

FISCAL YEAR 2015

ANNUAL REPORT

OCTOBER 1, 2014 — SEPTEMBER 30, 2015



TABLE OF CONTENTS

State Planning and Research (SPR), Part II, Program

Fiscal Year 2015 Annual Report

• Introduction.....	1
• Summary	1
• Program Milestones.....	2
• Fiscal Year 2015 Project Budget and Expenditure Summary Tables	
○ 80% Federally Funded Projects – Table 1	3
○ Completed 80% Federally Funded Projects – Table 2.....	5
○ 100% Federally Funded Projects – Table 3	6
• Program Project Progress Reports (Sequentially Listed by Project Number)	
○ 80% Federally Funded Projects	7
○ 100% Federally Funded Projects	64

**STATE PLANNING AND RESEARCH, PART II, PROGRAM
2015 ANNUAL REPORT**

Introduction

The Michigan Department of Transportation (MDOT) Statewide Planning and Research (SPR), Part II, Program is authorized and funded through the Code of Federal Regulations, Title 23, Part 420, Subpart B. This program is administered through the Research Administration Section in the Bureau of Field Services. The program funds projects that have been initiated to address specific research needs at MDOT. SPR, Part II funding can be used to research and evaluate new technologies that relate to design, construction, maintenance and operation of all surface transportation modes. Other eligible uses include technology transfer and certain training activities.

Each year, MDOT develops a program consisting of 80 percent federally funded projects and 100 percent federally funded projects. The program also includes funding for various national research initiatives such as the American Association of State Highway and Transportation Officials (AASHTO) Technical Service Programs (TSPs), Transportation Research Board (TRB), National Cooperative Highway Research Program (NCHRP) and University Transportation Centers (UTCs). The program must be reviewed and approved by the Federal Highway Administration (FHWA) Michigan Division Office prior to implementation. MDOT received FHWA approval on Aug. 13, 2014. This annual report covers the MDOT SPR Part II Program from Oct. 1, 2014 through Sept. 30, 2015.

Summary

Fiscal Year (FY) 2015 research was conducted in the following focus areas, representing several modes of transportation and MDOT's diverse business functions:

Multi-Modal Transportation

- Freight Rail

Program & Project Development

- Bridges and Structures
- Transportation Safety

Delivery and Operations

- Geotechnical and Foundation Design
- Intelligent Transportation Systems
- Maintenance
- Mobility, Systems, and Signal Operations
- Pavements and Materials

The FY 2015 SPR, Part II, Program consisted of 59 projects. 32 were 80 percent federally funded and 27 were 100 percent federally funded. The FY 2015 approved budget was \$7,049,475.32 and expenditures totaled \$6,413,509.62. Total project expenditures remained within the total project budgets as follows:

2014 and 2015 Biennial Research Program Budget and Expenditures

Program Categories	Total Expenditures	Total Budget
80% Federally Funded Projects	\$9,906,951.69	\$13,525,379.32
100% Federally Funded Projects	\$3,905,085.11	\$5,615,905.00
Total	\$13,812,036.80	\$19,141,284.32

Tables 1 and 2 summarize 80 percent federally funded projects that were funded in FY 2015 while the associated appendices contain one to two page project summaries with projects listed sequentially by project number. Projects in Table 1 are listed in ascending order by job number. Table 2 provides a summary of 80 percent federally funded projects completed in FY 2015. Information is presented by focus area.

Table 3 summarizes 100 percent federally funded projects. The information is listed in ascending order by job number. The two University Transportation Center reports itemize the sources of funding in addition to the SPR II funds reported in Table 3. For additional information regarding a specific project, please contact Research Administration.

Program Milestones

Research Administration and its stakeholders achieved the following significant milestones in FY 2015:

- Completed 15 80 percent federally funded projects with current and previous year expenditures of about \$3.68 million, as summarized in Table 2.
- Project managers led research advisory panels and held meetings to guide and manage the principle investigator's research.
- Funded the construction of a research test track evaluating technologies related to connected and automated vehicles interfacing with roadway infrastructure. The University of Michigan's Mobility Transformation Facility had its grand opening in summer 2015. The final phases of construction are still active.
- Published several *Research Spotlights*, highlighting the value of individual research projects.
- Continued with project and program planning for the 2016, 2017, and 2018 research programs after the next steps were postponed to FY 2015 because of funding limitations.
 - On May 7 and 8, 2015, a Research Summit was held to improve these research ideas previously approved in FY 14.
 - Problem statements were developed by project managers and recommended by the RAC members for REC review on July 16, 2015.
 - Approved problems statements for FYs 2016 and 2017 were submitted to FHWA- Michigan Division; in the FY 2016 SPR Part II program.
- Research Administration received FHWA approval of the proposed FY 2016 SPR Part II Program on August 12, 2015.

TABLE 1 - 80% FEDERALLY FUNDED PROJECTS

Project No.	FY 2015 Expenditures	Expenditures to Date	Total Budget	Project Manager	Agency	Principal Investigator	Title	Start Date	End Date	Page No.
120239	\$108,379.74	\$193,050.63	\$243,320.33	McQuiston, Carissa	WMU	Van Houten	Comparison of Alternative Pedestrian Crossing Treatments	10/1/2013	1/31/2016	8
120241	\$174,038.20	\$224,871.69	\$721,223.28	Chynoweth, Matt	LTU	Grace	Evaluating Long-Term Capacity and Ductility of Carbon Fiber Reinforced Polymer Presetting and Post Tensioning Strands	10/1/2013	9/30/2017	9
120242	\$33,726.23	\$39,965.66	\$250,000.00	Kanitz, Dean	WSU	Gates	Michigan Urban Trunkline Segments Safety Performance Functions (SPFs) Development and Support	3/1/2014	2/28/2016	11
120429	\$197,955.50	\$303,734.53	\$306,992.41	Lariviere, Kim	WMU	Kwigizile	Evaluation of Michigan's Engineering Improvements for Older Drivers	10/1/2013	9/30/2015	12
120482	\$122,290.51	\$218,527.92	\$257,061.16	Rogers, Corey	WMU	Aktan	Research on Evaluation and Standardization of Accelerated Bridge Construction (ABC) Techniques	10/1/2013	9/30/2017	13
121279	\$21,265.60	\$303,091.48	\$311,963.42	Bott, Mark	WSU	Gates	Evaluating the Costs and Benefits of Non-differential Freeway Speed Limits for Trucks and Buses; and the Outcomes of Raising All Vehicle Speed Limits	2/26/2013	7/31/2015	15
121281	\$18,647.45	\$420,951.87	\$427,453.56	Eacker, Michael	MSU	Buch	Preparation of Implementation of the Mechanistic-Empirical Pavement Design Guide in Michigan	10/1/2011	10/31/2014	19
121282	\$61,806.28	\$184,360.15	\$184,443.19	Endres, Richard	MSU	Baladi	Predictive Modeling of Freezing and Thawing of Frost-Susceptible Soils	10/1/2010	9/30/2015	22
121285	\$41,140.97	\$263,535.42	\$264,495.42	Curtis, Rebecca	LTU	Jensen	Evaluating Prestressing Strands and Post-Tensioning Cable in Concrete Structures Using Non-Destructive Evaluation (NDE) Methods Including Joint Shear Wave Analysis	10/18/2012	11/25/2015	24
121288	\$52,002.24	\$250,657.54	\$259,707.80	Kahl, Steve	WMU	Attanayake	Remote Monitoring of Fatigue Sensitive Details on Bridges	10/1/2012	3/30/2015	25
121289	\$2,953.96	\$237,012.37	\$236,435.73	Torres, Carlos	WSU	Savolainen	Study of High Tension Cable Barrier on Michigan Roadways	10/1/2011	12/31/2014	27
121347	\$40,396.84	\$249,733.93	\$249,999.90	Bramble, Mary	WSU	Datta	Evaluation of Non-Freeway Rumble Strips - Phase II	2/8/2013	3/31/2015	30
121348	\$34,483.66	\$269,123.92	\$269,123.91	Cook, Steve	MTU	Brooks	Evaluating the Use of Unmanned Aerial Vehicles (UAVs) for Transportation Purposes	5/22/2013	4/30/2015	32
121349	\$25,525.44	\$217,938.42	\$239,863.00	Polsdofer, Mark	CTC	Casey	Research Administration Section Planning and Communications	1/31/2012	12/31/2015	34
121351	\$37,046.72	\$233,223.04	\$247,819.01	Burns, Eric	MTU	Ahlborn	Evaluation of Bridge Decks Using Non-Destructive Evaluation (NDE) at Near Highway Speeds for Effective Asset Management	11/1/2012	3/31/2016	35
121354	\$1,948.97	\$138,989.09	\$254,948.74	Owen, Hilary	WSU	Gates	Balancing the Costs of Mobility Investments in Work Zones	6/19/2013	6/30/2015	36
121355	\$83,294.03	\$270,363.51	\$272,290.52	Firman, Jason	WMU	Kwigizile	Evaluating Michigan Commercial Vehicle Enforcement Strategies and Facilities	5/7/2013	3/30/2015	37
121357	\$121,597.28	\$326,938.42	\$354,794.14	Kahl, Steve	U of M	El-Tawil	Development, Characterization and Applications of a Non-Proprietary Ultra High Performance Concrete for Highway Bridges	3/30/2013	3/14/2016	39
121358	\$129,253.42	\$215,422.36	\$216,322.36	Cook, Steve	Alfred Benesch	Darwish	Infrastructure Monitoring Data Management	10/1/2009	7/15/2015	41

TABLE 1 - 80% FEDERALLY FUNDED PROJECTS

Project No.	FY 2015 Expenditures	Expenditures to Date	Total Budget	Project Manager	Agency	Principal Investigator	Title	Start Date	End Date	Page No.
121359	\$81,446.16	\$231,612.04	\$233,632.69	Castle, Collin	WMU	Oh	Cost and Benefits of MDOT Intelligent Transportation System Deployments	6/3/2013	7/31/2015	42
121361	\$195,664.02	\$244,425.69	\$250,100.20	Kanitz, Dean	WSU	Gates	Michigan Urban Trunkline Intersections Safety Performance Functions (SPFs) Development and Support	9/1/2013	6/30/2015	44
121362	\$57,090.98	\$114,300.66	\$195,224.23	Croze, Tim	LTU	Bandara	Evaluating the Use of Tow Plows	3/30/2013	12/31/2015	45
121363	\$226,477.53	\$417,273.14	\$561,176.40	Guerrazzi, Sam	MTU	Colling	Bridge Design System Analysis and Modernization	11/1/2013	9/30/2016	48
121364	\$843,781.80	\$4,227,771.99	\$4,860,029.81	Castle, Collin	Mixon Hill	Mixon	Advanced Applications of IntelliDrive Data Use Analysis and Processing 2 (DUAP2)	8/9/2011	1/31/2017	49
121365	\$61,964.85	\$98,040.00	\$491,549.00	Chynoweth, Matt	LTU	Grace	Statewide Overall Carbon Fiber Composite Cable Bridge Monitoring	10/1/2013	9/30/2020	55
121387	\$95,943.90	\$140,426.20	\$219,692.48	Grazioli, Mark	LTU	Bandara	Performance Evaluation of Subgrade Stabilization with Recycled Materials	10/1/2013	12/31/2015	56
121388	\$44,436.68	\$184,194.37	\$184,211.43	Eacker, Michael	MTU	You	Improving of Michigan Climatic Files in Pavement ME Design	10/1/2013	9/30/2015	57
121389	\$153,757.19	\$324,319.39	\$377,437.44	Kathrens, Rich	MTU	Brooks	Wireless Data Collection and Retrieval of Bridge Inspection/Management Information	10/1/2013	9/30/2016	58
121398	\$79,465.35	\$174,379.37	\$198,655.00	Maack, Nathan	MSU	Kutay	A Method to Assess the Use of New and Recycled Materials in Pavements	10/1/2013	6/30/2015	59
122203	\$1,659,864.81	\$1,659,864.81	\$3,200,000.00	Ajegba, Paul	U of M	Sweatman	Connected Vehicle & Transportation Technology Research	10/1/2013	6/30/2017	60
*126181	\$415.00	\$164,674.55	\$164,674.55	Robords, Alan	SME	Kohn	Performance of Michigan's Jointed Portland Cement Concrete (PCC) Pavements – Phase II	3/8/2007	*9/30/2008	62
127937	\$14,613.15	\$14,613.15	\$54,857.00	Castle, Collin	HNTB	Morris	MDOT Active Traffic Management (ATM) Technical Agenda Support	7/1/2015	4/15/2016	63
\$4,822,674.46 \$12,557,387.31 \$16,559,498.11 TOTAL 80% FEDERALLY FUNDED PROJECTS										

* This project was completed in 2008; however, a cost reimbursement adjustment was completed during fiscal year 2015. Please see the annual report form for additional information.

TABLE 2 - RESEARCH PROGRAM HIGHLIGHTS

PROJECT AREA	NUMBER OF PROJECTS	TOTAL EXPENDITURES	TOTAL EXPENDITURES IN PERCENTAGE
Program & Project Development			
Bridges and Structures	1	\$250,657.54	7%
Environment & Water Sources	0	\$0.00	0%
Innovative Contracting	0	\$0.00	0%
Real Estate & Permits	0	\$0.00	0%
Transportation Safety	5	\$1,337,998.00	36%
Rest Areas, Utilities, & Landscaping	0	\$0.00	0%
Surveys & Automated Design	0	\$0.00	0%
Work Force Development	0	\$0.00	0%
Subtotal	6	\$1,588,655.54	43%
Delivery & Operations			
Construction	0	\$0.00	0%
Geotechnical & Foundation Design	1	\$184,360.15	5%
Intelligent Transportation Systems	2	\$447,034.40	12%
Fleet/Facility Management & Operations	0	\$0.00	0%
Maintenance	1	\$269,123.92	7%
Mobility, Systems, & Signal Operations	2	\$409,352.60	11%
Pavements & Materials	3	\$779,525.61	21%
Worker/Facility Safety & Security Emergency Management	0	\$0.00	0%
Subtotal	9	\$2,089,396.68	57%
Multi-Modal Transportation			
Aviation	0	\$0.00	0%
Freight & Logistics	0	\$0.00	0%
Freight Rail	0	\$0.00	0%
Intercity Bus	0	\$0.00	0%
Local Transit	0	\$0.00	0%
Maritime	0	\$0.00	0%
Passenger Rail	0	\$0.00	0%
Private/For Hire Passenger Carriers	0	\$0.00	0%
Subtotal	0	\$0.00	0%
Planning & Finance			
Asset Management	0	\$0.00	0%
Contract Administration	0	\$0.00	0%
Finance	0	\$0.00	0%
Non-Motorized Planning & Development	0	\$0.00	0%
Program Development	0	\$0.00	0%
Transportation Policy	0	\$0.00	0%
Travel Demand Forecasting	0	\$0.00	0%
Subtotal	0	\$0.00	0%
TOTAL	15	\$3,678,052.22	100%

