLEM TITLE**
 Pavement performance of using foam in warm mix asphalt
- II. RESEARCH PROBLEM STATEMENT**
 There are many foaming techniques out there, but the pavement performance of each is unknown. Different foaming techniques may have effects on pavement performance.
- III. OBJECTIVE**
 Study the pavement performance of warm mix asphalt using foam in high volume traffic at MnROAD.
- IV. RESEARCH PROPOSED**
- Literature review.
 - Construct 4 or 5 sections with different foaming additives (mechanical/water in one and several chemical options for the other sections).
 - Monitor performance in high volume traffic and cold temperatures
 - Laboratory test on materials with different foaming additives
 - Pavement structure testing using FWD to assess stiffness of in-place materials.
- V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD**
 At least \$100,000 for each section so about \$500,000 project.
 (Estimate \$100/ton. At least 250 feet for each test section—about 1000 feet total. 4 or 5 inches plus same aggregate base plus grading.)
- VI. URGENCY AND PAYOFF POTENTIAL**
 High priority. MnROAD will serve as a primary evaluation facility. Payoff will be to provide guidance on how to effectively select foaming techniques.
- VII. RELATED RESEARCH**
- Existing foamed WMA sections
 - Literature Review
- VIII. PERSON(S) DEVELOPING THE PROBLEM**
 MnROAD Peer Exchange
- IX. PROCESS USED TO DEVELOP PROBLEM STATEMENT**
 MnROAD Peer Exchange brainstorm session
- X. DATE AND SUBMITTED BY**
 June 11, 2014

I. PROBLEM TITLE

Performance of pavements with high RAP

II. RESEARCH PROBLEM STATEMENT

There is pressure to use more recycled materials to support sustainability, but it is unknown how well the pavement will perform when using a high percentage in asphalt.

III. OBJECTIVE

Determine impact on performance of using high RAP materials on a high traffic, cold weather system through fatigue testing and low temperature characterization. The project may need to develop fatigue testing to characterize the fatigue life of the mixture (virgin oil/rejuvenator).

IV. RESEARCH PROPOSED

- Literature review
- Develop a laboratory test matrix for percentages of RAP to evaluate. Also vary binder and rejuvenator.
- Develop/determine fatigue testing methods to characterize the mixtures (laboratory).
- Using the test methods developed, determine which combination has optimum fatigue life.
- Build the optimum RAP combination on MnROAD for performance evaluation.
- Evaluate the Canadian mixture using the developed test method.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

\$750,000 over two or three years. (1 year of lab testing, then build section, then evaluate).

VI. URGENCY AND PAYOFF POTENTIAL

High priority. MnROAD will serve as a primary evaluation facility. Payoff will be to provide guidance on optimal RAP content for use in HMA and how high RAP content may affect pavement life.

VII. RELATED RESEARCH

High Reclaimed Asphalt Pavement Use –FHWA Publication No.: FHWA-HRT-11-057

VIII. PERSON(S) DEVELOPING THE PROBLEM

MnROAD Peer Exchange

IX. PROCESS USED TO DEVELOP PROBLEM STATEMENT

MnROAD Peer Exchange brainstorm session

X. DATE AND SUBMITTED BY

June 11, 2014

CONCRETE PROJECTS

I. PROBLEM TITLE

Sustainable Practices for Concrete Pavement

II. RESEARCH PROBLEM STATEMENT

With the growing prevalence of disappearing aggregate sources there is the need to examine potential for increased usage of recycled aggregate in concrete

III. OBJECTIVE

Build test sections involving use of concrete from existing sections. Include existing studies and Examine for the 3 sustainable objectives: Environmental, Economic and Performance.

IV. RESEARCH PROPOSED

- Build a full depth optimized recycled aggregate content test section using concrete from existing section
- Examine various SCM Contents. Find Poisson's Ratio, COTE and Elastic moduli
- Instrument with VW etc
- Include existing study sections
- Perform Freeze thaw and petrographic
- Monitor seasonally for Performance particularly joints, polishing and cracking
- Perform life cycle cost analysis or ROI based on early performance

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

- Test Cell Cost: Concrete Removal & Construction
- Monitoring Cost: Seasonal Monitoring
- Research: Consultant for 5 years to render periodic report and final report. Explore Participation of cement & aggregate producers and SCM with carbon binding properties

VI. URGENCY AND PAYOFF POTENTIAL

Involves ROI analysis based on performance data acquired. Rapid disappearance of aggregate sources.

