EXHIBIT A
SCOPE OF SERVICES

OPTIMIZED TACONITE-BASED PAVEMENT REPAIR COMPOUND AND DEPLOYMENT SYSTEM

BACKGROUND

Potholes and other types of premature pavement failures are an ongoing repair challenge and expense for transportation maintenance departments at all levels. These pavement failures, at a minimum, create rough roads and poor driving conditions, but often degenerate into vehicle-damaging safety hazards that incur the wrath of the driving public, negative attention from the news media, and interrupt or slow commerce. The University's Natural Resources Research Institute (NRRI) has developed and patented a rigid, taconite mineral-based, all season rapid setting repair compound that contains neither petroleum nor Portland Cement Concrete (PCC). As such, its environmental footprint is much smaller than cold mix or hot mix asphalt products, mastic, and PCC-based repair compounds.

This project will: 1) refine NRRI's taconite-based repair compound, with an emphasis on developing and optimizing a finer-grained ("pumpable/extrudable") formulation; and 2) develop and field test/demonstrate a low-cost mechanized system that can efficiently mix and a place the repair compound in larger quantities while minimizing or eliminating direct contact and hand-mixing by maintenance personnel. The optimized formulation will utilize relatively low-cost and abundant mining byproducts and co-products, and the mechanized deployment system would make use of relatively inexpensive commercially available, i.e., "off-the-shelf", equipment. The expected economic benefits include costs savings for both raw materials and maintenance labor. In addition, the rapid-setting nature of the formulation combined with the mechanized deployment system would allow pavement and pothole repairs to be conducted faster and with moving traffic control, thereby avoiding lengthy traffic-disrupting lane closures. Key project outcomes are lower costs, good-quality and longer-lasting repairs, and improved productivity.

OBJECTIVE

Anticipated benefits of this project include: material cost savings (via lower raw material costs than high-cost alternatives, and/or by acting as a "foundation filler" for a thinner overlying application of more expensive flexible repair materials such as mastic, thereby reducing the quantity and cost of using such materials); labor savings (achieved through faster repairs); reduced life cycle costs (through longer-lasting and less frequent repairs); reduced environmental impacts (the repair compound contains neither PCC nor petroleum components); and user benefits (again, more efficient repairs by maintenance crews).

Economic benefits can be estimated using a Comparative Cost Analysis approach that considers, for example, raw material costs for various repair options and quantifies speed of repair (e.g., repairs per ton per hour). Environmental benefits could also be estimated based on a comparison of the Global Warming Potential (GWP), per ton, of various repair options.

This project will have a strong research implementation component by conducting and demonstrating the repair compound and deployment system during full-scale maintenance activities that are coordinated with local, county and state maintenance departments and crews.

SCOPE

This project will have three major components: 1) develop and optimize a taconite/mining byproduct-based, rapid-setting repair compound formulation having coarser-grained and finer-grained (i.e., fine aggregate) compositions, including compositions that are pumpable/extrudable. Adding potential "flexibility" to the repair formulation will also be further pursued; 2) test the mixing and installation of the repair compound using commercially-available mixing and deployment equipment; and 3) implement the research findings by conducting field trials/demonstrations on representative asphalt and PCC pavement failures under various seasonal weather conditions.

ASSISTANCE

Traffic control will be required for the field deployment and demonstration portion of the project.

WORK PLAN

Task Descriptions

Task 1: Repair Compound Formulation Optimization, Test Site Identification, Equipment Identification, and Preliminary (Pre-Deployment) System Testing

Under this task, the University will:

1. Acquire repair compound raw materials (minerals components and liquid activator);
2. Develop and test one or more "optimal" rapid repair formulation(s), including a potential "deactivator" to simplify equipment and tool cleanup;
3. Characterize the formulations(s);
4. Prepare sufficient quantities for Task 2;
5. Investigate currently-available Department of Transportation (DOT), state and/or county, maintenance equipment and commercially available equipment options, and identify which are most likely to be suitable for the intended deployment system;
6. Work with one or more equipment vendors and raw material provider, and try to secure temporary loan of equipment to conduct preliminary evaluation of how repair compound formulation(s) are handled by the equipment;
7. Perform scaled-up in-house testing to identify potential problems and adjustments to the equipment or compound;
8. Perform smaller-scale preliminary field tests/demonstration during the summer of 2016 and winter of 2016-2017;
9. Fabricate accessory items, if needed, to optimize system for performance and field deployment; and
10. Meet in early spring of 2017 and jointly review research results to date, and develop a plan for coordinating and carrying out larger-scale Task 2 field deployment, demonstrations, and testing.