TABLE 3 - 100% FEDERALLY FUNDED PROJECTS

Project No.	FY 2015 Expenditures	Expenditures to Date	Total Budget	Agency	Project Manager	Title	Start Date	End Date	Page No.	
SPR1284(007)	\$8,000.00	\$24,000.00	\$64,000.00	AASHTO	Barondess, Margaret	Environmental Technical Assistance Program (ETAP)	10/1/2013	9/30/2020	65	
SPR1284(019)	\$105,000.00	\$105,000.00	\$105,000.00	AASHTO / FHWA	Clover, Andre	AASHTO Engineering Technical Service Programs	10/1/2014	9/30/2015	66	
TPF-5(054)	\$25,000.00	\$135,000.00	\$210,000.00	South Dakota DOT	Cook, Steve	Development of Maintenance Decision Support System	6/1/2012	9/30/2018	67	
TPF-5(206)	\$50,000.00	\$150,000.00	\$200,000.00	Virginia DOT	Smith, Matt	Research Program to Support the Research, Development, and Deployment of System Operations Applications of Vehicle Infrastructure Integration (VII)	10/1/2012	12/31/2016	69	
TPF-5(215)	\$7,000.00	\$37,500.00	\$58,500.00	Minnesota DOT	Clover, Andre	Transportation Engineering and Road Research Alliance (TERRA)	10/1/2009	9/30/2015	71	
TPF-5(218)	\$50,000.00	\$150,000.00	\$200,000.00	Minnesota DOT	Droste, Justin	Clear Roads Winter Highway Operations Pooled Fund	10/1/2009	9/30/2017	74	
TPF-5(231)	\$0.00	\$175,000.00	\$350,000.00	MDOT	Nederveld, Lee	ITS Pooled Fund Program (ENTERPRISE)	10/1/2009	9/30/2019	77	
TPF-5(237)	\$5,000.00	\$25,000.00	\$25,000.00	Missouri DOT	Briseno, Alexandra	Transportation Library Connectivity and Development	5/1/2011	9/30/2015	84	
TPF-5(242)	\$0.00	\$50,000.00	\$50,000.00	Louisiana DOT	Eacker, Michael	Traffic and Data Preparation for AASHTO MEPDG Analysis and Design	6/1/2012	9/30/2016	88	
TPF-5(254)	\$6,813.73	\$152,832.18	\$173,000.00	MDOT	Juntunen, Dave	Evaluation and Analysis of Decked Bulb-T Beam Bridges	9/19/2011	2/28/2015	90	
TPF-5(267)	\$0.00	\$0.00	\$990,000.00	Alabama DOT	Bleech, Curtis	Accelerated Performance Testing for the NCAT Pavement Test Track	4/15/2015	9/30/2017	92	
TPF-5(269)	\$0.00	\$60,000.00	\$60,000.00	Minnesota DOT	Krom, Ben	Development of an Improved Design Procedure for Unbonded Concrete Overlays	4/13/2012	9/30/2016	94	
TPF-5(271)	\$10,000.00	\$30,000.00	\$30,000.00	Kansas DOT	Chynoweth, Matt	Reorganization of Section 5, Concrete Structures, of the AASHTO LRFD Bridge Design Specifications	10/1/2012	9/30/2015	96	
TPF-5(285)	\$0.00	\$50,000.00	\$50,000.00	Maryland DOT	Endres, Richard	Standardizing Lightweight Deflectometer Measurements for Quality Assurance (QA) and Modulus Determination in Unbound Bases and Subgrades	10/1/2013	12/31/2015	98	
TPF-5(286)	\$15,000.00	\$45,000.00	\$75,000.00	Iowa DOT	Staton, John	Next Generation Concrete Pavement Road Map	10/1/2012	9/30/2015	99	
TPF-5(290)	\$25,000.00	\$50,000.00	\$75,000.00	Iowa DOT	Gustafson, Dawn	Aurora Program	10/1/2013	9/30/2016	101	
TPF-5(297)	\$17,500.00	\$35,000.00	\$70,000.00	Oklahoma DOT	Stallard, Tim	Improving Specifications to Resist Frost Damage in Modern Concrete Mixtures	10/1/2013	9/30/2017	102	
TPF-5(308)	\$98.65	\$98.65	\$95,000.00	MDOT	Curtis, Beckie	The Use of Bridge Management Software in the Network Analysis of Big Bridges	10/1/2015	9/30/2017	103	
TPF-5(313)	\$12,000.00	\$12,000.00	\$60,000.00	Iowa DOT	Staton, John	Technology Transfer Concrete Consortium [Old TPF-5(159)]	10/1/2014	9/30/2019	104	
TPF-5(319)	\$25,000.00	\$125,000.00	\$175,000.00	FHWA	Peplinski, Suzette	Transportation Management Center (TMC) Pooled Fund Study [Old SPR-2(207)]	10/1/2014	9/30/2017	106	
TPF-5(320)	\$0.00	\$0.00	\$50,000.00	Indiana DOT	Bower, Steve	Base Funding for the North Central Superpave Center	6/1/2015	9/30/2016	107	
TPF-5(321)	\$175,602.00	\$175,602.00	\$181,766.00	FHWA	Clover, Andre	TRB Core Program Activities Period Covering- FFY 2015 (TRB FY 2016)	10/1/2014	9/30/2015	108	
TPF-5(330)	\$0.00	\$0.00	\$30,000.00	Ohio DOT	Bower, Steve	No Boundaries Roadway Maintenance Practices	5/29/2015	9/30/2017	110	
TPF-5(415)	\$915,038.00	\$915,038.00	\$1,100,00.00	FHWA	Clover, Andre	National cooperative highway research program NCHRP for FY2015	10/1/2014	9/30/2015	111	
126199	\$81,000.00	\$81,000.00	\$162,000.00	AASHTO	Mullins, Jill	AASHTOWare Development Project - Project Bids Software (PBS)	10/1/2014	9/30/2016	113	
126401	\$24,542.84	\$24,542.84	\$120,001.00	MSU	Chelotti, Erin	Development of an Acceptance test for Chip Seal Projects: Highway Pavement Preservation UTC	11/1/2014	1/31/2017	114	
126721	\$33,239.94	\$33,239.94	\$99,997.35	MTU	Johnson, Nikkie	National University Rail Center for Research, Education and Technology Transfer (NURails) UTC	1/1/2015	12/31/2016	116	
	\$1,590,835.16	\$2,640,853.61	\$3,759,264.35	TOTAL 100% FEDERALLY FUNDED PROJECTS						

80% FEDERALLY FUNDED PROJECTS

Sequentially Listed by Job Number

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2015**

PROJECT TITLE: Comparison of Alternative Pedestrian Crossing Treatments

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Carissa McQuiston

CONTRACT/AUTHORIZATION NO.	2013-0069 Z2	PROJECT START DATE	10/1/2013
PROJECT NO.	120239	COMPLETION DATE (Original)	4/30/2015
OR NO.	OR14-018	COMPLETION DATE (Revised)	1/31/2016
RESEARCH AGENCY	Western Michigan University		
PRINCIPAL INVESTIGATOR	Ronald Van Houten		

BUDGET STATUS

FY 2015 Budget		Total Budget	
Vendor Budget FY 2015	\$100,450.61	Total Vendor Budget	\$218,513.35
MDOT Budget FY 2015	\$6,875.00	Adjusted MDOT Budget	\$24,806.98
Vendor FY 2015 Expenditures	\$97,798.04	Total Budget	\$243,320.33
MDOT FY 2015 Expenditures	\$10,581.70	Total Expenditures	\$193,050.63
		Total Amount Available	\$50,269.70

PURPOSE AND SCOPE

There is a need for low cost countermeasures to increase yielding to pedestrians at crosswalks on multilane roads with moderate to high Average Daily Traffic (ADT). Current treatments include the Rectangular Rapid Flashing Beacon (RRFB), which costs around \$20,000 per installation, and the Pedestrian Hybrid Beacon that costs \$100,000. The costs of these treatments limit their installation. The development of low cost alternatives is needed to improve pedestrian safety. Initial studies have demonstrated that in street signs (R1-6) used as a gateway treatment (three signs for each two lanes approach) can produce yielding level comparable to those produced by an RRFB or Pedestrian Hybrid Beacon. On a typical two lane road the in-street sign could be located on the centerline and near the curb on each outside lane forming a "gateway." Other configurations could be developed for three or four lane roadways. This study will determine conditions that this treatment can be substituted for other treatments or used in conjunction with other devices.

FISCAL YEAR 2014 ACCOMPLISHMENTS

Fiscal Year 2014 kicked off the project and discussion was generated around crossing locations to consider for the study. Different systems such as Quick Kurb and Pexco City Post have been obtained in respective colors to evaluate the potential of the systems based on different placements. Locations have been determined and some preliminary observations have been recorded and evaluations of the information are being considered. Due to the available coordination of the researcher and MDOT maintenance staff the permanent installations were not able to be performed this fall and the contract will need extension. Some of the systems were evaluated in temporary installation with promising results. Vehicle yielding rates for some of the crossing locations exceeded 90 percent.

FISCAL YEAR 2015 ACCOMPLISHMENTS

Gateway signs/City Posts were installed at agreed upon locations in Ann Arbor, Benton Harbor, Kalamazoo, and Marshal. The WMU team collected yield compliance data at each site during the period of installation. Press release by MDOT highlighting these installations was sent out. Meetings with research team were held to keep project on task. Initial findings data was presented at various conferences.

FISCAL YEAR 2016 PROPOSED ACTIVITIES

Summary of data collected by research team to be compiled and analyzed. Final recommendations and guidance documents to be produced by WMU team.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

The project was extended nine months to January 31, 2016, allowing more time for MDOT to install pedestrian gateways and sufficient time to collect installation performance data.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

Project completion expected in fiscal year 2016.

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2015**

PROJECT TITLE: Evaluating Long Term Capacity and Ductility of Carbon Fiber Reinforced Polymer Prestressing and Post Tensioning Strands

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Matthew Chynoweth

CONTRACT/AUTHORIZATION NO.	2013-0065 Z2	PROJECT START DATE	10/1/2013
PROJECT NO.	120241	COMPLETION DATE (Original)	9/30/2016
OR NO.	OR14-024	COMPLETION DATE (Revised)	9/30/2017
RESEARCH AGENCY	Lawrence Technological University		
PRINCIPAL INVESTIGATOR	Nabil Grace		

BUDGET STATUS

FY 2015 Budget		Total Budget	
Vendor Budget FY 2015	\$641,529.79	Total Vendor Budget	\$691,814.05
MDOT Budget FY 2015	\$28,860.00	Adjusted MDOT Budget	\$29,409.23
Vendor FY 2015 Expenditures	\$173,901.43	Total Budget	\$721,223.28
MDOT FY 2015 Expenditures	\$136.77	Total Expenditures	\$224,871.69
		Total Amount Available	\$496,351.59

PURPOSE AND SCOPE

Use of Carbon Fiber Reinforced Polymer (CFRP) as longitudinal prestressing, and transverse post tensioning is a viable alternate to the 270 ksi low relaxation steel strands currently used by MDOT is prestressed and post tensioned bridge superstructures. CFRP strands are not subject to corrosion, and have strength characteristics similar to steel. MDOT has used CFRP transverse post tensioning on two structures, and has projects planned for CFRP longitudinal prestressing. This is a material MDOT will be using on future projects as well.

The current AASHTO LRFD Bridge Design Specifications do not contain guidance on the design of elements using CFRP prestressing or post tensioning. ACI 440.1R-09 provides guidance on the jacking and final stresses in CFRP strands to stay within a desired ductility range, and also provides guidance on the initial elastic losses of the CFRP fibers and resin. CFRP strands lack the ductility of steel strands, and therefore, allowable maximum stress values are recommended to ensure ductile behavior of the overall structure, so the failure mode is similar to that of a steel strand structure.

ACI 440 discusses the creep rupture characteristics of CFRP strands, but due to lack of good historical data, discussions of long term losses due to creep, concrete shrinkage, and effects of environmental factors are very general. Bond fatigue, bond lengths for splices, susceptibility to fire damage, and other severe exposure conditions are also not addressed due to the lack of long term testing data. Long term losses need to be taken into account during the initial design, as these values are subtracted from the ultimate capacity of the materials. AASHTO provides detailed methods and empirical equations for determining these losses in steel strands, however, no equivalent equations are available for CFRP strands. For current CFRP projects, detailed finite modeling has been performed to determine the performance of the materials. For CFRP strands to be used as a production design material, methodologies and empirical equations need to be developed to quantify these values, and provide the designer with the guidance on how to properly apply these methodologies.

The long term losses and other environmental effect will also need to be known for load ratings of structures with CFRP elements.

FISCAL YEAR 2014 ACCOMPLISHMENTS

Performed laboratory testing for creep rupture, bond fatigue, bond splice length, development length, lap lengths, anchorage testing, long term relaxation testing, and long term losses and creep testing. Evaluation of worldwide design guidelines, and documentation of deficiencies when compared to AASHTO requirements.

FISCAL YEAR 2015 ACCOMPLISHMENTS

Continuation of creep rupture, bond fatigue, bond length, cold weather, fire chamber and environmental testing and dissemination of the results. As part of the analytical phase of the project, the PI has proposed a modified prestressed flexural design methodology, and a modified shear design methodology. The flexural methodology uses the concept of equivalent area of prestressing given the area of strand material. The PI assisted MDOT with the design of the CFCC prestressed bub-T M-86 over Prairie Creek bridge using this new methodology. The RAP also met with the PI twice during 2015 to observe laboratory testing, and provide feedback on results to date.

FISCAL YEAR 2016 PROPOSED ACTIVITIES

Continuation of all laboratory testing, and finalizing of design specifications. Begin development of MathCAD design sheets using the new flexural and shear methodologies for use on future MDOT projects.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

None.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

Project completion expected in fiscal year 2017.

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2015**

PROJECT TITLE: Michigan Urban Trunkline Segments Safety Performance Function (SPFs) Development and Support

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Dean Kanitz

CONTRACT/AUTHORIZATION NO.	2013-0070 Z3	PROJECT START DATE	3/1/2014
PROJECT NO.	120242	COMPLETION DATE (Original)	2/28/2016
OR NO.	OR14-026	COMPLETION DATE (Revised)	
RESEARCH AGENCY	Wayne State University		
PRINCIPAL INVESTIGATOR	Timothy Gates		

BUDGET STATUS

FY 2015 Budget		Total Budget	
Vendor Budget FY 2015	\$243,760.57	Total Vendor Budget	\$250,000.00
MDOT Budget FY 2015	\$6,187.50	Adjusted MDOT Budget	\$0.00
Vendor FY 2015 Expenditures	\$33,726.23	Total Budget	\$250,000.00
MDOT FY 2015 Expenditures	\$0.00	Total Expenditures	\$39,965.66
		Total Amount Available	\$210,034.34

PURPOSE AND SCOPE

To have full functionality of the Highway Safety Manual for Michigan there is a need to develop safety performance functions (SPFs) tailored to urban segment facilities. SPFs will allow transportation professionals at all levels the ability to scientifically evaluate facilities prior to design for the expected number of crashes, crash severities, crash types and return on investment from a safety perspective. The scope of work includes the following:

1. Literature Review
2. Identification of Sites
3. Data Collection
4. Data Analysis
5. SPF Development
6. Develop Maintenance Cycle
7. Develop Maintenance Process
8. Develop Deliverables
9. Demonstration materials and meetings

Types of urban segment facilities to be evaluated are:

1. Urban Trunkline Two-Lane Arterial
2. Urban Trunkline Three-Lane Arterial (TWLTL)
3. Urban Trunkline Four-Lane Undivided
4. Urban Trunkline Four-Lane Divided
5. Urban Trunkline Five-Lane (TWLTL)
6. Urban Trunkline Greater Than Four-Lane Undivided
7. Urban Trunkline Greater Than Four-Lane Divided
8. Urban Trunkline Greater Than Five-Lane (TWLTL)

FISCAL YEAR 2014 ACCOMPLISHMENTS

The literature review and identification of sites has been completed. The data collection and analysis are underway.

FISCAL YEAR 2015 ACCOMPLISHMENTS

The literature review was completed. The database of segments was compiled and is under review prior to be considered for regionalized analysis. Data attributes are being pulled from various sources while some apparent locations have some SPF development ongoing.