VII. RELATED RESEARCH

Izevbekhai & Akkari Aggregate Avoidance Test method of Quantifying benefits of RCA in Concrete. TRB 2014

VIII. PERSON(S) DEVELOPING THE PROBLEM

MnDOT B. Izevbekhai & T. Burnham
FHWA : S. Vanikar & K. Kliethermes
MODOT: J. Donahue
WisDOT : Steve Krebs

IX. PROCESS USED TO DEVELOP PROBLEM STATEMENT

Popular Demand, Peer Exchange

X. DATE AND SUBMITTED BY

June 2014 Dr. Bernard Igbafen Izevbekhai , P.E.

I. PROBLEM TITLE

Sustainable Preservation of Thin Concrete Pavements and Overlays

II. RESEARCH PROBLEM STATEMENT

With the growing prevalence of thinner concretes, particularly concrete overlays, there is a need for techniques to preserve and extend their service life.

III. OBJECTIVE

To provide a tool in the pavement preservation toolbox for the life extension of thin concrete pavements including Unbonded Overlays (UBOL) and Bonded Concrete over Asphalt (BCOAs AKA Whitetopping)

IV. RESEARCH

- Utilize cracked test sections including cracked BCOA, Cell 38 with broken panels and extensively heaved sections.
- If necessary create artificial distresses on the panels.
- Include precast repairs, fiber reinforcement and / epoxy/ Polymer concrete etc as necessary.
- Perform optimal repairs and monitor seasonal performance
- Perform life cycle cost analysis or ROI based on early performance

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

- Test Cell Cost: FD Removal , Construction and Instrumentation
- Monitoring Cost: Seasonal Monitoring
- Research: Consultant Retained for 5 Years to Render Periodic Report and Final Report Explore Participation of fiber producers, precast industry and epoxy suppliers.

VI. URGENCY AND PAYOFF POTENTIAL

Will involve ROI analysis based on performance data acquired

VII. RELATED RESEARCH

In house PDRs , UMD Repair Materials Studies. Missouri Rehab of UBOL in I-35, Sawed to smaller panels

VIII. PERSON(S) DEVELOPING THE PROBLEM

MnDOT B. Izevbekhai & T. Burnham
FHWA : S. Vanikar & K. Kliethermes
MoDOT: J. Donahue
WisDOT : Steve Krebs

IX. PROCESS USED TO DEVELOP PROBLEM STATEMENT

Peer Exchange

X. DATE AND SUBMITTED BY

June 2014. Dr. Bernard Izevbekhai, P.E.

I.	PROBLEM TITLE
	Sustainable Solutions to Joint Deterioration
II.	RESEARCH PROBLEM STATEMENT
	OGAB cells are typically unstable but drainable. Need stable bases with drainage enhancement
III.	OBJECTIVE
	<ul style="list-style-type: none"> • Build regular test section of concrete over non-drainable base. • Replicate cell 13 design with GJD. • Include joints using shredded tires as wick drains • Include other possible alternatives • Include existing studies and examine for the performance over time. • Design for sustainable and long term drainability requiring minimum maintenance
IV.	RESEARCH PROPOSED
	<ul style="list-style-type: none"> • Build a full-depth optimized recycled aggregate content test section using concrete from existing section. • Examine various SCM contents • Instrument with VW etc Install moisture and thermocouple + watermark trees • Include existing study sections • Perform Freeze thaw and petrographic • Monitor seasonally for Performance particularly joints, polishing and cracking • Perform life cycle cost analysis or ROI based on early performance
V.	ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD
	<ul style="list-style-type: none"> • <u>Test Cell Cost:</u> Concrete section: Minimize cost by combining with RCA concrete • <u>Monitoring Cost:</u> Seasonal monitoring, Flooding test, 3D GPR + regular monitoring • <u>Research:</u> Consultant for 5 years to render periodic report and final report. Explore Participation of GJD manufacturers and shredded tire producers. Perform INVEST analysis.
VI.	URGENCY AND PAYOFF POTENTIAL
	Involves ROI analysis based on performance data acquired. Rapid disappearance of aggregate sources. Urgent need for implementation calls for rapid research effort
VII.	RELATED RESEARCH
	MnDOT Cell 13 in-house research
VIII.	PERSON(S) DEVELOPING THE PROBLEM
	<ul style="list-style-type: none"> • MnDOT B. Izevbekhai & T. Burnham • FHWA : S. Vanikar & K. Kliethermes • MODOT: J. Donahue • WisDOT : Steve Krebs
IX.	PROCESS USED TO DEVELOP PROBLEM STATEMENT
	Peer Exchange
X.	DATE AND SUBMITTED BY
	Dr. Bernard Izevbekhai, P.E.