Task 2: Research Implementation Activities

Under this task, the University will implement the research, including field trials; demonstrations; documentation; and system and repair performance monitoring. The University will conduct cooperative field trials/demonstrations on representative asphalt and PCC pavement failures at locations identified in Task 1, under representative seasonal weather conditions. The University will document field trials (e.g., videography) for meetings, presentations, and/or workshops, and monitor and document field performance and condition of repairs.

Task 3: Compile Report, Technical Advisory Panel Review and Revisions

Under this task, the University will prepare a draft report, following MnDOT's publication guidelines, to document project activities, findings and recommendations. This report will need to be reviewed by the Technical Advisory Panel (TAP), updated by the University's Principal Investigator to incorporate technical comments, and then approved by the Technical Liaison before this task is considered complete. Holding a TAP meeting to discuss the draft report and review comments is strongly encouraged. TAP members may be consulted for clarification or discussion of comments.

Task 4: Editorial Review and Publication of Final Report

During this task, the Approved Report will be processed by MnDOT's Contract Editors. The editors will review the document to ensure it meets the publication standard. This task must be completed within the contract time because the editors will provide editorial comments and request information from the University's Principal Investigator.

Task Deliverables

Task:	Deliverable(s):
1:	Optimized Rapid Repair Formulation(s); Identification and Testing of Formulations; Preliminary Formulation Testing (lab and field); Identification of Equipment and Preliminary Testing of Mechanized and Portable System for Larger-Scale Task 2 Deployment, Field Testing, and Demonstration; A Summary report; A Meeting with the Project TAP (spring of 2017)
2:	Presentation of Initial Project Findings at Quarter 1 or Quarter 2 2018 Conference(s) or Workshop (for example, presentation of to-date project findings at Transportation Research Board [January 2018], National Road Research Alliance Conference [February 2018], and/or Center for Transportation Studies Research Conference [2018]; A Summary Report; A Meeting with the Project TAP
3:	Participation in Fall Maintenance Expo (2018); A Draft Report; Final Report, approved for publication
4:	Final Published Report

PROJECT SCHEDULE

Schedule

	2016								2017											
Months:	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
Task 1	X	X	X	X	X	X	X	X	X	X	X	X	X	X						
Task 2															X	X	X	X	X	X
Task 3																				
Task 4																				

	2018											
Months:	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**
Task 1												
Task 2	X	X	X	X	X	X						
Task 3							X	X	X	X		
Task 4											X	X

Deliverable Due Dates

Task:	Draft Deliverable Due Date:	Final Task Approval Date:
1:	April 30, 2017	June 30, 2017
2:	April 30, 2018	June 30, 2018
3:	August 31, 2018	October 31, 2018
4:		December 31, 2018

Key Milestones

Key Milestones	Target Date	Description
Identify project locations	Before July 1, 2016	Finalize project locations during the "early start" period
Develop modified repair formulation(s) and assess equipment options	Late 2016	Conduct in-house formulation testing and evaluated/test deployment equipment
Conduct initial repairs	Winter 2016-17	Smaller-scale repairs installed to assess formulation(s) and performance, and to make modifications as needed
Full system deployment	2017	Deploy mechanized system and install repairs
Conference and/or workshop presentation(s) (Task 2)	Early 2018	Presentation of project findings to date
Fall Maintenance Expo	Fall 2018	Participate in 2018 Fall Maintenance Expo to demonstrate repair compound and system

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