FISCAL YEAR 2016 PROPOSED ACTIVITES

Finish data collection and analysis. Complete SPF development and develop a maintenance cycle for the continued use of the SPFs. Develop all deliverables and respective demonstration materials.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

Contract was transferred from Wayne State University to Michigan State University.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

Project completion expected in fiscal year 2016.

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2015**

PROJECT TITLE: Evaluation of Michigan's Engineering Improvements for Older Drivers

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Kim Lariviere

CONTRACT/AUTHORIZATION NO.	2013-0069 Z3	PROJECT START DATE	10/1/2013
PROJECT NO.	120429	COMPLETION DATE (Original)	9/30/2015
OR NO.	OR14-013	COMPLETION DATE (Revised)	
RESEARCH AGENCY	Western Michigan University		
PRINCIPAL INVESTIGATOR	Valerian Kwizgile		

BUDGET STATUS

FY 2015 Budget		Total Budget	
Vendor Budget FY 2015	\$193,195.45	Total Vendor Budget	\$295,581.91
MDOT Budget FY 2015	\$5,475.00	Adjusted MDOT Budget	\$11,410.50
Vendor FY 2015 Expenditures	\$189,937.57	Total Budget	\$306,992.41
MDOT FY 2015 Expenditures	\$8,017.93	Total Expenditures	\$303,734.53
		Total Amount Available	\$3,257.88

PURPOSE AND SCOPE

The purpose of this project is to determine the safety benefits of the following countermeasures for all drivers, and specifically drivers over the age of 65:

- Clearview Font on Guide Signs
- Box Span Signal Installation
- Pedestrian Countdown Signal Installation
- Fluorescent Yellow sign Sheeting
- Lane Use Arrows on Diagrammatic Signing

The research objectives include the following:

- Evaluating the safety benefits of each of the studied improvements for all ages and for older drivers
- Develop Safety Performance Functions (SPFs) and Crash Modification Factors (CMFs) for these improvements

The scope of work includes the following tasks:

- Task 1: Literature Review
- Task 2: Survey Older Drivers
- Task 3: Data Collection
- Task 4: Develop Safety Performance Functions for Reference Group
- Task 5: Empirical Bayes Analysis to Develop Crash Reduction Factors
- Task 6: Develop Safety Performance Functions for Future Implementations
- Task 7: Economic Analysis
- Task 8: Final Report and Presentation.

FISCAL YEAR 2014 ACCOMPLISHMENTS

Literature review complete; Locations of installed countermeasures determined; Reference locations for data analysis complete; Survey and analysis of results regarding older adult opinions of countermeasures is complete; SPF's for the most reference locations developed.

FISCAL YEAR 2015 ACCOMPLISHMENTS

All countermeasure SPFs were developed and added to the HSM spreadsheet. Cost Benefit ratios were determined. The final report was completed, published.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

None.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

CMFs have been added to the HSM spreadsheet, and those not available for automatic calculations in the spreadsheet have been included in a separate tab within the spreadsheet.

A presentation/poster session will be made at the 2016 TRB meeting regarding the pedestrian countdown signal findings from this project.

MDOT will continue to install/promote the use of the 5 engineering countermeasures studied in this project, they will be listed as potential countermeasures in the Local Road Safety Plans currently being developed.

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2015**

PROJECT TITLE: Research on Evaluation and Standardization of Accelerated Bridge Construction (ABC) Techniques

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Corey Rogers

CONTRACT/AUTHORIZATION NO.	2013-0069 Z4	PROJECT START DATE	10/1/2013
PROJECT NO.	120482	COMPLETION DATE (Original)	9/30/2015
OR NO.	OR14-019	COMPLETION DATE (Revised)	9/30/2017
RESEARCH AGENCY	Western Michigan University		
PRINCIPAL INVESTIGATOR	Haluk Aktan		

BUDGET STATUS

FY 2015 Budget		Total Budget	
Vendor Budget FY 2015	\$153,383.75	Total Vendor Budget	\$249,163.14
MDOT Budget FY 2015	\$7,440.00	Adjusted MDOT Budget	\$7,898.02
Vendor FY 2015 Expenditures	\$122,290.51	Total Budget	\$257,061.16
MDOT FY 2015 Expenditures	\$0.00	Total Expenditures	\$218,527.92
		Total Amount Available	\$38,533.24

PURPOSE AND SCOPE

The primary purpose of this research is to evaluate and standardize accelerated bridge construction, by creating scoping guidelines through investigation of national best practices and implementation of a decision making matrix.

Objectives include:

1. Review the ABC activities in other states and monitor any current ABC projects taking place in Michigan at the time of this project.
2. Evaluate methods and describe risks of substructure construction and constructability issues for utilizing deep foundations outside of existing pier/abutments and the use of precast footing elements and/or post tensioning systems for footing construction.
3. Evaluate the constructability issues associated with bridge slides and Self Propelled Modular Transports (SPMTs) and what the site conditions necessary to successfully move bridges
4. Evaluate the costs and describe risks associated with SPMT moves, bridge slides, and unique foundation construction compared to conventional construction. Incorporate impacts to traffic and lane rentals when determining cost to benefit ratios.
5. Identify additional design requirements for moves and slides such as additional deck reinforcement, jacking stiffeners, structural stability during moves, and construction tolerances for ABC vs. conventional construction. Consider the unique loading conditions created during ABC. Also, discuss geotechnical risk management strategies for the construction of specialized geotechnical work

The scope of work includes the following tasks:

1. State-of-the-Art and State-of-the-Practice Literature Review
2. Scoping Guidelines for ABC Implementation with Focus on SPMT and Slides
3. Methodologies for Design and Construction of Foundations for Replacement of Bridges While in Service
4. Cost Analysis, Life Cycle Costs and Cost/Benefit Ratio of ABC:
5. Reporting: including quarterly progress reports, an annual interim report, and a final report.
6. Develop functional specifications and MI-ABCD software. The MI-ABCD software will help MDOT determine the most cost effective feasible accelerated bridge construction technique or traditional construction technique to use on a proposed project.
7. Monitor MDOT's Bridge slide operations and movement and recommend hydraulic slide technology.
8. Develop and test targeted accelerated construction user awareness tools.

The following table shows SPR II and Bridge funding for this project:

Funding Source	FY 14 Expenditures	FY 15 Expenditures	Total Expenditures	Total Budget
SPR II	\$ 96,237.41	\$ 122,290.51	\$218,527.92	\$257,061.16
Bridge	\$ 0	\$ 19,321.19	\$19,321.19	\$19,997.85

FISCAL YEAR 2014 ACCOMPLISHMENTS

The state of the art literature review has advanced with the review of several key documents. Draft scoping parameters have been defined to assist with a decision matrix. Preliminary cost estimating techniques have been outlined. Foundation design survey of other states has advanced and findings have been documented.

FISCAL YEAR 2015 ACCOMPLISHMENTS

ABC Decision making framework extended to include lateral slides and SPMTS's. 2014 bridge slide monitoring and evaluation completed. Constructability issues and costs of ABC compiled and included in the framework. Final report for scope tasks 1 to 5 completed.

FISCAL YEAR 2016 PROPOSED ACTIVITIES

Develop functional specifications and MI-ABCD software.
Monitor MDOT's Bridge slide operations and movement and recommend hydraulic slide technology.
Develop and test targeted accelerated construction user awareness tools.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

Additional time, scope and funding was approved to develop Mi-ABCD software, monitor bridge slides, and develop user awareness tools. Two years of additional research was approved.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

Project will end in fiscal year 2017.

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2015**

PROJECT TITLE: Evaluating the Costs and Benefits of Non-differential Freeway Speed Limits for Trucks and Buses; and the Outcomes of Raising All Vehicle Speed Limits

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Mark Bott

CONTRACT/AUTHORIZATION NO.	2013-0070 Z2	PROJECT START DATE	2/26/2013
PROJECT NO.	121279	COMPLETION DATE (Original)	5/1/2014
OR NO.	OR13-009	COMPLETION DATE (Revised)	7/31/2015
RESEARCH AGENCY	Wayne State University		
PRINCIPAL INVESTIGATOR	Timothy Gates		

BUDGET STATUS

FY 2015 Budget		Total Budget	
Vendor Budget FY 2015	\$26,807.38	Total Vendor Budget	\$300,060.61
MDOT Budget FY 2015	\$0.00	Adjusted MDOT Budget	\$11,902.81
Vendor FY 2015 Expenditures	\$17,935.44	Total Budget	\$311,963.42
MDOT FY 2015 Expenditures	\$3,330.16	Total Expenditures	\$303,091.48
		Total Amount Available	\$8,871.94

PURPOSE AND SCOPE

The purpose of the research is to determine the impacts of raising speed limits:

First, the impact of raising freeway truck and bus speed limits from the present 60 mph to 65 mph or 70 mph. This includes what safety and speed impacts could occur if the speed limits were raised for truck/buses, what impacts occurred when other states raised their speed limits and those states that have a differential speed limit. This research is also to determine the economic impacts to the state and the trucking industry.

Second, the study evaluates the impacts of increasing the overall speed limits on michigan routes (freeway and non-freeway). The analysis includes the economic, environmental, legal, and social outcome of raising the statewide speed limit on select roadways. It includes documenting the processes used by other states to raise the speed limit statewide on their roadway system.

Third and fourth component of this research project were funded by non SPR II funds as noted in the table below. For the third component, the research provided guidance for developing a prioritization strategy for considering speed limit increases on rural, two-lane highways. The traffic safety research literature has shown traffic crashes/injuries/fatalities to be affected by mean (and 85th percentile) speeds, as well as by the variance in speeds. To this end, extensive research has been conducted to assess the impacts of speed limits for limited access facilities (i.e., interstates and other freeways). However, research on non-limited access facilities has been limited. Driver speed selection is strongly affected by roadway characteristics (e.g., horizontal/vertical alignment, shoulder width, presence of passing lanes, access point density, etc.) on these facilities, making it important to better understand the relationships between these characteristics and traffic crashes, injuries, and fatalities. This is particularly true in light of proposed increases to the speed limits of such facilities.

Finally, the fourth component of the research evaluated the I-94 corridor from the Indiana State Line to US-127 South with the goal of recommending potential countermeasures to mitigate corridor crashes.

The following table shows SPR II and Traffic Safety funding for this project:

Funding Source	FY 13-14 Expenditures	FY 15 Expenditures	Total Expenditures	Total Budget
SPR II - JN 121279	\$ 281,825.88	\$ 21,265.60	\$303,091.48	\$311,963.42
Traffic JN 124729	\$ 840.20	\$108,372.20	\$109,212.40	\$109,990.99

FISCAL YEAR 2013 ACCOMPLISHMENTS

Task 1: Literature Review

A state-of-the-art literature review has been conducted. Relevant research literature was identified, summarized, and critically reviewed by graduate students under the supervision of the Principal Investigators (PIs). These summaries are being compiled into a comprehensive topical summary, which will be included as a part of the final report.

Task 2: Survey of State Agencies

Draft survey tools were developed and reviewed by the Research Advisory Panel (RAP). These surveys have been implemented and the results are being used to determine available state-level data, as well as to identify state DOT-sponsored research for inclusion in the literature review.

Task 3: Collect Historical Data: Michigan and Other States

Data collection activities have begun. Historical fatal crash data have been obtained and support data is being requested from various state departments of transportation.

Task 4: Collect Field Speed Data

Preliminary field speed data was collected. Full scale data collection is currently under way in Michigan, Indiana, and Ohio.

FISCAL YEAR 2014 ACCOMPLISHMENTS

Task 1: Literature Review

The revised literature review has been included as a part of the final report.

Task 2: Survey of State Agencies

A survey was implemented to obtain feedback from the trucking industry. The results of these surveys have been summarized in the project report.

Task 3: Collect Historical Data: Michigan and Other States

Data collection activities have been completed. Historical fatal crash data have been obtained and support data was requested from the FMCSA and various state departments of transportation. This includes vehicle miles of travel, speed limit information, and any other pertinent information. The scope was expanded from truck-involved fatality data to more broadly cover fatalities for all vehicle types. The results have been described in the project report.

Task 4: Collect Field Speed Data

Data were ultimately collected at a total of 160 locations for trucks, buses, and passenger vehicles. The methods have been described in the final report.

Task 5: Analyze Speed Data

Preliminary analyses were conducted to determine aggregate statistics (e.g., mean, 85th percentile, variance). More detailed analyses were subsequently conducted to ascertain the impacts of speed limit policies on these speed measures. The results have been described in the project report.

Task 6: Analyze Crash Data

An analysis of national fatalities has been completed. This analysis considered data for all vehicle crashes (passenger vehicle and truck-involved). Separate analyses were conducted for urban and rural interstates in order to ascertain trends between states with different speed limit policies while controlling for other factors, such as vehicle miles traveled. A before-and-after study was performed for crashes on select urban freeways where the speed limit was recently increased from 55 to 65 or 70 mph. The effects of speed limits on non-freeway fatal crashes were assessed based on prior research findings. The methods and results have been described in the project report.

Task 7: Conduct Economic Analysis of Policy Alternatives

The WSU team worked with MDOT to obtain infrastructure costs in order to estimate the potential economic impacts associated with speed limit increases (e.g., alignment and other geometric issues, signage, etc.). Additional economic costs and benefits, including increased fuel consumption costs, travel time benefits, and crash costs (or benefits) were also estimated. Using these estimated economic costs and benefits, the research team estimated the benefit/cost ratio for several potential speed limit increase scenarios at the statewide level. The methods and results have been described in the project report.

Task 8: Present Findings to Leadership

WSU presented the preliminary results to the MDOT Engineering Operation Committee on May 1, 2014. A follow-up presentation of the revised research findings by WSU to the Engineering Operation Committee occurred on July 10, 2014.

Task 9: Final Report

The draft final report was prepared and submitted to MDOT on April 2, 2014. After receiving comments from MDOT, WSU subsequently revised the final report and resubmitted on May 16, 2014. After receiving further comments from MDOT, WSU again revised and resubmitted the report on June 2, 2014. Final comments were received from MDOT and the finalized final report was submitted to MDOT for final acceptance on July 21, 2014.

The following three tasks progressed during fiscal year 14 and were documented in the final report identified in task 9:

Task 10: Identify the Environmental Costs and Benefits

Michigan-specific calibration data has been obtained by MDOT for use in MOVES in order to estimate potential air quality impacts of speed limit policy changes. The University of Akron is assisting in conducting this analysis. MDOT has also assisted in conducting preliminary analyses to estimate potential pavement impacts. The methods and results have been described in the final report.

Task 11: Survey County and Local Road Officials and Police

Draft survey questions were developed and this content was used as part of a focus group activity facilitated by WSU on March 20, 2014.

Task 12: Survey ACEC members and MDOT engineers

Draft survey questions were developed and this content was used as part of a focus group activity facilitated by WSU on March 20, 2014.

The following tasks have been approved within scope revision #3 and will provide expanded assessment of non-freeway roadway speed limit policies.

Task 13: Literature Review for Two-Lane Highways

The research team has identified and reviewed documents pertaining to operations, safety, and policy related to speed limits for non-freeway roadways. A written literature review is in progress and will be included within the final report.

Task 14: Data Collection

WSU has created a comprehensive crash database by merging the Michigan crash databases from 2004 - 2013 with the statewide sufficiency files from the same period. Additional data from outside the sufficiency file are also being added, including horizontal curvature information, school locations, speed reduction zones, and MDOT's driveway count file. Crash prediction models have been developed to determine the significance of the various infrastructure related factors.

