EXHIBIT A
SCOPE OF SERVICES

THIN WHITETOPPING SELECTION PROCEDURES

BACKGROUND
Minnesota participated in the Federal Highway Administration (FHWA) Pooled Fund Study TPF 5-165, *Development of Design Guide for Thin and Ultrathin Concrete Overlays of Existing Asphalt Pavements* and the University of Pittsburgh designed the bonded concrete overlay of asphalt mechanistic-empirical design procedure (BCOA-ME). This type of pavement structure with a 4"-6" bonded concrete overlay on existing asphalt roadway has been referred to as thin and ultra-thin whitetopping.

The one area of deficiency in the application of the BCOA-ME design is the lack of a detailed procedure to determine if a roadway is a good or a poor candidate for thin whitetopping (BCOA).

The Guide to Concrete Overlays, 3rd edition, dated May 2014, produced by the National Concrete Pavement Technology Center has a chapter dealing with the evaluation and selection on thin whitetopping. The evaluation deals with hot mix asphalt distresses but does not quantify the amount of material property qualities required for BCOA. Also it does not take into account the structural soundness of the remaining hot mix asphalt (HMA) pavement properties.

OBJECTIVE
The objective of this study is to develop a procedure to evaluate asphalt pavements for concrete overlay. The selection procedure will be a combination of BCOA evaluation criteria identified in the Guide to Concrete Overlays with establishing what minimum properties of the asphalt pavement required, and if, when, and what procedures should be followed in evaluating these properties. The procedures may include comparing the proposed pavement structure with the existing materials layers, where to core the existing asphalt pavement, and what cracks and other distresses need to be repaired. The procedures will be written in the same format as the MnDOT Pavement Design Manual.

These procedures should provide MnDOT, counties and cities with a usable method to help determine which asphalt roads can be cost-effectively rehabilitated using thin whitetopping (concrete overlay on asphalt pavement) and to aid in pavement design. This should reduce the likelihood of premature failure due to poor pavement structure, and improve pavement performance and service life, which will in turn decrease maintenance and future construction costs.

SCOPE
The scope of this study is to develop a procedure to be used in the evaluation of asphalt pavements for bonded concrete overlay. The procedures include those listed in the above objectives. The procedures will be written in the same format as the MnDOT Pavement Design Manual. To be as efficient as possible, the University's project team will work with members of the University's Concrete Overlay Committee which has been in existence since 2008 when the work first started on the second edition of the *Guide for Concrete Overlays.* As the work progresses, the University will hold web-based conference calls with the Technical Advisory Review Panel (TARP).

Task 2 will utilize the criteria identified in the 2014 Guide to Concrete Overlays but placed in the format of MnDOT Pavement Design Manual.

Task 3 will require obtaining test data on existing HMA from good and poor performing thin whitetopping projects. It will require obtaining test data on existing thin whitetopping projects that have good and poor performance. Where possible, other data will be obtained from other states and tested by MnDOT. MnDOT, in consultation with the University, will determine what tests are important. Once MnDOT agrees on the test to be conducted, MnDOT will complete the tests and collect the data in the form provided by the University over a mutually agreed time period.

WORK PLAN

Task Descriptions

Task 1: Literature Review
Under this task, the University will review the processes used by other agencies for selecting roadways for thin (4"- 6") PCC whitetopping. A focused search of state highway agency design procedures and recent research results will be conducted to identity current practices for the functional and structural performance evaluation and characterizing the properties of existing HMA to be used as a structural layer in bonded concrete overlay applications. An emphasis will be placed on cold-weather states. In addition, the University will review industry publications for guidance.

Task 2: Develop Integrated Selection Procedures for Evaluating Existing HMA as a Candidate for a BCOA
Under this task, the University will develop the necessary steps and visual examination procedures for evaluating existing HMA pavements in an integrated approach as a candidate for a BCOA, utilizing, in part, the 2014 CP Tech Centers *Guide to Concrete Overlays -third edition.* The University's team will identify the steps, collection of historical data, and visual examination criteria regarding the existing asphalt pavements performance and distress issues required to determine if it is a good candidate for BCOA. The purpose of the evaluation of the existing asphalt pavement functional and structural performance condition is to identify any distresses and performance problems that currently exist and what are the causes. This information helps determine if the asphalt pavement is a good candidate for concrete bonded overlay and to what extent repairs are required to allow the existing pavement to serve as a cost-effective and monolithic member of the concrete overlay. As part of this process, condition assessment selection criteria will be developed for pavement coring, existing distresses, vertical constraints, profile grades, effects of grade changes, shoulder areas, support and other design conditions. This task will be combined with Tasks 3, 4 and 5 to complete the selection procedures.