PAVEMENT PRESERVATION PROJECTS

I. **PROBLEM TITLE**

Optimal timing for placement of chip seal on HMA

II. **RESEARCH PROBLEM STATEMENT**

All opinions about timing are antidotal. To prevent aging, you must seal the pavement at year one. Some wait until 7-8 years.

III. **OBJECTIVE**

Determine the optimal time to place the chip seal. Determine the LCC benefits. Discuss placement of the first and future chip seals

IV. **RESEARCH PROPOSED**

- Literature search.
- Design experiment layout.
- Build sections
- Performance monitoring.
- Need for a second cycle??

V. **ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD**

\$500,000. Initial 3-4 year study. 5-8 evaluation. 15-20 year evaluation.

VI. **URGENCY AND PAYOFF POTENTIAL**

- No report can tell when the first chip seal can be placed and why.
- Information on benefits vs time is needed.
- The current trend is toward preservation of pavements.

VII. **RELATED RESEARCH**

- NCHRP 680
- MDOT study by APT
- NCHRP 14-14

VIII. **PERSON(S) DEVELOPING THE PROBLEM**

Pavement Preservation Team

IX. **PROCESS USED TO DEVELOP PROBLEM STATEMENT**

Peer Exchange

X. **DATE AND SUBMITTED BY**

June 11, 2014

I.	PROBLEM TITLE Design, construction, and evaluation, of Thin HMA overlays in cold climates, (less than 1” thick)
II.	RESEARCH PROBLEM STATEMENT Need for mix specifications (a guide spec).
III.	OBJECTIVE <ul style="list-style-type: none"> • AASHTO guide spec type final product. • Scoping guidelines for when and where to place these overlays. • Construction guidelines. Weather at the time of placement. • Mix design procedures. • Protecting the structure from environmental effects.
IV.	RESEARCH PROPOSED <ul style="list-style-type: none"> • Literature search. • ID and collect samples of mix placed. • Collect samples specs. • 4.75 mm mix. • UTBWC with type A or B aggregate size. • May follow NCAT type process for evaluation and monitoring. • Cost of overlays need to be calculated.
V.	ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD \$500,000 total cost. For three years to complete the initial study. Evaluation at five years. Also need 15-20 years for long term evaluation.
VI.	URGENCY AND PAYOFF POTENTIAL Need for cold region locations to verify research elsewhere in the country and to further develop the concept for cold regions. Thin HMA has potential to provide cost savings that are needed as budgets are stressed.
VII.	RELATED RESEARCH <ul style="list-style-type: none"> • Texas study has been completed. • NCAT has performed research studies and mix design information. • TRB Research digest
VIII.	PERSON(S) DEVELOPING THE PROBLEM Pavement Preservation Team.
IX.	PROCESS USED TO DEVELOP PROBLEM STATEMENT Peer Exchange
X.	DATE AND SUBMITTED BY June 11, 2014

TOOLS PROJECTS

I. **PROBLEM TITLE**

Next Generation Systems for Measuring and Evaluating Surface Characteristics

II. **RESEARCH PROBLEM STATEMENT**

- Antiquated performance test methods – ASTM locked-wheel skid tester (70 year old technology).
- Unified data collection process; system for testing inter-related characteristics.
- Addresses MnROAD PP Subcommittee statement: Design and performance of surface texturing with respect to smoothness, noise, friction, splash spray and rolling resistance in a unified approach.

III. **OBJECTIVE**

Develop enhanced measurement technology and platform to measure pavement surface characteristics (friction, texture, noise, etc).

IV. **RESEARCH PROPOSED**

1. Review and assess current 3D technologies.
2. Utilizing these technologies develop equipment platform to measure multiple characteristics.

V. **ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD**

Estimated resources and time to complete is ~\$1,500,000 and 36 months.