Task 15: Field Speed Data Collection

Speed data for passenger vehicles and heavy vehicles were collected using RADAR and LIDAR at 100 locations on MDOT non-freeway roadways during July of 2014. The locations included 26 different roadways spread across 34 counties from all seven MDOT regions. Roadway segments were identified from possible candidate locations for speed limit increases provided to WSU by the PM and RAP. Several speed reduction zone locations were included in addition to the standard locations with posted speed limits of 55 and 65 mph. The data have been compiled into a series of spreadsheets for analysis. Prediction models have been estimated. Preliminary results were presented to MDOT at the RAP meetings on July 28, 2014 and September 16, 2014. This task is complete.

Task 16: Develop Prioritization Process

A process for prioritization of segments to be considered for speed limit increase is under development. This process is based on consideration of numerous safety, operational, and infrastructure performance measures for all MDOT statewide non-freeway roadway segments. The process relies on the data found within the comprehensive crash database referenced in Task 14 and uses performance measure criteria recommended by the MDOT EOC and the MDOT RAP.

Task 17: Review Geometric Features of Select Segments

Segments have been identified and design plans are being collected for review.

Task 18: Assess Need for Infrastructure Investment

No progress to report during the quarter. Prioritization of infrastructure investments will be a primary topic of discussion at the October 14 RAP meeting.

Task 19: Benefit-Cost Analysis of Investment Scenarios

No progress to report during the quarter.

Task 20: Prepare Final Project Report

Literature review is in progress. No additional progress to report.

FISCAL YEAR 2015 ACCOMPLISHMENTS

Task 21: Review Literature on Winter Road Safety Issues and Countermeasures

A comprehensive review of the literature was performed to determine causal effects of winter season crashes and potential countermeasures for such crashes, including treatments across a range of costs. This task is complete

Task 22: Collect Data for I-94 Study Corridor

The research team has collected detailed data for the I-94 corridor between the Indiana State Line and Exit 142 (US-127 S), east of Jackson, MI and assembled the data into a single database. These data included traffic crashes (2012-2014), volumes, roadway geometry, weather, and surrounding land cover. Crash data were obtained from the Michigan State Police crash database. Specifically, the crash data included information on crash type, crash severity, road surface condition, month, weather condition, and other circumstances of concern related to winter crashes. Traffic volumes and various geometric features will be compiled from the MDOT sufficiency file. Other data, including weather, horizontal curvature, vertical elevations, and adjacent land cover were obtained from the appropriate sources. This task is complete.

Task 23: Determine Crash Causal Factors and Identify Crash "Hot Spots" for Study Corridor

Ultimately, the traffic crash, volume, geometry, weather, and land cover data collected in Task 22 were analyzed and hot spots were identified along the corridor. The hot spot maps were presented at a series of meetings with MDOT and MSP within each county along the corridor and provided basis for subsequent field reviews and UD-10 reviews of the primary hot spots to identify the critical characteristics contributing to the overrepresentation of crashes. A detailed statistical analysis of crashes was also performed and was included in the final report. This task is complete.

Task 24: Recommend Potential Countermeasures to Mitigate Corridor Crashes

The research team assisted MDOT and MSP with development of proposed short, medium, and long term countermeasures to treat corridor crashes. These items are documented in the final report.

Task 25: Assist MDOT with Preparation of Presentation Materials and Report Content

A series of maps, graphics, and corresponding data tables have been prepared and was presented at the corridor meetings. Specifically, these items depicted crash occurrence along the corridor, and specifically identified hot spot locations where crashes are overrepresented. The WSU team also assisted MDOT with preparation of the final report for this I-94 corridor safety study and has delivered a draft (and subsequent revised drafts) to MDOT. The research team has presented the study results to the project team and MDOT/MSP leadership. All deliverables have been submitted and accepted by MDOT. This task is complete.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

Tasks 21 to 25 were approved with scope revision #4 and will provide support for the I-94 corridor safety study in southwest and university regions. Timeline for expanded scope is April 1, 2015 - July 31, 2015.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

The research has produced the following three reports:

Evaluating the Impacts of Speed Limit Policy Alternatives (RC-1609A)

Evaluating Outcomes of Raising Speed Limits on High Speed Non-Freeways (RC-1609B)

Evaluation of the I-94 Corridor from the Indiana State Line to US-127 South

All reports are being used to guide MDOT in addressing legislative inquiries in proposed changes in speed limits and operations of major corridors.

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2015**

PROJECT TITLE: Preparation of Implementation of the Mechanistic-Empirical Pavement Design Guide in Michigan

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Michael Eacker

CONTRACT/AUTHORIZATION NO.	2010-0294 Z5	PROJECT START DATE	10/1/2011
PROJECT NO.	121281	COMPLETION DATE (Original)	9/30/2014
OR NO.	OR10-022	COMPLETION DATE (Revised)	10/31/2014
RESEARCH AGENCY	Michigan State University		
PRINCIPAL INVESTIGATOR	Neeraj Buch		

BUDGET STATUS

FY 2015 Budget		Total Budget	
Vendor Budget FY 2015	\$12,267.84	Total Vendor Budget	\$400,000.00
MDOT Budget FY 2015	\$1,000.00	Adjusted MDOT Budget	\$27,453.56
Vendor FY 2015 Expenditures	\$5,766.15	Total Budget	\$427,453.56
MDOT FY 2015 Expenditures	\$12,881.30	Total Expenditures	\$420,951.87
		Total Amount Available	\$6,501.69

PURPOSE AND SCOPE

Part 1: HMA Mixture Characterization

- Review what HMA properties are currently being tested by MDOT and which ones need to be considered for future testing in order to appropriately characterize MDOT HMA mixes for the M-E PDG.
- Test HMA samples collected from MDOT construction projects for the inputs necessary in the M-E PDG. The principal investigator should provide a statistically based test matrix that will cover all of Michigan's geographic regions as well as a majority of the mixes identified in the HMA Mixture Selection Guidelines (Section 6.03.09 of the Road Design Manual available on the MDOT Web site). A number of mixes have already been tested under the MDOT research project "Development of Specification for the Superpave Simple Performance Tests (SPT)". The researcher is expected to utilize information from this recently completed project.
- Provide recommendations on the appropriate values and input levels for HMA mixtures for use in the M-E PDG pavement designs.
- Identify future needs, such as necessary design model calibrations, possible focus of other research, methods for verification of as-built properties, etc., that would be beneficial to MDOT in improving its design practice for new, reconstruct, and rehabilitation pavements.
- Recommend what types of changes in the HMA should trigger new characterization testing.

Part 2: Evaluation of Rehabilitation Fixes

- Review the sensitivity analysis completed under MDOT research project "Evaluation of the 1-37A Design Process for New and Rehabilitated JPCP and HMA Pavements". Identify the most critical/sensitive input parameters for use in the M-E PDG for pavement rehabilitation designs. Recommend any currently available methods (such as tests, procedures, or equipment) to more accurately determine input values for those inputs that are highly sensitive.
- Provide technical criteria for selecting pavement sections to consider for predicted/observed performance comparisons. This should be a statistically based matrix based on geographic regions, traffic levels, pavement type, fix type, etc.
- Perform comparisons between the M-EPDG predicted pavement performance and the observed performance of selected pavement sections.
- Analyze the performance comparisons and provide recommendations as to whether or not M-E PDG should be used by MDOT for rehabilitation designs. Include, if applicable, any limitations of use for rehabilitation that the research results would suggest.
- Provide recommendations on the appropriate values and input levels for all critical/sensitive parameters for use in M-E PDG pavement rehabilitation designs.
- Identify future needs, such as necessary design model calibrations, possible focus of other research, etc. that would be beneficial to MDOT in improving its design practice for pavement rehabilitation.

Part 3: Calibration and Validation

- Determine the best method for calibration.
- Evaluate the readiness of Michigan's Pavement Management System (PMS) to provide the necessary data for M-E PDG calibration and validation. Identify deficiencies and recommend course of action to remedy.
- Design a statistically based matrix for comparison of predicted with observed performance. The matrix should be statistically based on geographic regions, traffic levels, pavement type, fix type, etc.
- Compare predicted performance from M-E PDG to observed performance of in-service pavements.
- Adjust performance models so that predicted performance more closely matches observed, thereby reducing error and bias.
- Validate the model adjustments on an independent set of in-service pavements.

7. Recommend a plan for future calibration and validation to ensure that the performance models are continuously improved, including any database needs.

FISCAL YEAR 2012 ACCOMPLISHMENTS

Part1, HMA Mixture Characterization

64 HMA mixtures from MDOT construction projects were delivered to MSU. Dynamic modulus testing was conducted on 57 of them and Indirect Tensile Strength testing was conducted on 18. In addition, samples of 55 asphalt cement binders from those mixes were also delivered to MSU. Dynamic shear modulus has been conducted on 40 of them using the 25 mm plate and 19 using the 8 mm plate.

Using the test data from the HMA mixes and binder samples, the Witczak equation for predicting dynamic modulus that is in the MEPDG pavement design software, was calibrated so that there is better agreement between actual test data and predicted results. This will improve predicted values for HMA mixes that were not tested.

MSU began developing a software package that will allow pavement designers to select the appropriate inputs for HMA layers when designing an asphalt pavement. The software will allow the user to select the HMA mix according to the appropriate Region and mix type. They can then export the input files and then import them into MEPDG or DARWin-ME. The results in the export files are based on the test results of the mixes and binders sampled from MDOT projects.

Part 2, Evaluation of Rehabilitation Fixes

A sensitivity analysis of inputs specific to rehabilitation fixes was conducted. This builds on the sensitivity study conducted for new/reconstruct designs under a previous research project. Inputs were changed one at a time to determine which ones affect the output the most. These sensitive inputs were then subjected to a more detailed sensitivity analysis that looked at interactions between multiple inputs. Last, a global sensitivity analysis was started which will look at changing all of the sensitive inputs over the entire range of potential values. 3-dimensional surfaces can be plotted from this analysis that allow a visual analysis of how much these inputs affect the output and over what range this occurs.

A validation of predictions from the MEPDG software was also started. This involves comparing distresses observed from in-service pavements with predicted distresses from MEPDG. 6 to 10 projects from for each of the following fixes were identified to be used in this work:

- Unbonded concrete overlays
- Rubblized concrete with HMA resurfacing
- HMA over existing concrete
- HMA over existing composite
- ASCRL overlays
- Crush and shape with HMA resurfacing

HMA over existing HMA projects have not been chosen yet.

FISCAL YEAR 2013 ACCOMPLISHMENTS

Part1, HMA Mixture Characterization

The final report for Part 1 was accepted and published by MDOT.

An updated version of the DynaMod software (developed as a part of this research project) was provided by Michigan State University (MSU) and has been under evaluation by MDOT.

Part 2, Evaluation of Rehabilitation Fixes

The global sensitivity analysis was completed and the results were summarized into a useable set of charts and tables for pavement designers. This completed the full range of sensitivity analyses. The verification of the predictive models for rehabilitation designs was completed. The conclusion from the verification was that the models require local calibration to improve the accuracy of the predictions for Michigan pavements.

The final report for Part 2 was accepted and published by MDOT.

Part 3, Calibration and Validation

Part 3 was started with a literature search of on-going or completed calibration work by other states. 145 new and reconstruct projects currently in-service in Michigan were identified to be included in the calibration process. The 32 rehabilitation projects from Part 2 of the study will also be included in the calibration. Project records for many of these identified new/reconstruct projects were searched to look for materials inputs required by the ME software. Because the project records for the rehabilitation projects were searched during Part 2 of the study, the calibration process was started with those project types. It is intended that rehabilitation and new/reconstruct projects will be calibrated separately and will result in a separate set of calibration coefficients for each.

Michigan State University requested transverse laser profiles that are taken by MDOT's Pavement Management data vendor. These profiles were requested to help calibrate the rutting predictions of the ME software.

FISCAL YEAR 2014 ACCOMPLISHMENTS

Calibration of the predictive models in the ME software was completed. The calibration was conducted for both reconstruct designs as well as rehabilitation designs. Overall, the local calibration using Michigan pavement management data improved the predictive capabilities over the default (national) calibration. In addition, standard error for each model (which is used for reliability

calculations) was established. The draft final report was delivered on July 31, 2014. An agenda for a technology transfer class was drafted.

FISCAL YEAR 2015 ACCOMPLISHMENTS

The final report was accepted and published.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

10/9/2013 – The due date of this project was extended to allow additional time for the analysis of transverse pavement profile data to improve the rutting predictions of the ME software. The project was also delayed due to the time necessary for MDOT to search as-constructed records for use in calibrating the performance models.

7/10/2014 – A one month extension was granted to allow additional time to review and edit the draft final report.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

With the delivery of the calibration coefficients, the following items are now being implemented:

- HMA test results from Part 1 are being used in the ME design software. For the mix/binder combinations that weren't tested, the DynaMOD software developed under this project is being used to provide predicted HMA properties.
 - The sensitivity results from Part 2 are being used to focus our efforts as we decide which rehabilitation fix types will be designed with ME.
 - The calibration factors provided under Part 3 were adopted and will be used when ME is used for any official pavement designs.
 - Description of how to utilize the HMA test/predicted results from Part 1, and the calibration results from Part 3 were included in the MDOT ME User Guide for Mechanistic-Empirical Pavement Design – Interim Edition. This user guide was approved by the Engineering Operations Committee for publication as an MDOT manual in March of 2015. Information from Part 2 will be incorporated in a future edition.
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**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2015**

PROJECT TITLE: Predictive Modeling of Freezing and Thawing of Frost-Susceptible Soils

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Richard Endres

CONTRACT/AUTHORIZATION NO.	2010-0294 Z9		PROJECT START DATE	10/1/2012
PROJECT NO.	121282		COMPLETION DATE (Original)	9/30/2014
OR NO.	OR10-047		COMPLETION DATE (Revised)	9/30/2015
RESEARCH AGENCY	Michigan State University			
PRINCIPAL INVESTIGATOR	Gilbert Baladi			

BUDGET STATUS

FY 2015 Budget		Total Budget	
Vendor Budget FY 2015	\$14,917.95	Total Vendor Budget	\$99,453.00
MDOT Budget FY 2015	\$5,000.00	Adjusted MDOT Budget	\$84,990.19
Vendor FY 2015 Expenditures	\$24,054.11	Total Budget	\$184,443.19
MDOT FY 2015 Expenditures	\$37,752.17	Total Expenditures	\$184,360.15
		Total Amount Available	\$83.04

PURPOSE AND SCOPE

MDOT has a large investment in retaining walls, many of which are located in the metro Detroit area. Poor quality backfill soils have caused drainage problems behind many wall sections. In addition to the increased hydrostatic pressure on the wall, freezing and thawing of frost susceptible soils may impose additional forces on these structures.

Furthermore, many grade separation bridges are founded on spread footings where under clearance requirements have increased since initial construction. Design engineers often ask to remove a portion of the soil cover over the spread footings to facilitate lowering the pavement grade beneath the structure. Removing soil cover results in less protection against frost heave.

Design engineers lack tools for prediction of frost depth and design of insulation countermeasures. Underprediction of frost impacts could cause failure of retaining walls and spread footings. Over prediction could cause unnecessary removal and replacement of existing bridge foundations when lower underclearance is needed. Better methods are needed to predict frost depth and design countermeasures.

FISCAL YEAR 2013 ACCOMPLISHMENTS

- Literature Review- 100% complete.
- Developed heat transfer frost depth model- 100% complete.
- Completed validation of the frost depth model.
- Begin development of a heave and earth pressure model.
- Soil samples from the U.P. were delivered to MSU during the 2013 summer.
- Second batch of soil samples at MDOT's soil laboratory. To be delivered to MSU next quarter.
- Held a project progress meeting on February 5, 2013. 1) Discussed literature review performed; preliminary validation of numerical model UNSAT-H; soils thermal properties measurements, using the thermal conductivity apparatus; review of MDOT field data collected at instrumented sites. 2) Demonstrated soil thermal measurements and instrumentation associated with soil thermal testing (temperature chamber, dataloggers, hydraulic sensors, etc.).
- May 3, 2013 presented draft results from heat flow simulation model.