Task 3: Establish Minimum BCOA Requirements of the Remaining Mix Properties for the HMA Pavement
Under this task, the University will involve the development of what HMA mix volumetric properties HMA pavement should have for BCOA. The University's team will identify appropriate HMA material property criteria and, when necessary, test procedures (Modulus of Elasticity, Falling Weight Deflectometer [FWD], etc.) for MnDOT to perform on existing asphalt pavements as a means to better characterize the existing asphalt as a structural layer in a bonded concrete overlay application. The data collected by MnDOT will be used to develop enhanced guidance regarding common design inputs for BCOA design procedures. Each section of the procedure will contain a number of graphs, photos as necessary and dialog that fits the section subject matter. The format will follow MnDOT's Pavement Design Manual. Subject matters to be covered include, but are not limited to:

- air voids
- tensile stress ratio
- modulus of elasticity (stiffness)
- fatigue resistance
- aging of asphalt mixtures
- balance between high stiffness values versus high shear creep(bonded overlays)
- moisture susceptibility (stripping potential)

Task 4: Comparing Proposed Pavement Structure and Existing Roadway Data
Under this task, the University will develop a procedure for comparing the proposed pavement structure with the existing materials layers and FWD testing results on a longitudinal profile. Given existing roadway data (e.g. layer moduli from FWD testing, thickness cores, pavement condition indices, etc.), it is beneficial to plot this data on an X-Y chart. These plots are helpful in determining:

- Maximum milling thickness
- Areas which may have subgrade stability issues requiring additional field investigation and/or pre-overlay repair
- Whether multiple whitetopping design thicknesses are necessary or beneficial to address variable existing conditions.
- Step-by-step procedures for plotting this data will be developed. Examples will also be provided to illustrate how these plots should be interpreted.

Task 5: Determine How Existing Transverse Cracks in the HMA Could Affect Selection or Design
Under this task, the University will develop a procedure to determine when a transverse or longitudinal crack needs to be repaired and makes the roadway a good candidate for thin Portland Cement Concrete (PCC) whitetopping. What is the condition and characteristic of the transverse or longitudinal crack? How does that determine what to do? The primary issue with cracks in the existing HMA is reflective cracking in the bonded concrete overlay due to differential movement. For example, thermal cracks can reflect in the concrete overlay at an early-age or develop later in the life of the overlay. Guidance will be developed which assists the designer in characterizing the potential for reflective cracking and/or the need to perform some pre-overlay repair, based on the width of the crack, the HMA material properties, placement conditions and the proposed thickness of the concrete overlay.

Task 6: Compile Report, TARP Review and Revisions
The University will prepare a draft final report, following MnDOT's publication guidelines, to document project activities, findings, and recommendations. The final report will serve as a guide to establish a process in selecting roadway for thin whitetopping rehabilitation repair in the pavement design manual. The final report will be submitted to the TARP for review and comment. A web-based teleconference with TARP members will be held to discuss all comments and to receive input. Final revisions to the report will reflect the consensus of the research team, TARP and technical representative of MnDOT.

Task 7: Editorial Review and Publication of Final Report
During this task the TARP approved report will be processed by MnDOT's contract editors. The University will work with MnDOT editors and complete the editing. Final formatting of the report will be done after MnDOT's review and in the format MnDOT's editor's request. The University's schedule provides for two months after the submittal of the draft final report for the technical liaison to submit comments back to the University's Principal Investigator (PI), and 1.5 months for the PI to address the comments and prepare the final deliverable for MnDOT's approval.

Task Deliverables

Task:	Deliverable(s):
1:	Memorandum, summarizing the task work
2:	Memorandum, summarizing the task work, including minimum requirements
3:	Memorandum, summarizing the task work, including minimum requirements
4:	Memorandum, summarizing the task work; Written Procedure, describing how to compare the proposed pavement structure and existing roadway data
5:	Memorandum, summarizing the task work and a written procedure
6:	Draft Final Report, editable for publication
7:	Final Published Report

PROJECT SCHEDULE

Task Completion Dates

Task:	Draft Deliverable Due Date:	Final Task Approval Date:
1:	December 1, 2015	January 15, 2016
2:	July 15, 2016	September 15, 2016
3:	July 15, 2016	September 15, 2016
4:	May 1, 2016	June 30, 2016
5:	July 15, 2016	September 15, 2016
6:	November 1, 2016	December 15, 2016
7:	December 15, 2016	April 1, 2017

Task Durations

	2015			2016											2017			
Months:	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**Task Completion Date**
Task 1	X	X	X	X															January 15, 2016
Task 2		X	X	X	X	X	X	X	X	X	X	X							September 15, 2016
Task 3		X	X	X	X	X	X	X	X	X	X	X							September 15, 2016
Task 4						X	X	X	X										June 30, 2016
Task 5										X	X	X							September 15, 2016
Task 6												X	X	X	X				December 15, 2016
Task 7															X	X	X	X	April 1, 2017

Key Milestones

Milestone	**Target Date**	**Description**
Task 1	October 15, 2015	Key Start Date
Task 2	June 15, 2016	Need Initial Comments Back from MnDOT on Draft
Task 3	November 1, 2015	Date Which Testing by MnDOT needs to Start
Task 3	August 15, 2016	Need Initial Comments Back from MnDOT on Draft
Task 4	June 1, 2016	Need Initial Comments Back from MnDOT on Draft
Task 5	August 15, 2016	Need Initial Comments Back from MnDOT on Draft
Task 6	December 1, 2016	Need Initial Comments Back from MnDOT on Draft
Task 7	February 15, 2017	Need Initial Comments Back from MnDOT on Draft

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