VI. **URGENCY AND PAYOFF POTENTIAL**

High priority. Can begin immediately. Does not have to wait until Phase III begins although MnROAD will serve as a primary evaluation facility to verify effectiveness. Benefit will be enhanced pavement network condition assessments.

VII. **RELATED RESEARCH**

Continuation of MnROAD Phase II surface texture studies.
Integrated texture and noise model study (FHWA project).
Splash/spray model development (FHWA project).
Work done by technology and equipment integrators (Pathways, etc.)

VIII. **PERSON(S) DEVELOPING THE PROBLEM**

MnROAD Peer Exchange – Tools Group

IX. **PROCESS USED TO DEVELOP PROBLEM STATEMENT**

1. MnDOT Peer Exchange Tools Group brainstorm session.
2. Topics identified out of Pavement Preservation Subcommittee. 1. Surface characteristics of diamond ground PCC surfaces. Design and performance of surface texturing with respect to smoothness, noise, friction, splash spray and rolling resistance in a unified approach. 2. Cost-benefit of pavement smoothness (how smooth is smooth enough for older pavements at different vehicle travel speeds. Local low volume vs. high speed high volume).

X. **DATE AND SUBMITTED BY**

June 11, 2014 (Robert O., LaDonna R., Larry W., Dave V.)

- I. PROBLEM TITLE**
Develop User Interface for MnROAD Database
- II. RESEARCH PROBLEM STATEMENT**
Currently the MnROAD database is contained within a relational database. Data is extracted using cryptic SQL queries. Extracted data is essentially a collection of directories and files. A graphical user interface (GUI) is required to make accessing the data more intuitive.
- III. OBJECTIVE**
Develop an enhanced GUI for all data contained within the MnROAD database. The resultant product will have the ability to run on a wide range of platforms, preferably a web-based application.
- IV. RESEARCH PROPOSED**
1. Determine web interface platform suitable for the project.
 2. Test the interface
 3. Incorporate discussion group via website for providing feedback. Project team can respond to modifications, new modules, etc. This will allow the benefits of the project to be easily incorporated at the project closeout time.
 4. Finalize and release to users.
- V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD**
Estimated resources and time to complete is ~\$500,000 and 24 months.
- VI. URGENCY AND PAYOFF POTENTIAL**
High priority. Can begin immediately. Does not have to wait until Phase III begins. Benefit will be more intuitive queries of the database resulting in increased access to a wider audience of researchers.
- VII. RELATED RESEARCH**
LTPP InfoPave
- VIII. PERSON(S) DEVELOPING THE PROBLEM**
MnROAD Peer Exchange – Tools Group
- IX. PROCESS USED TO DEVELOP PROBLEM STATEMENT**
MnDOT Peer Exchange Tools Group brainstorm session
- X. DATE AND SUBMITTED BY**
June 11, 2014 (Robert O., LaDonna R, Larry W., Dave V.

Appendix E – Update of the MnROAD Top Research Ideas (September 2014)

MnROAD has continued to update the needs statements discussed at the peer exchange and has shared them nationally with other group and agencies. Below are the current higher priority ideas as of September 2014. Note these will be used as a basis for future pooled fund efforts, and the peer exchange was instrumental in helping define this list.

General Studies (PCC related also)

1. Lightly Surfaced Roadways
 - a. HMA and PCC
 - b. FDR Stabilization
2. Duel (Driving and Passing) Roadways Design
 - a. PCC driving lane – HMA passing lane for rehabilitation?
3. Cross walk markings
4. Shoulder Alternatives / Preservation
5. Base Studies
 - a. Drainability
 - b. Recycled Materials
 - c. Large stone recycled Base
6. Trench Repairs (FHWA study that might need test sections maybe before 2016)
7. Access to the MnROAD Database (2014 peer exchange)

Flexible MnROAD Studies

1. Design, construction, and evaluation of HMA Overlays
 - a. (Peer - Illinois, Minnesota, Indiana, Texas, Washington, Maine)
 - b. MnROAD Old concrete WB Lanes / Thickness / Rubbilize
2. Asphalt Mixture Characteristics (Performance Testing)
 - a. High Recycled Mixes (2014 Peer Exchange)
3. Full Depth Reclamation
4. Longitudinal Joint Construction (2014 Peer Exchange)
 - a. Tough to do at MnROAD
5. Performance of asphalts modified with engine oil
 - a. FHWA and Industry
6. Performance of warm mix pavements designed and constructed with asphalt foam manifolds (2014 Peer Exchange)
7. Central plant-mixed bituminous
 - a. Industry Interests – NCAT Tie