FISCAL YEAR 2014 ACCOMPLISHMENTS

- Complete development of the heave and earth pressure model.
- Complete validation of the heave and earth pressure model.
- Couple the heat transfer model with prediction of earth pressure from frost heave.
- Validate models by applying to MDOT field data from selective sites.
- Training workshop.
- Spotlight issue
- Final Report; including an executive summary with implementation action plan.

FISCAL YEAR 2015 ACCOMPLISHMENTS

- Reviewed and updated Final Report incorporating comments from Research Advisory Panel.
- Conducted Implementation training session with region soils engineers and Lansing based geotechnical and pavements staff

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

- Extension of project completion date to June 30, 2015-Approved 5/12/2015 (Allow panel sufficient time for review of final report)
- Extension of project completion date to June 30, 2015-Approved Aug of 2015 (Allow panel sufficient time to train MDOT staff outside of peak construction season)

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

- Recommend that MDOT map and study current process used to implement Seasonal Load Restrictions (SLR).
 - Recommend that MDOT review current SLR process with respect to this research, and SLR processes used in Minnesota and Wisconsin.
 - Recommend MDOT consider SLR policy which incorporates Road Weather Information System (RWIS)
 - Recommend MDOT continue monitoring research outcomes of Aurora SPR-3(042) Project 2012-05.
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**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2015**

PROJECT TITLE: Evaluating Prestressing Strands and Post-Tensioning Cable in Concrete Structures using Nondestructive Evaluation (NDE) methods including Joint Shear Wave Analysis				
FUNDING SOURCE: <input checked="" type="checkbox"/> SPR, Part II <input type="checkbox"/> OTHER (PLEASE EXPLAIN)				
PROJECT MANAGER: Rebecca Curtis				
CONTRACT/AUTHORIZATION NO.	2010-0293 Z4		PROJECT START DATE	10/1/2012
PROJECT NO.	121285		COMPLETION DATE (Original)	9/30/2014
OR NO.	OR10-038		COMPLETION DATE (Revised)	11/25/2015
RESEARCH AGENCY	Lawrence Technological University			
PRINCIPAL INVESTIGATOR	Elin Jensen			
BUDGET STATUS				
FY 2015 Budget			Total Budget	
Vendor Budget FY 2015	\$249,999.97		Total Vendor Budget	\$249,999.97
MDOT Budget FY 2015	\$960.00		Adjusted MDOT Budget	\$14,495.45
Vendor FY 2015 Expenditures	\$41,140.97		Total Budget	\$264,495.42
MDOT FY 2015 Expenditures	\$0.00		Total Expenditures	\$263,535.42
			Total Amount Available	\$960.00
PURPOSE AND SCOPE				
<p>Prestressed beams are commonly used in highway bridge construction, and segmental post-tensioned bridges are becoming more widely used for medium and long span bridge construction. These types of structures rely heavily on steel prestressing strands and post tensioning strands for strength and durability. Additionally, it is very important during the construction of these bridges to implement a good quality control plan to ensure the proper placement of the strands and ensure ducts are fully grouted in accordance with the design. Methods to determine the overall condition of these strands are critical to verify the overall integrity and safety of these structures. Because the strands are embedded in concrete and often the area is complex and congested, non-destructive evaluation methods are needed to evaluate the condition and proper placement of the strands.</p>				
The following table shows SPR II and Bridge funding for this project:				
Funding Source	FY 13-14 Expenditures	FY 15 Expenditures	Total Expenditures	Total Budget
SPR II	\$ 222,394.42	\$ 41,140.97	\$263,535.39	\$264,495.42
Bridge	\$ 0	\$ 0	\$25,000.00	\$25,000.00
FISCAL YEAR 2013 ACCOMPLISHMENTS				
<ul style="list-style-type: none"> • Literature Report was completed • Salvaged box beams were obtained • Preliminary analysis of MIRA results for Group I laboratory box beams and MDOT salvaged beam was conducted • Testing of MDOT salvaged beam using the canin (corrosion monitoring device), profometer and hammer was partially completed. • Preparation of specimen II began 				
FISCAL YEAR 2014 ACCOMPLISHMENTS				
Field testing has been completed on Bridge carrying I-131 SB over Muskegon river and I-96 EB over Canal Rd in Dimondale. The final laboratory specimens have been constructed. Data analysis progressed concurrently with field and laboratory work.				
FISCAL YEAR 2015 ACCOMPLISHMENTS				
Laboratory and field testing was finalized in 2015. The draft report was submitted and reviewed.				
FISCAL YEAR 2016 PROPOSED ACTIVITES				
The Final Report and Implementation Plan will be submitted in FY 2016.				
JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))				
Project timeframe was extended to allow for additional field investigation.				
SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)				
Project will be completed in FY 2016.				

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2015**

PROJECT TITLE: Remote Monitoring of Fatigue Sensitive Details on Bridges

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Steve Kahl

CONTRACT/AUTHORIZATION NO.	2010-0297 Z7	PROJECT START DATE	10/1/2012
PROJECT NO.	121288	COMPLETION DATE (Original)	9/30/2014
OR NO.	OR10-041	COMPLETION DATE (Revised)	3/30/2015
RESEARCH AGENCY	Western Michigan University		
PRINCIPAL INVESTIGATOR	Upul Attanayake		

BUDGET STATUS

FY 2015 Budget		Total Budget	
Vendor Budget FY 2015	\$58,727.54	Total Vendor Budget	\$249,997.83
MDOT Budget FY 2015	\$5,780.00	Adjusted MDOT Budget	\$9,709.97
Vendor FY 2015 Expenditures	\$49,677.28	Total Budget	\$259,707.80
MDOT FY 2015 Expenditures	\$2,324.96	Total Expenditures	\$250,657.54
		Total Amount Available	\$9,050.26

PURPOSE AND SCOPE

MDOT performs inspections of over 200 bridges with fatigue sensitive details. AASHTO LRFD (2010) classifies fatigue sensitive details into two groups: (1) load-induced fatigue and (2) distortion-induced fatigue. Identification of details that are prone to load-induced fatigue is straight forward. The distortion-induced fatigue can result from many different causes; hence, these details need to be identified through inspection and analysis. Further, the distortion-induced fatigue details need to be inspected in detail or monitored to gather real-time data. Hence, MDOT's needs are twofold. The first is to monitor the stress state of such details to calculate the remaining fatigue life so that the inspection, monitoring, or maintenance can be scheduled as needed. The second is to detect fatigue crack initiation and monitor fatigue crack growth to schedule maintenance activities. Both these needs require monitoring the structures as needed. Hence, a portable data logger is required. This process involves installing sensors at multiple bridges and moving the data logger from bridge to bridge, as needed, to monitor stresses, detect cracks, and monitor crack growth. Therefore, the structural health monitoring (SHM) system should be simple enough for an inspector with a minimal training to operate and maintain, while it is robust enough to provide necessary data, data processing capability, and include other tools needed for bridge management personnel.

The SHM system that will be developed through this research will help remote monitoring of fatigue sensitive details in steel bridges to (1) alert the bridge managers when a crack is initiated so that the crack growth is monitored to schedule maintenance activities, (2) monitor stress flow to calculate remaining fatigue life, evaluate maintenance effectiveness, improve design details, and understand the structural response under permit loads or during maintenance activities.

FISCAL YEAR 2013 ACCOMPLISHMENTS

Task 1: State-of-the-Art Literature Review

Structural modeling techniques for distortion-induced fatigue modeling were reviewed.
Fatigue life calculation models are being reviewed.

Task 2: Bridge Structural Analysis

Bridge model was updated using data collected during field inspection.

Studies are being conducted to identify the best modeling options for distortion-induced fatigue details as part of the global structure.

Task 3: SHM System Development

A SHM system was developed, purchased, and installed.

Task 4: SHM System Installation, Calibration, and Data Analysis

The SHM system was installed.

Acoustic emission (AE) sensor configuration was calibrated using the standard procedures for the detail.

Task 6: Reporting

All quarterly reports and a synthesis report were submitted.

FISCAL YEAR 2014 ACCOMPLISHMENTS

Task 1: State-of-the-Art Literature Review

Reviewed literature on the latest fatigue life calculation models.

Reviewed literature on **acoustic emission** data processing techniques.

Task 2: Bridge Structural Analysis

Evaluated different finite element modeling and data processing techniques for hot spot and/or notch stress calculation. Implemented the concepts on a full bridge model that represents the I-94 EB over Puetz road bridge. Hot spot stress under a fatigue truck was calculated in order to determine the fatigue life of a welded detail.

Task 4: SHM System Installation, Calibration, and Data Analysis

Strain, acoustic emission, and power supply data were recorded. Data analysis techniques were evaluated to develop meaningful results for bridge management decision-making.

Task 6: Reporting

Interim annual report for FY13 was completed. 8th quarterly report submitted.

FISCAL YEAR 2015 ACCOMPLISHMENTS

Final report published 12-30-14. Training session took place at WMU campus on 6-10-15 for handoff of AE monitoring system and theory of operation.

FISCAL YEAR 2016 PROPOSED ACTIVITIES

None.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

Time extension only - Coordination and design issues with solar power hookup and cold temperatures resulted in power demand exceeding capacity of system to recharge. This power issue at a remote location delayed operation of system such that one year monitoring was not possible, but with extension several months' data collection could be realized and incorporated into project results. Requested extension of project from 9/30/14 to 3/30/15. Approved 6-23-14

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

1. Implement AE data interpretation capability demonstrated during this study in an on-line system to provide reliable input with minimal interpretation requirements for inspection based maintenance management.
 2. Develop a fatigue cracking signal characteristic database using typical steel and welds used in Michigan bridges.
 3. Install the AE monitoring system with the on-line signal classification system at a half dozen sites to gather data from typical fatigue-sensitive details to identify optimal settings and to optimize other deployment issues.
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**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2015**

PROJECT TITLE: Study of High Tension Cable Barrier on Michigan Roadways

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Carlos Torres

CONTRACT/AUTHORIZATION NO.	2010-0298 Z3	PROJECT START DATE	10/1/2011
PROJECT NO.	121289	COMPLETION DATE (Original)	12/31/2014
OR NO.	OR10-036	COMPLETION DATE (Revised)	
RESEARCH AGENCY	Wayne State University		
PRINCIPAL INVESTIGATOR	Peter Savolainen		

BUDGET STATUS

FY 2015 Budget		Total Budget	
Vendor Budget FY 2015	\$2,377.32	Total Vendor Budget	\$223,895.17
MDOT Budget FY 2015	\$0.00	Adjusted MDOT Budget	\$15,494.52
Vendor FY 2015 Expenditures	\$0.00	Total Budget	\$236,435.73
MDOT FY 2015 Expenditures	\$2,953.96	Total Expenditures	\$237,012.37
		Total Amount Available	\$0.00

PURPOSE AND SCOPE

The purpose and scope of this project includes the following:

- Determine the average level of effectiveness of high tension cable barrier in reducing median crossover crashes (e.g., 95% effective at capturing/redirecting impacting vehicles) for all cable barrier installations in Michigan.
- Estimate the overall life-cycle cost of high tension cable barrier in Michigan.
- Perform a cost-benefit analysis for each high tension cable barrier installation in Michigan and determine if the benefits of the installation outweigh the costs.
- Propose guidelines for installing high tension cable barrier. Cable barrier guidelines should be based on specific characteristics, such as crash frequency, traffic volumes, roadway location, etc. Cable barrier guidelines recommended as part of this study must be clearly defined and must specify which characteristic(s) they are based on.
- Explore the effects of cable barrier placement. Specifically, compare the crash history of cable barrier installations in Michigan and determine if there is a relationship between the number of cable barrier impacts and the lateral offset between the cable barrier and the nearest traveled lane.
- Explore the effects of regional weather patterns in Michigan and the frequency of cable barrier impacts. Specifically, identify cable barrier installations in areas that traditionally have specific weather patterns (e.g., "snow belt" areas), compare the frequency of cable barrier impacts in areas with specific patterns to cable barrier installations in other regions of Michigan, and determine if there is a relationship between the frequency of cable barrier impacts and regional weather patterns.
- Explore the effects of traffic volumes and the frequency of cable barrier impacts. Specifically, compare the crash history of cable barrier installations in Michigan based on roadway traffic volumes and determine if there is a relationship between the number of cable barrier impacts and traffic volume.
- Compare the level of effectiveness of comparable four-cable and three-cable systems. MDOT has at least two cable barrier installations where the barrier has four individual cables. Both of these four-cable systems meet National Cooperative Highway Research Program Report 350, Test Level 3 (NCHRP 350, TL-3) and are approved for use on 1:4 slopes. MDOT also has several cable barrier installations which only have three cables, and these cable systems also meet NCHRP 350, TL-3 and are approved for use on 1:4 slopes. Determine the number of cable barrier impacts on similar installations (i.e., three-cable versus four-cable), determine the number of crashes where the impacting vehicle breached the cable system, and determine if four-cable systems have resulted in fewer breaches compared to three-cable systems.
- Determine the percentage of cable barrier impacts on Michigan roadways involving motorcycles, and determine the crash severity of motorcyclists impacting cable barrier. Determine the percentage of motorcycle crashes on Michigan roadways where the motorcyclist impacted other barrier types (i.e., traditional guardrail, concrete barrier) and compare the frequency and severity of those crashes to motorcycle crashes involving high tension cable barrier.

10. Estimate the number of vehicular impacts involving traditional beam guardrail and permanent concrete barrier installations in Michigan and compare this to the number of impacts involving high tension cable barrier. Determine if high tension cable barrier is more susceptible to vehicular impacts compared to other barrier types (i.e., traditional beam guardrail and concrete barrier).
11. Create marketing tools and techniques that could be used to promote the use of high tension cable barrier to the general public, and help give cable barrier a positive image.
12. Explore the relationship between cable barrier installation and the ability of official vehicles to cross the freeway median. Median barrier installation closes all unofficial median crossovers and forces all official vehicles (e.g., emergency first responders, law enforcement, maintenance vehicles, etc.) to use official median crossovers or interchanges to change bounds. Therefore, determine what effects cable barrier installation has had on the day-to-day operations of emergency first responders, law enforcement, and maintenance. Also, determine if cable barrier installation has had an adverse impact on the day-to-day operations of emergency first responders, law enforcement, and maintenance. Examine MDOT's current median crossover guidelines as it pertains to crossover spacing. If deemed appropriate, suggest modifications to the median crossover spacing guidelines.

FISCAL YEAR 2012 ACCOMPLISHMENTS

Task 1: High Tension Cable Barrier Literature Review

A detailed state-of-the-art literature review has been conducted. Relevant research literature has been identified and each document has been summarized and critically reviewed by Wayne State University graduate student staff under the supervision of the Principal Investigators (PIs). These summaries have been compiled into a comprehensive topical summary, which will be included as a part of the final report.

Task 2: Crash Data Collection

Details of all completed and planned cable barrier installations have been obtained from MDOT. The associated plans and proposals have been used by graduate student staff to determine the limits of each installation. This information has been entered into a database that was used to construct a geographic information system (GIS) map. This map provides details of the installation limits for each cable barrier section, the side(s) of the road on which the barriers are located, and the locations where turnarounds are provided. The Project Manager (PM) has also provided details of recent cable barrier installations that have occurred, as well as sites where installation is scheduled in the near future. Using this location information, data for crashes along such segments have been obtained under the direction of the PIs. MDOT has also provided the research team with location information for all turnaround locations, including non-cable barrier locations.

Task 3: Crash Data Analysis

The research team has reviewed UD-10 crash report forms for crashes resulting in K and A injuries at select locations over the period from 2002 to 2006 in order to ensure consistency between Wayne State University's (WSU's) methods and those utilized by MDOT during a prior analysis. Subsequently, the UD-10 crash report forms were collected for all crashes that occurred on the freeway segments where cable barrier has been installed. As a part of this review, the research team is identifying all target (i.e., median-related) crashes that occurred up to five years prior to cable barrier installation. In addition to the crashes along the cable barrier sections, other non-cable barrier sections along the same freeways are being identified in order to compare crash trends between types of median treatments.

Task 4: In-Depth Crash Investigation

The research team has met with the Michigan State Police (MSP) to discuss a proposed methodology for in-depth crash investigations to be conducted by traffic crash reconstructionist. Given current resource constraints within MSP, the research team is currently collecting more detailed data from crash report forms, as well as supplementary information that is available through design plans, aerial photography, and other data sources. The data that is being collected includes cross-slope information, details of the horizontal and vertical alignment, and information related to the damage sustained during specific crashes as can be determined by available maintenance and repair data.

Task 5: Collection of Maintenance, Repair, and Cost Data

Construction cost data has been obtained and contact with MDOT has been established with respect to obtaining maintenance, repair, and other data. The research team will begin review of these data in coordination with MDOT.

Task 6: Conduct Survey of Emergency Service Personnel

A draft survey tool was developed to obtain feedback as to the impacts of cable median barriers on emergency response. MDOT reviewed and approved the proposed survey tool. The survey was implemented and completed during fiscal year 2013.

FISCAL YEAR 2013 ACCOMPLISHMENTS

1. Continued crash data collection, review, and analysis.
2. Continued collection of additional supplementary data for the purposes of the crash analysis.
3. Continued collecting maintenance and repair cost data.
4. Implemented and completed survey tool for emergency response personnel.
5. Conducted survey of emergency response personnel.

FISCAL YEAR 2014 ACCOMPLISHMENTS

1. Completed crash data collection, review, and analysis.
 2. Completed collection of maintenance and repair cost data.
 3. Analyzed all data collected and completed the objectives of the research study.
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4. Created marketing tools and techniques that could be used to promote the use of high tension cable barrier to the general public, and help give cable barrier a positive image.
 5. Prepared a draft report and draft versions of the other deliverables for this research study and submitted the report and deliverables to MDOT (Research Advisory Panel members) for review and approval.

FISCAL YEAR 2015 ACCOMPLISHMENTS

Finalized report and other deliverables for this research study and submitted the final report and deliverables to MDOT.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

Original completion date was revised from 9/30/14 to 12/31/14 to give WSU more time to make necessary revisions to the draft report and complete the deliverables.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

The cable barrier report developed as a result of this project gave MDOT a better understanding of the benefits and limitations of cable barrier installation, and also provided a better insight on cable barrier performance on Michigan roadways.

MDOT will utilize the findings from the report on future cable barrier projects to make improvements in determining whether cable barrier installation is economically feasible. Furthermore, MDOT staff will have the ability to take factors such as the barrier's lateral offset from the roadway, annual snowfall, and roadway curvature into consideration when performing cost analyses. As a result, MDOT staff will be able to make better decisions when considering cable barrier installation.

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2015**

PROJECT TITLE: Evaluation of Non-Freeway Rumble Strips - Phase II

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Mary Bramble

CONTRACT/AUTHORIZATION NO.	2013-0070 Z1	PROJECT START DATE	2/8/2013
PROJECT NO.	121347	COMPLETION DATE (Original)	9/30/2014
OR NO.	OR13-007	COMPLETION DATE (Revised)	3/31/2015
RESEARCH AGENCY	Wayne State University		
PRINCIPAL INVESTIGATOR	Tapan Datta		

BUDGET STATUS

FY 2015 Budget		Total Budget	
Vendor Budget FY 2015	\$40,662.81	Total Vendor Budget	\$249,999.90
MDOT Budget FY 2015	\$7,000.00	Adjusted MDOT Budget	\$0.00
Vendor FY 2015 Expenditures	\$40,396.84	Total Budget	\$249,999.90
MDOT FY 2015 Expenditures	\$0.00	Total Expenditures	\$249,733.93
		Total Amount Available	\$265.97

PURPOSE AND SCOPE

There were 1,084 fatalities, 7,485 severe injuries, and a total of 324,174 reported crashes in Michigan in 2007. Lane departure crashes play a large role in the number of crashes and fatalities in Michigan as well as nationwide. To combat this, MDOT has taken on a new, innovative approach to safety by installing centerline and shoulder non-freeway rumble strips across the state in fiscal year 2008, 2009, and 2010, in order to lower fatalities and crashes caused by drivers leaving their lane. MDOT's centerline and shoulder non-freeway rumble strip implementation cost approximately \$9 Million over this three year period.

This research is the second phase of a research project related to this rumble strip installation. Three years of 'after' crash data will be collected and analyzed, drivers and residents will be surveyed as to their acceptance of the rumble strips, MDOT pavement and maintenance personnel will be surveyed as to their experiences and opinions about the installation and finally information from Phase I and Phase II will be used to develop a 'How-To' initiate a rumble strip program document.

FISCAL YEAR 2013 ACCOMPLISHMENTS

Task 1: Literature Review

A detailed literature review was completed as a part of the Phase I study. New literature is being reviewed and will be incorporated into an updated state of the art literature review, as well as any subsequent literature made available in the duration of the project.

Task 2: Three Years of "After" Crash Data Collection

Candidate "after" period crash data has been identified through the year 2012. This process matched that of the Phase I study "before" period data. The "after" period crash data identification will continue when 2013 crash data becomes available.

Task 3: Pavement Design and Maintenance Personnel's Impression Survey

A survey was prepared and distributed to MDOT personnel. Responses by November 15, 2013 were requested.

Task 4: Identify and Review "After" Target Crashes

Based on the candidate crashes identified as a part of task 2, "after" period target crashes are currently being identified by the criteria developed as part of the Phase I study. This process will continue once year 2013 crash data becomes available.

Task 5: Identify Focus Group and Conduct Meeting

MDOT has provided a list of potential candidates for the focus group.

Task 6: Perform Crash Analysis

No progress reported this year.

Task 7: Develop and Perform Public Impression/Opinion Survey

A survey was prepared and distributed on MDOT social media. The survey is open until November 15, 2013.

Task 8: Development of Centerline Rumble Strip System-wide Implementation Guideline

No progress reported this year.

FISCAL YEAR 2014 ACCOMPLISHMENTS

Task 1: Literature Review

New literature has been reviewed and will be incorporated into an updated state-of-the-art literature review.

Task 2: Three Years of “After” Crash Data Collection

All candidate “after” period crash data has been identified, through 2013. This process matched that of the Phase I study “before” period data.

Task 3: Pavement Design and Maintenance Personnel’s Impression Survey

A survey was distributed to MDOT personnel. Survey results were presented in the focus group meeting.

Task 4: Identify and Review “After” Target Crashes

Based on the candidate crashes identified as a part of Task 2, “after” period target crashes have been identified via the criteria developed as part of the Phase I study.

Task 5: Identify Focus Group and Conduct Meeting

Focus group meeting was conducted on 9/11/2014.

Task 6: Perform Crash Analysis

In-depth analysis of the crash data is currently being performed now that crash data collection and identification is complete. Preliminary results were provided in a draft technical memo at the end of August.

Task 7: Develop and Perform Public Impression/Opinion Survey

A survey was distributed via MDOT’s public relations department. Survey results were presented in the focus group meeting.

Task 8: Development of Centerline Rumble Strip System-wide Implementation Guideline

Initial input from several local agencies was received at the focus group meeting. Guideline development is continuing.

FISCAL YEAR 2015 ACCOMPLISHMENTS

Task 1: Literature Review

New literature has been reviewed and incorporated into an updated state-of-the-art literature review.

Task 2: Three Years of “After” Crash Data Collection

Methods for collecting “after” period crash data were documented, following the same process used to collect “before” data during the Phase I study.

Task 3: Pavement Design and Maintenance Personnel’s Impression Survey

Survey results were included in the final report.

Task 4: Identify and Review “After” Target Crashes

A final review and some revisions of the candidate crashes was completed. Methods for identifying candidate crashes were documented in the final report.

Task 5: Identify Focus Group and Conduct Meeting

A focus group meeting was conducted on 9/11/2014. Meeting input was used to shape implementation guidelines.

Task 6: Perform Crash Analysis

In-depth analysis of the crash data was performed. Preliminary results were provided in a draft technical memo. Final results were published in the final report.

Task 7: Develop and Perform Public Impression/Opinion Survey

A survey was distributed via MDOT’s public relations department. Survey results were presented in the focus group meeting and included in the final report.

Task 8: Development of Centerline Rumble Strip System-wide Implementation Guideline

Initial input from several local agencies was received at the focus group meeting. A guideline document was completed.

All deliverables completed and delivered.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

No-cost time extension approved in June 2014. Additional time was needed to review crash data from the most recent year. There was also a delay in receiving the traffic volume data needed, which delayed the analysis. Additionally the focus group meeting needed to be delayed until more attendees were available.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

Rumble strips, including the centerline rumble strips that were the focus of the research, are already standard features on high-speed rural trunkline roads. The research provided compelling evidence that rumble strips are a highly effective and cost efficient safety feature that MDOT will continue to install on its roadways. With the results of the crash analysis and the development of the implementation guidelines document, the intent is to reach out to other state agencies and the local agencies within Michigan to promote rumble strip use and help agencies with the implementation of rumble strips on their roadway systems.

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2015**

PROJECT TITLE: Evaluating the use of Unmanned Aerial Vehicle (UAVs) for Transportation Purposes

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Steve Cook

CONTRACT/AUTHORIZATION NO.	2013-0067 Z1	PROJECT START DATE	5/22/2013
PROJECT NO.	121348	COMPLETION DATE (Original)	11/30/2014
OR NO.	OR13-008	COMPLETION DATE (Revised)	4/30/2015
RESEARCH AGENCY	Michigan Technological University		
PRINCIPAL INVESTIGATOR	Colin Brooks		

BUDGET STATUS

FY 2015 Budget		Total Budget	
Vendor Budget FY 2015	\$10,120.10	Total Vendor Budget	\$269,123.91
MDOT Budget FY 2015	\$1,200.00	Revised MDOT Budget	\$0.00
Vendor FY 2015 Expenditures	\$34,483.66	Total Budget	\$269,123.91
MDOT FY 2015 Expenditures	\$0.00	Total Expenditures	\$269,123.92
		Total Amount Available	\$0.00

PURPOSE AND SCOPE

- Develop UAV technology that will provide visual inspection capabilities for pump stations, roadway lighting fixtures, sewers and culverts from an aerial platform. The technology must be capable of collecting visual images of equal quality to existing ground based inspection (tracked vehicles and human based) techniques. The technology must be capable of flying within confined spaces as small as a 24 inch diameter pipe.
- Develop UAV technology that will provide aerial monitoring of traffic conditions. Image quality must be equivalent to that provided by publicly available web based mapping services such as Google Earth and Bing Maps.
- Develop UAV technology that will provide bridge condition data from an aerial platform to supplement routine and in-depth inspections. Condition data includes both surface condition and non-destructive structural assessment data of bridge element integrity. These evaluation techniques typically require ultrasonic, infrared, thermo-graphic, radar and visual inspection technologies.
- Develop UAV technology that can collect LiDAR (Light Detection and Ranging) based surveying information.

FISCAL YEAR 2013 ACCOMPLISHMENTS

- Conduct literature search
- Develop prototype vehicles that meet the requirements of objectives 1, 2, 3 & 4.
- Demonstrated UAV technology in confined spaces of an MDOT large pump station
- Task 1-4; approximately 30% complete.
- State of Practice/Literature Review document (task #5); approximately 95% complete.
- Determine steps to obtain the required approvals from federal and state government to conduct needed unmanned aerial operations required for research and implementation.

FISCAL YEAR 2014 ACCOMPLISHMENTS

- Collect condition data from multiple sites as determined by MDOT. Conduct field trials of the prototype equipment.
- Analyze collected data for accuracy. Compare UAV collected data to comparable data obtained from existing collection methods.
- Provide final data to MDOT in a format specified by MDOT.
- Produce and deliver a final report that summarizes the results of the data analysis. This includes information that summarizes the quality and effectiveness of UAV collected data.
- Provide an implementation plan for utilizing the new UAV technology in MDOT operations.
- Deliver operating UAV equipment and provide user training to MDOT personnel.
- Provide demonstration at ITS World Congress – Detroit
- Provide demonstration to MDOT RAP and EOC

FISCAL YEAR 2015 ACCOMPLISHMENTS

Final Report provided.

UAV and sensor technologies purchased for MDOT UAV Phase 1 project

- Bergen hexacopter with controller and four batteries, purchased for MDOT as its UAV equipment for evaluation, testing, and use (\$5,964.99)
- Vectornav VN-200 GPS/inertial navigation system (INS) used for our LiDAR data collection from the hexacopter system (\$2,487.98)
- A FLIR Tau2 thermal camera used for our bridge assessment of delaminations (\$3,425.00)
- A Nikon D800 36-megapixel camera used for aerial image collection (\$2,996.95)

5. The DJI Phantom 2 Vision quadcopter we used for this project (for example, for the under-bridges & I-96 construction site images) (\$1,221.95)
6. A Nikon D3200 camera used to help with lab testing of the thermal setup (\$841.99)
7. The 15-foot blimp we used for the traffic monitoring demonstration (\$860.00)
8. A FPV factory Mariner 1 waterproof quadcopter purchased to safely image the underside of structures (bridges) that go over water (\$1,290.00)
9. A 4G enabled Samsung Galaxy camera we used with the traffic monitoring blimp to transmit near real-time video (could be used with a UAV as well) (\$549.99)

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

The budget for this project was increased in the Summer of 2014 to provide live demonstrations and presentations at the 2014 ITS World Congress. A subsequent extension was also granted later in 2014 since time was taken from specific project work for the ITS World Congress. One additional extension was granted since new rules on small UAV's were still pending so the user training required by the vendor could not occur timely. This final revision also included a scope change to include some additional data collection work at the request of the project manager.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

Bridge deck spalling

Using the Bergen Hexacopter platform and 36 megapixel Nikon D800 with 50 mm prime lens optical camera system, aerial imagery of two bridge decks was collected at two frames per second. This imagery was reconstructed into a model of the bridge deck to help locate distress features such as spalls. The high resolution (2.5 mm or 1/10 inch) orthorectified image allowed for easy identification of visible spalling and patchwork. Additionally, a digital elevation model of the bridge deck was created and processed through algorithms to automatically detect spalls. The detected spalls are placed into a GIS shapefile, which quantifies the total area of spalling on a bridge deck.

The use of a UAV and remote sensing provides more accurate quantitative results through the use of automated algorithms as compared to the use of manual visualization methods currently implemented by MDOT. Similar to MDOT reports, quantitative values such as the total area and percent of spalling as compared to the entire bridge deck can be reported. Using UAVs / remote sensing methods therefore potentially eliminates the need for bridge lane closures or placing MDOT inspectors on the bridge with traffic.

Bridge Deck Delaminations

Additionally, by using the Bergen Hexacopter platform to fly the FLIR Tau-2 thermal camera over bridge decks, aerial thermal imagery was collected to determine areas of the bridge deck that contain delaminations. Since delaminations are within the bridge deck (below the surface), optical imagery will not suffice and therefore thermal imagery is required. Collected thermal images were georeferenced to the orthorectified bridge deck image, enhancing image interpretation and usefulness of the thermal data. Bridge patching and delaminations were highly visible in this type of imagery. The thermal imagery was processed through algorithms that automatically detected and quantified the total area of potential delaminations.