Pavement Preservation

1. HMA Optimal timing and selection of PP treatments
 - a. Low and high traffic volume roads. (Indiana, Texas, California, Michigan, Washington, and FHWA)
 - b. NCAT Tie – Test Track testing along with Low and High volume offsite testing in Alabama and Minnesota
2. Pavement preservation for lightly surfaced roadways
3. Effects of pavement performance with rejuvenators
4. Pavement preservation for shoulders

Concrete MnROAD Studies

1. Improved Durability Solutions for Concrete Pavement
 - a. Colored concrete durability
 - b. Improved drainage concepts
 - c. Effectiveness of topical treatments – joints
 - d. Effectiveness of topical treatments - mitigation of ASR after diamond grinding
 - e. Durable rehabilitation techniques for thin concrete pavements and overlays
2. Improved/innovative materials and curing solutions for concrete pavements
 - a. Microspheres in lieu of air entraining – BASF (Charles Nmai)
 - b. Timing of curing
 - i. Scaling issues for both low w/c and ready mixes (roadways and flat work)
 - c. Alternate curing materials
 - d. Internal curing
 - e. Alternatives for Flyash – Natural pozzolans
 - f. Recycled materials in PCC – Higher % PCC or “black rock”
 - i. Ultra high early patching performance
3. Next generation concrete overlays
 - a. Phase 2 improvements to BCOA-ME
 - b. Thin CRCP concrete overlays
 - c. Full depth reclamation with concrete overlay
 - d. Crack and seat PCC with unbonded concrete overlay
 - e. Bonded precast concrete panel overlays
 - f. RCC concrete overlay
4. Alternative PCC design and load transfer mechanisms
 - a. 6’x6’ panels on cement treated or fiber reinforced subgrade
 - b. Alternate dowel bar number/size/spacing – measuring concrete stresses
5. Tools
 - a. Advancements in repair estimating tools for concrete joint rehabilitation
 - b. Field Anchor Study – Develop a test that matches the force a concrete paver especially related to concrete overlays on existing HMA and PCC pavements. Inspector test.

Appendix F – MnDOT Research Project Evaluation Sheet

This MnDOT form may be of interest to other agencies looking for tools to track project outcomes and implementation activities.

Project Evaluation Sheet

This is an internal document for use by RS&L management; this sheet will not be shared with the investigator or otherwise published. The project advisor should record approval of this document in ARTS.

Project Title:

ARTS #:

Contract #:

Report #:

- **PC:**
- **TL:**
- **PI:**
- **PA:**

Marketing Opportunity?	<input type="checkbox"/>
Implementation Potential?	<input type="checkbox"/>
Research Opportunity?	<input type="checkbox"/>
Benefits Quantifiable?	<input type="checkbox"/>
Issues?	<input type="checkbox"/>

(Indicate if they didn't respond)

Related Projects (specify end date if not complete):

Success Story? (Yes, no, maybe; elaborate)

Is the project currently expected to deliver the benefits from the project proposal? Explain if there are quantifiable benefits.

How innovative were the results of this research?

How will the research be used? How has it been used?

Additional research or other work recommended? (elaborate; specify by whom if possible) Who should these research results be shared with?

Was the amendment process smooth? (remove question if N/A)

Identify any roadblocks to deployment:

Comments from people involved *(Identify who made each comment. Specifically mention PC performance as rated by the PI/TL. Mention if the PI or anyone else was unable to contribute to this evaluation, and check the "Issues" box if this is an ongoing/significant concern and bold the comment here.)*

Question Sheet

This is for note-taking by the preparer of the Eval sheet; it will not be submitted along with p. 1 to RS&L management (you can use it to take notes and leave it in when you submit to Mark if you have additional points which you're not sure should be in the sheet or not, though).