As compared to MDOT's manual methods such as the use of chain dragging or hammer soundings, the use of a UAV and remote sensing provides more accurate quantitative results through the use of automated algorithms. Similar to MDOT reports, quantitative values such as the total area and percent delamination as compared to the entire bridge deck can be reported. Similar to the use of optical imagery to detect spalls, using UAVs / thermal remote sensing methods potentially eliminates the need for bridge lane closures or placing MDOT inspectors on the bridge with traffic.

LiDAR Bridge Model

By placing a Hokuyo light detection and ranging (LiDAR) unit on the Bergen Hexacopter and flying over a bridge, collected LiDAR data was processed into a 3-D LiDAR point cloud. The point cloud was determined to be a very high-quality representation of the bridge, with guard rails, curbs, surrounding embankments, and construction equipment all being visible.

Additional UAV Capabilities

The use of UAVs was also implemented for traffic monitoring and confined space inspections. For traffic monitoring, a small-sized blimp platform with an attached Samsung 4G Galaxy optical sensor were tested. The tethered blimp is capable of being deployed for multiple hours at a time, without the need for additional helium.

Confined Spaces / Pump Stations

Confined spaces and pump stations were also inspected through the use of mini-UAVs. In these demonstrations, the mini-UAVs were flown through access hatches and then around the pump station to collect imagery the condition of infrastructure inside of the confined space. Live video collected by the UAV was transmitted to a cell phone, allowing the UAV operator to see the condition of pipes or other infrastructure.

Phase I helped in the development of the scope and deliverables for phase II.

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2015**

PROJECT TITLE: RESEARCH ADMINISTRATION SECTION PLANNING AND COMMUNICATIONS

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Mark Polsdofer

CONTRACT/AUTHORIZATION NO.	2012-0298	PROJECT START DATE	01/31/2012
PROJECT NO.	121349	COMPLETION DATE (Original)	03/31/2015
OR NO.	OR12-021	COMPLETION DATE (Revised)	12/31/2015
RESEARCH AGENCY	CTC & Associates, LLC		
PRINCIPAL INVESTIGATOR	Patrick Casey		

BUDGET STATUS

FY 2015 Budget		Total Budget	
Vendor Budget FY 2015	\$47,450.02	Total Vendor Budget	\$239,863.00
MDOT Budget FY 2015	\$0.00	Total MDOT Budget	\$0.00
Vendor FY 2015 Expenditures	\$25,525.44	Total Budget	\$239,863.00
MDOT FY 2015 Expenditures	\$0.00	Total Expenditures	\$217,938.42
		Total Amount Available	\$21,924.58

PURPOSE AND SCOPE

1. Assist Research Administration with developing, designing, writing and editing of new or updated manuals, assorted newsletters and other communication materials.
2. Plan Research Summit Materials for interaction with Universities and private consultants.
3. Produce newsletters outlining the results of research projects.
4. Provide support as-needed for additional documentation, such as the development of the new Innovations Report.

FISCAL YEAR 2013 ACCOMPLISHMENTS

1. Develop Communications of documents such as At-A-Glance, Research Spotlights and other newsletters: Partially fulfilled and ongoing.
2. Research and Implementation Manual: Completed.
3. Innovations Report: Partially fulfilled and ongoing.
4. Annual Report: Completed.

FISCAL YEAR 2014 ACCOMPLISHMENTS

1. Annual Report.
2. Update Innovations Report.
3. Develop Communications of documents such as At-A-Glance, Research Spotlights and other newsletters as directed by Research Administration.
4. Assist with May 2014 Research Summit.

FISCAL YEAR 2015 ACCOMPLISHMENTS

1. Develop Communications of documents such as 2014 At-A-Glance, numerous Research Spotlights and a pooled fund success story document: Partially fulfilled and ongoing.

FISCAL YEAR 2016 PROPOSED ACTIVITIES

Completion of outstanding Research Spotlight documents and Pooled Fund Success Stories document.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

Additional time is needed to complete services. Proposed revision date: March 31, 2016.

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2015**

PROJECT TITLE: Evaluation of Bridge Decks using Non-Destructive Evaluation (NDE) at Near Highway Speeds for Effective Asset Management

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Eric Burns

CONTRACT/AUTHORIZATION NO.	2010-0295 Z7	PROJECT START DATE	11/1/2012
PROJECT NO.	121351	COMPLETION DATE (Original)	10/31/2014
OR NO.	OR10-043	COMPLETION DATE (Revised)	3/31/2016
RESEARCH AGENCY	Michigan Technological University		
PRINCIPAL INVESTIGATOR	Theresa Ahlborn		

BUDGET STATUS

FY 2015 Budget		Total Budget	
Vendor Budget FY 2015	\$10,044.13	Total Vendor Budget	\$243,251.57
MDOT Budget FY 2015	\$1,020.00	Adjusted MDOT Budget	\$4,567.44
Vendor FY 2015 Expenditures	\$27,144.84	Total Budget	\$247,819.01
MDOT FY 2015 Expenditures	\$9,901.88	Total Expenditures	\$233,223.04
		Total Amount Available	\$14,595.97

PURPOSE AND SCOPE

The objectives of this project include the following:

1. Research commercially available or deployment ready non-destructive evaluation (NDE) methods to evaluate bridge decks top surface area for delaminations, spalling, and cracking at near highway speeds.
2. Research NDE methods to evaluate bridge deck bottom surfaces and fascia's for delaminations without hands on contact.
3. Identify, review, or develop post processing methods to efficiently view, analyze, and report bridge deck spalling, cracking, and delamination consistent with MDOT's bridge management systems.

The scope of work for this project includes the following tasks:

1. Literature Review and a state of the practice review of Transportation agencies in the US and internationally to determine what NDE methods are being used.
2. Research Design and Planning - Plan studies of NDE methods and deck condition indicators. Understand MDOT's current bridge deck condition indicators and how they are used.
3. Data Collection - 1) Collect data on and/or experiment with NDE methods to evaluate bridge deck bottom surfaces and fascia's for delaminations without hands on contact. 2) Collect data on and/or experiment with commercially available or deployment ready NDE methods to evaluate bridge decks top surface for delaminations, spalling, and cracking at near highway speeds. Coordinate a portion of the deck testing prior to a series of deck rehabilitation projects so that chain drag testing, non-destructive testing, and destructive testing can be used to compare and validate the techniques. NDE methods should have data on ease of use, availability, reliability, ease of interpreting results collected among other issues. Collect information on current bridge inspection processes.
4. Analysis: Analyze data to make statistically sound recommendations on NDE method as they relate to current MDOT's bridge management systems, including cost, ease of use, availability, reliability, ease of interpreting results and other important factors.
5. Reporting: Develop deliverables.
6. Demonstration: Demonstrate NDE techniques recommended for use and educate MDOT staff about thier use.

FISCAL YEAR 2013 ACCOMPLISHMENTS

Selected and completed 4 fall bridge field reviews. Began analyzing field data.

FISCAL YEAR 2014 ACCOMPLISHMENTS

Completed field reviews of bridges. Reviewed and analyzed field data. Began the final report.

FISCAL YEAR 2015 ACCOMPLISHMENTS

Completed the final research report. Added additional structures for field reviews as part of the implementation plan.

FISCAL YEAR 2016 PROPOSED ACTIVITES

Complete, analyze, and report results of a pilot study by December 2015.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

A pilot study was added to the scope of work and the project was extended to December 2015. Several large bridges normally inspected by MDOT will now be inspected by the researcher using advanced NDE methods at near highway speed.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

Project expected completion in fiscal year 2016.

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2015**

PROJECT TITLE: Balancing the Costs of Mobility Investments in Work Zones

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Hilary Owen

CONTRACT/AUTHORIZATION NO.	2013-0070 Z5	PROJECT START DATE	6/19/2013
PROJECT NO.	121354	COMPLETION DATE (Original)	5/15/2015
OR NO.	OR13-004	COMPLETION DATE (Revised)	6/30/2015
RESEARCH AGENCY	Wayne State University		
PRINCIPAL INVESTIGATOR	Timothy Gates		

BUDGET STATUS

FY 2015 Budget		Total Budget	
Vendor Budget FY 2015	\$117,908.62	Total Vendor Budget	\$250,000.00
MDOT Budget FY 2015	\$0.00	Adjusted MDOT Budget	\$4,948.74
Vendor FY 2015 Expenditures	\$1,948.97	Total Budget	\$254,948.74
MDOT FY 2015 Expenditures	\$0.00	Total Expenditures	\$138,989.09
		Total Amount Available	\$115,959.65

PURPOSE AND SCOPE

Part 1:

- The objective of this study is to establish guidance on the appropriate level of investment in temporary measures to maintain mobility in work zones.

Part 2:

- Analyze how the type of work being performed and the equipment usage and placement affects driver behavior, traveler and worker safety, highway capacity and contractor efficiency.
- Use this information to develop a decision support tool to determine the appropriate mobility strategy for various pavement types and work types for use in the life-cycle cost analysis process.

FISCAL YEAR 2013 ACCOMPLISHMENTS

- Task 1: Conduct state-of-the-practice survey. All State DOTs have been sent the survey, and responses are being compiled.
- Task 2: Conduct State-of-the-art literature review. This task has begun and remains ongoing.
- Task 3: Implement public survey on work zone delay. This task has begun and remains ongoing.
- Task 4: Collect Mobility, safety and cost data. This task has begun and remains ongoing.

FISCAL YEAR 2014 ACCOMPLISHMENTS

- Task 1: Complete state-of-the-practice survey.
- Task 2: Complete state-of-the-art literature review.
- Task 3: Complete public survey on work zone delay.
- Task 4: Continue to collect mobility safety and cost data for ongoing and past projects.
- Task 5: Begin working on operational, safety, and economic analysis of selected work zone mobility strategies.
- Task 6: Prepare Part 1 report.

FISCAL YEAR 2015 ACCOMPLISHMENTS

- Task 6: Completed draft and final version of Phase 1 report

FISCAL YEAR 2016 PROPOSED ACTIVITIES

None.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

Both the MDOT Research and Project Managers (RM/PM) decided not to proceed with the original project's planned Phase 2. The PM requested revisions be made to the draft final report to express that all necessary data elements were not in place to complete the development of a comprehensive Decision Support Tool; a specified deliverable in the planned Phase 2.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

In order to complete the Decision Support Tool in Phase 2 of this research study, a more robust data set is needed with detailed accounting of work zone layout and work activities on real-time basis. This information can most accurately be obtained in real time with ongoing construction projects in future years. MDOT will pursue gathering the detailed information necessary for future year construction projects as outlined in the recommendations from the Phase 1 report. This data will then be aggregated and only then can an analysis can be completed to create an optimized decision tree for efficient use of resources in work zones and investment in temporary mobility during construction.

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2015**

PROJECT TITLE: Evaluating Michigan Commercial Vehicle Enforcement Strategies and Facilities

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Jason Firman

CONTRACT/AUTHORIZATION NO.	2013-0069 Z1	PROJECT START DATE	5/7/2013
PROJECT NO.	121355	COMPLETION DATE (Original)	3/30/2015
OR NO.	OR13-005	COMPLETION DATE (Revised)	
RESEARCH AGENCY	Western Michigan University		
PRINCIPAL INVESTIGATOR	Valerian Kwizgile		

BUDGET STATUS

FY 2015 Budget		Total Budget	
Vendor Budget FY 2015	\$83,579.90	Total Vendor Budget	\$268,560.45
MDOT Budget FY 2015	\$2,000.00	Adjusted MDOT Budget	\$3,730.07
Vendor FY 2015 Expenditures	\$81,652.89	Total Budget	\$272,290.52
MDOT FY 2015 Expenditures	\$1,641.14	Total Expenditures	\$270,363.51
		Total Amount Available	\$1,927.01

PURPOSE AND SCOPE

The primary goals of this study is to define the benefits of each of the 14 fixed weigh stations in Michigan, the cost of upgrading and maintaining these weigh stations and the cost of using alternative solutions (Wireless Weigh in Motion (WWIM), safe enforcement sites, permanent intermittent truck weigh stations (PITWS) etc.) in place of the fixed weigh station or as an enhancement to it. This will include a benefit/cost analysis to help MDOT and MSP in decision making on future commercial vehicle enforcement strategies.

The project will identify the value of each fixed weigh stations as currently they are the only legal place to weigh a vehicle if the operator objects to using a PITWS site. The stations are also used for administrative and training purposes. Other factors to consider will be the significance of the corridor, border weigh stations, commercial volume, percent overweight, safety and redundancy. This project will also be able to quantify the damage of overweight vehicles to the state highway system.

Detailed information on the advantages and disadvantages of each enforcement treatment will also be included.

FISCAL YEAR 2013 ACCOMPLISHMENTS

Task 1: Literature Review:

- Gathering and reviewing literature about commercial vehicle enforcement strategies in other states and other countries
- Reviewing MDOT documents related to commercial vehicle enforcement in Michigan
- Creating GIS databases for WIM sites, fixed weigh stations, and safe enforcement sites

Task 2: Surveying other states and Canada:

- Establishing contact list for conducting the survey
- Designing questionnaire for a survey of other states and Canada to identify CVE strategies implemented and determine the effectiveness of these strategies. Study technologies used to conduct commercial vehicle enforcement

Site Visits to select Michigan fixed weigh stations and other CVE sites:

- Monday July 29, 2013 - Cambridge Weigh Station and Monroe Weigh Station.
- Wednesday July 31, 2013 - Ionia Weigh Station
- Monday August 5, 2013 – New Buffalo Weigh Station
- Wednesday August 14, 2013 – Grass Lake Weigh Station and Safe Enforcement Site at Oshtemo Rest Area
- Tuesday August 20, 2013 - Check-Lane Operation at Zeeland Rest Area

Progress meeting with the RAP on Thursday August 22, 2013.

FISCAL YEAR 2014 ACCOMPLISHMENTS

Task 2: Surveying other states and Canada:

- Completed the survey of other states and Canada

Task 3: Detailed all potential enforcement strategies identified in the literature review and survey of other states and Canada

Task 4: Developed criteria to evaluate virtual weigh station spacing distribution

- Examined the usability of WIM data for identifying locations with higher overweight problems
- Acquired Michigan Truck Flow Model from MDOT

Task 5: Summarized conditions of each existing fixed weigh station and the costs to update each fixed weigh station.

Task 6: Collected Crash Data

Task 7: Obtained costs associated with each enforcement strategy.

Research progress meeting with the RAP on 9/22/14

FISCAL YEAR 2015 ACCOMPLISHMENTS

- Task 6: Performed a safety analysis of commercial vehicle enforcement strategies
- Task 7: Quantified benefits and conducted B/C analysis
- Task 8: Summarized the effectiveness of all enforcement strategies
- Task 9: Completed the draft final report and submitted to MDOT for review.
- Task 9: Completed the final report and delivered to MDOT on March 30, 2015.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

None.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

The research findings are expected to be used by MDOT and MSP in decision making of future commercial vehicle enforcement strategies. Specifically, the improvements and enhancements of fixed weigh stations and alternative technologies identified, together with their associated costs, will help MDOT and MSP prioritize infrastructure and technology investments in short term (1-5 years) and long term (6-10 years).

Infrastructure improvement: The research results indicated that a number of existing fixed weigh stations will benefit from upgrades and enhancements. These include Fowlerville (EB and WB), Ionia (EB and WB), and Pontiac (SB). Additionally, the research results indicated that an additional fixed weigh station is most likely needed in Grand region. However, the need to add a new fixed weigh station should be confirmed through further study of truck travel patterns and paths as well as evaluation of potential violation rates. The research findings also suggest that MDOT consider removing Cambridge and Telegraph fixed weigh stations since they are located on low truck volume routes.