Ask these of interviewees (i.e. TL, PI, anyone else involved spoken to on the phone in the course of TS research):

1. **In what ways (if any) did the project fall short of its original objectives?** (If you don't have a copy of the original proposal, ask where this project came from: who proposed it, and can you have a copy of that. If there are discrepancies between what was originally proposed and what was present on the actual contract, or between those and any rescoping that happened in an amendment, ask about that.)
2. **Were performance metrics re. expected benefits prepared as part of this project? Are there measurable impacts we can cite for this project? (e.g. dollars/lives saved)** (Explain that RS&L can help calculate these benefits.)
3. **What still needs to be done to implement the results of this project? Please identify any anticipated roadblocks to implementation.**
4. **Is the current project still innovative at this point?** (or in the course of it were other technologies introduced that render its findings less relevant?)
5. **Should MnDOT (or LRRB) fund further development of this line of research? How high a priority should this work have? Has an additional research need statement been developed for a follow-up project? (To TL:) Will you be requesting additional funding along this line of research within the next six months?**
6. **Can you identify any specific informational/technology transfer needs for this project?** (Specify the audience and/or venue. Make it clear that RS&L pays for marketing.)
7. **Did any problems come up in the project re. the people involved, the process, the MnDOT or other office involved? Identify any roadblocks encountered.**
8. (When not talking to the PC) **Were you satisfied with the service you received from the PC? Was this person helpful and timely?**
9. (When not talking to PI) **Did the PI have the needed expertise for the project? Did the PI provide information from the project in time to be useful? Given a choice, would you work with this researcher/firm again?**
10. (When talking to PI or TL) **What was your experience with the amendment process? Do you have any suggestions for improving the process?**

Questions for PC (if PC is contacted by e-mail):

1. **Did the project stay on time/on budget? If not, why not?**
2. **What still needs to be done to implement the results of this project? Please identify any anticipated roadblocks to implementation.**
3. **Did any problems come up in the project re. the investigator, the panel, the process, the MnDOT or other office involved? Identify any roadblocks encountered.**

Questions to ask the Project Manager (send as a ticker with initial contact to set up a phone interview):

- 1. How well does this project align with MnDOT (or LRRB) goals? How does it affect other related projects? [When sending this question, please provide them with any related projects info that we already have so they don't think we're asking that.]**
- 2. Have the results of the project been deployed? How?**
- 3. What additional projects would be required to deploy these results? Are there plans in place that you're aware of to solicit funding for additional projects?**
- 4. Is the current project still innovative at this point? (or in the course of it, were other technologies introduced that render its findings less relevant?) Please provide any other insights you may have re. the project's success not already covered by your above responses.**

Email questions for PI (use ONLY if PI has been unavailable for a phone interview):

- 1. What efforts are or should be going on to implement the results of this project? Do you foresee any particular roadblocks to implementation?**
- 2. What are the next steps involved with this research? Are you aware of other research going on in this area that MnDOT (or LRRB) should be made aware of?**
- 3. Did any problems come up in the project re. the project panel, the process, the MnDOT or other office involved? Please identify any roadblocks encountered.**

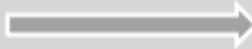
Appendix G – State DOT Research Implementation Template

State DOT Research Implementation Assessment

State DOT:

Assessor Name and Email:

Please complete the questions below.

Name of Study Current Study Problem Identification Date Study Start Date Study Completion Date	Major Study Findings (listing accommodates up to 5 specific study findings) and the Estimated Likelihood of Use of Each Research Finding (0 to 10 scale with 10 being full implementation)	Implementation Considerations for Each Major Study Finding				
		Training	Specifications	Test Methods	Construction Operations	Policy
		Change or Add Agency Training (yes_or_no and specific type of training if yes)	Change or Add Specifications? (yes_or_no and specific spec if yes)	Change or Add Test Method? (yes_or_no and specific test)	Change or Add Construction Operation? (yes_or_no and specific construction operation)	Change or Add Agency Policy? (yes_or_no and specific policy or all new policy)
Study Name:	1					
Problem Identification Date:	2					
Study Start Date:	3					
Study Completion Date:	4					
Study Completion Date:	5					
Additional details can be noted in this row and allows for limited discussions of specific implementation issues. 	This 0 to 10 estimate is your view on whether the Agency should implement a specific finding associated with this study.	Will agency personnel require training to implement this finding? Which agency personnel require the training?	Does an agency used specification exist? Is the approval process to modify an existing specification extensive? Does this finding require a whole new specification?	Does a relevant test method exist or is a whole test method required? Is the equipment expensive or affordable?	Will the construction techniques required create more complex plant or field operations? What are those complexities and what are the anticipated risks associated with that complexity. Do inspector daily reports require modification?	Does a relevant agency policy exist? Is the approval or modification process extensive?