Technology integration and data consolidation: The research revealed that a number of technologies can be installed at fixed locations to allow integration of commercial vehicle data from different sources. The technologies that can be installed include Overview Camera (OVC), License Plate Reader (LPR), and DOT Number Reader (DOTNR). Integration of technologies and consolidation of data will enable electronic identification and verification of safety compliance of commercial vehicles to ensure that officers focus their inspection resources on those vehicles, carriers and drivers most likely to present a significant safety risk. In addition to fixed locations, similar technologies can be installed in mobile trailers to allow officers to patrol and enforce commercial vehicle laws at locations without fixed weigh stations more efficiently. The research analyses indicated that fixed weigh stations are beneficial on routes where the commercial vehicle average daily traffic (CADT) is more than 2,200, however it is important to have enforcement strategies that can be implemented on routes that experience low commercial vehicle volumes and potentially higher rates of violation. The mobile trailers, coupled with wireless Weigh-In-Motion (WIM) and Permanent Intermittent Truck Weigh Stations (PITWS), have the potential to capture violators on such routes that are not monitored by fixed weigh stations to provide the necessary deterrence.

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2015**

PROJECT TITLE: Development, Characterization and Applications of a Non Proprietary Ultra-High Performance Concrete for Highway Bridges

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Steve Kahl

CONTRACT/AUTHORIZATION NO.	2013-0068 Z1	PROJECT START DATE	3/30/2013
PROJECT NO.	121357	COMPLETION DATE (Original)	3/30/2015
OR NO.	OR14-020	COMPLETION DATE (Revised)	3/14/2016
RESEARCH AGENCY	University of Michigan		
PRINCIPAL INVESTIGATOR	Sherif El-Tawil		

BUDGET STATUS

FY 2015 Budget		Total Budget	
Vendor Budget FY 2015	\$112,100.00	Total Vendor Budget	\$343,053.21
MDOT Budget FY 2015	\$1,660.00	Adjusted MDOT Budget	\$11,740.93
Vendor FY 2015 Expenditures	\$116,172.44	Total Budget	\$354,794.14
MDOT FY 2015 Expenditures	\$5,424.84	Total Expenditures	\$326,938.42
		Total Amount Available	\$27,855.72

PURPOSE AND SCOPE

Ultra-High Performance Concrete (UHPC) is a specially formulated concrete that is capable of achieving extremely high performance. When properly reinforced with steel fibers, the material is capable of achieving the following properties:

1. High compressive strength, approaching that of mild steel.
2. High tensile strength, several times that of regular concrete.
3. Pseudo-ductility, with tensile softening strains of up to an order of magnitude greater than that of regular concrete.
4. Exceptional energy absorption prior to fracture.
5. Extremely small crack widths, small enough to practically eliminate ingress of chlorides.
6. Exceptional durability, primarily enabled by the very small crack widths and the extremely high packing density of the material at the microstructure level.
7. Self-consolidating properties, which simplify construction.
8. Autogenous self-healing properties, enabled by small crack widths under service loads.

As of recently, the primary commercially available UHPC on the US market was available through LaFarge and marketed as Ductal®. Ductal is a proprietary material that is much more expensive than regular concretes. Construction using Ductal and other similar materials available through European suppliers requires specially certified contractors and costly construction processes, such as pressure or heat treatment, which are impractical to achieve in the field. High material cost coupled with complicated and costly construction procedures have seriously delayed widespread adoption of UHPC in the US. An alternative UHPC developed at the University of Michigan (U of M), here termed np-UHPC for non-proprietary-UHPC, has the potential for removing all obstacles preventing widespread use of UHPC in the State of Michigan and in the US.

The study has 7 research objectives, each of which will be achieved in a specific project task as detailed in the next section:

Objective 1: Survey and identify potential applications for np-UHPC, particularly for Accelerated Bridge Construction (ABC) and Precast Bridge Element Systems (PBES)

Objective 2: Investigate whether a family of new np-UHPC materials, with a range of compressive strengths ranging from 15 ksi to 30+ ksi, can be made using locally available components. Can the cost be made commensurate with performance and minimized through optimization? What classification scheme should be used?

Objective 3: Characterize the properties of the new family of np-UHPCs developed in this project, focusing on tensile strength, compressive strength, modulus of elasticity, and durability by laboratory testing.

Objective 4: Selecting: 1) continuous bridge decks and 2) deck overlays as two promising applications of np-UHPC, conduct finite element simulations to evaluate potential, quantify the effect of using np-UHPC, and prepare for field demonstrations and proof-of concept testing.

Objective 5: Conduct limited field demonstration and lab tests to show proof-of-concept for the selected applications. Provide for a batch scale up test for MDOT staff to observe the batching, mixing, placement, curing, and sampling characteristics.

Objective 6: Develop design, operational, and maintenance guidance for the chosen applications.

Objective 7: Develop use guidance on np-UHPC with cost/benefit analysis procedures.

FISCAL YEAR 2013 ACCOMPLISHMENTS

Task 1 – Completed. Applications of UHPC: This task surveyed applications of np-UHPC, focusing in particular on Precast Bridge Element Systems (PBES).

Task 2 – Completed. Identified Sources of Materials for np-UHPC: U of M identified both local and national suppliers, in that order of priority, making a concerted effort to avoid international suppliers. We anticipate that steel fiber suppliers may be the most problematic; however, we have already identified US companies that have the potential for supplying suitable fibers. As part of this task, a systematic optimization process that relies on feedback from test results was developed to change the amount of the various material components with the objective of reducing costs while maintaining a performance characteristic, e.g. either strength or ductility.

Task 3 – About 30% complete. Material Performance and Characterization: U of M proposed classifying the performance of the new np-UHPC using a categorization scheme. The proposed limits can be adjusted depending on the test results and in conjunction with the MDOT project manager. For all classes, U of M is striving to ensure that the strain at peak tensile stress is greater than 0.3%. Such a value is important since steel bars yield at about 0.21% and implies that the new material is effective not only in service but up to and after yielding of the bars. Based on determinations made in Task 2, test results, in conjunction with other published results, are evaluated as they become available and used to direct our effort to reduce mix cost. The criteria U of M is using for performance evaluation are compressive strength, tensile strength and tensile strain at peak stress.

FISCAL YEAR 2014 ACCOMPLISHMENTS

Tasks 1, 2, 3, listed above were completed, along with the following:

Task 4 - Simulation Studies of np-UHPC

Task 6 - Synthesis: develop design, operational, and maintenance guidance

The following tasks were partially completed:

Task 5 - Field and Structural Testing approximately 75% complete

Task 7 - Cost Benefit Guidance has just started.

FISCAL YEAR 2015 ACCOMPLISHMENTS

Tasks 1-6 have been completed.

Task 7 - Cost Benefit Guidance is ongoing. The final report has been started.

FISCAL YEAR 2016 PROPOSED ACTIVITIES

Complete final report.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

A funded time extension was requested to address unexpected finding in Task 5. Most of the remaining pull out tests have been concluded and the beam testing data has been processed. The extension consisted of conduct additional testing of beams and new pull out tests. Due to the experimental results in task 5 not matching with expectations, it was desired to confirm the bond and development length via additional pull out testing. This was important for design purposes. Because of the additional testing, the timeframe was extended to incorporate data analysis and reporting.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

Project expected completion in fiscal year 2016.

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2015**

PROJECT TITLE: Infrastructure Monitoring Data Management

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Steve Cook

CONTRACT/AUTHORIZATION NO.	2009-0642 Z1	PROJECT START DATE	10/01/2009
PROJECT NO.	121358	COMPLETION DATE (Original)	9/30/2011
OR NO.	OR09-148	COMPLETION DATE (Revised)	7/15/2015
RESEARCH AGENCY	Alfred Benesch and Company		
PRINCIPAL INVESTIGATOR	Ihab Darwish		

BUDGET STATUS

FY 2015 Budget		Total Budget	
Vendor Budget FY 2015	\$52,955.42	Total Vendor Budget	\$215,422.36
MDOT Budget FY 2015	\$900.00	Total MDOT Budget	\$900.00
Vendor FY 2015 Expenditures	\$129,253.42	Total Budget	\$216,322.36
MDOT FY 2015 Expenditures	\$0.00	Total Expenditures	\$215,422.36
		Total Amount Available	\$900.00

PURPOSE AND SCOPE

To evaluate the ability to collect vehicle probe data from specially equipped vehicles. Also, to use a telecommunication backhaul that allows the collection of the data to be analyzed and evaluated for road surface and road quality conditions.

FISCAL YEAR 2010 ACCOMPLISHMENTS

Worked on Milestone 1, which includes design and coordination of hardware/software needs.

FISCAL YEAR 2011 ACCOMPLISHMENTS

Completed Milestone 1

FISCAL YEAR 2012 ACCOMPLISHMENTS

Completed Milestone 2, which include commencing data collection to the server.

FISCAL YEAR 2013 ACCOMPLISHMENTS

Work In Progress: Milestones 3, 4, 5, 6, and preliminary planning for 2014 - ITS World Congress demonstration.

FISCAL YEAR 2014 ACCOMPLISHMENTS

Work In Progress in 2014:

- Continue data collection.
- Analyze and organize data.
- Complete a white paper for presentation and distribution.
- Provide live feed demonstration display of video and data from Cut River Bridge site for 2014 - ITS World Congress in Detroit (September 7-14, 2014).

FISCAL YEAR 2015 ACCOMPLISHMENTS

Completed all remaining tasks and submitted Final Report to MDOT.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

Multiple NCTE's were granted due to occasional inclement weather delays and numerous delays with data collection due to equipment breakdowns.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

Maintenance and operation of current system. Possible system development and deployment on other like infrastructure.

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2015**

PROJECT TITLE: Costs and Benefits of MDOT Intelligent Transportation System Deployments

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Collin Castle

CONTRACT/AUTHORIZATION NO.	2013-0069 Z5	PROJECT START DATE	6/3/2013
PROJECT NO.	121359	COMPLETION DATE (Original)	4/30/2015
OR NO.	OR14-004	COMPLETION DATE (Revised)	7/31/2015
RESEARCH AGENCY	Western Michigan University		
PRINCIPAL INVESTIGATOR	Jun-Seok Oh		

BUDGET STATUS

FY 2015 Budget		Total Budget	
Vendor Budget FY 2015	\$83,466.81	Total Vendor Budget	\$233,394.69
MDOT Budget FY 2015	\$2,300.00	Adjusted MDOT Budget	\$238.00
Vendor FY 2015 Expenditures	\$81,446.16	Total Budget	\$233,632.69
MDOT FY 2015 Expenditures	\$0.00	Total Expenditures	\$231,612.04
		Total Amount Available	\$2,020.65

PURPOSE AND SCOPE

The purpose of this project is to quantify costs and benefits of individual ITS devices and systems in Michigan. This research compiles all ITS devices deployed in Michigan and classifies them into geographical areas and device types. Costs and benefits are quantified by its type using data from Traffic Operation Centers as well we traffic simulation analysis in selected corridors.

FISCAL YEAR 2013 ACCOMPLISHMENTS

During FY 2013, literature reviews on TOCs in other states and existing cost and benefit studies were completed. Other tasks in progress include the following:

Task 1: Literature Review

- Reviewed other TOCs
- Reviewed cost and benefit of other ITS

Task 2: Reviewing MDOT's ITS Deployments

- Visited WMTOC (7/8/2013), STOC (8/12), and SEMTOC (8/14/2013)
- Collected MDOT ITS Inventory
- Built GIS Database for MDOT ITS Deployment
- Collecting ITS cost data
- Reviewed sites (corridors) for detailed analysis

Task 3: User Perception Survey

- Began designing user perception survey

Task 4: Collecting Performance Data

- Began collecting ITS performance data
- Received an access to NAVTEQ database
- Received a list of TOC data users

Meetings: Progress meeting (October 2, 2013) at MDOT

FISCAL YEAR 2014 ACCOMPLISHMENTS

Task 3: User Perception Survey

- Collected additional survey data and completed data analysis

Task 5: Selection of Analysis Tool and Modeling

- Selected Paramics simulation model as an analysis tool
- Collected data for modeling
- Developed corridor models for selected sites
- Analyzed data for selected corridors
- Began processing data for the TMC areas
- Developed simulation models and began quantifying benefits

Task 6: Cost and Benefit of ITS System

- Analyzed cost and benefit factors
- Started processing ITS benefits
- Collected cost data and began analyzing cost data
- Began processing data and estimating ITS benefits

Task 7: Cost and Benefit of Individual ITS Devices

- Started reviewing benefits by individual ITS devices

FISCAL YEAR 2015 ACCOMPLISHMENTS

Task 5: Selection of Analysis Tool and Modeling

- Developed corridor models
- Analyzed data for selected corridors

Task 6: Cost and Benefit of ITS System

- Analyzed ITS cost data by type and area
- Estimated ITS benefits by area
- Quantified benefit-cost ratios

Task 7: Cost and Benefit of Individual ITS Devices

- Estimated benefits by individual ITS device
- Quantified benefit-cost ratios by ITS device

Task 8: Recommendations and Final Report

- Developed final recommendations
- Submitted the final report

FISCAL YEAR 2016 PROPOSED ACTIVITIES

Not Applicable.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

The research team experienced some inconsistency in results from the initial data sources analyzed. Recently identified were other sets of data which may answer the inconsistency problem. The principal investigator needed more project time to process the newly identified data sets again in order to confirm consistency and accuracy of the results. The completion date was revised from 6/3/2013 to 7/31/2015. The revision was approved on 12/17/2014.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

1. Develop and manage a consistent statewide incident database shared among all three MDOT Traffic Operations Centers
 2. Deploy an FCP program in the WMTOC region
 3. Future investments should focus on DMS and CCTV installation, while deployment of MVDS needs further studies in conjunction with the coming wake of Connected Vehicle technology
 4. TV and radio media outlets should focus on exposing safety-related travel information and operators should tailor Mi Drive information according to seasonal trends.
-

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2015**

PROJECT TITLE: Michigan Urban Trunkline Intersections Safety Performance Function (SPFs) Development and Support

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Dean Kanitz

CONTRACT/AUTHORIZATION NO.	2013-0070 Z4	PROJECT START DATE	9/1/2013
PROJECT NO.	121361	COMPLETION DATE (Original)	5/31/2015
OR NO.	OR14-015	COMPLETION DATE (Revised)	6/30/2015
RESEARCH AGENCY	Wayne State University		
PRINCIPAL INVESTIGATOR	Timothy Gates		

BUDGET STATUS

FY 2015 Budget		Total Budget	
Vendor Budget FY 2015	\$208,303.55	Total Vendor Budget	\$250,100.20
MDOT Budget FY 2015	\$10,500.00	Adjusted MDOT Budget	\$0.00
Vendor FY 2015 Expenditures	\$195,664.02	Total Budget	\$250,100.20
MDOT FY 2015 Expenditures	\$0.00	Total Expenditures	\$244,425.69
		Total Amount Available	\$5,674.51

PURPOSE AND SCOPE

To have full functionality of the Highway Safety Manual for Michigan there is a need to develop safety performance functions (SPFs) tailored to urban intersection facilities. SPFs will allow transportation professionals at all levels the ability to scientifically evaluate facilities prior to design for expected number of crashes, crash severities, crash types and return on investment from a safety perspective. The scope of work includes the following:

1. Literature Review
2. Identification of Sites
3. Data Collection
4. Data Analysis
5. SPF Development
6. Develop Maintenance Cycle
7. Develop Maintenance Process
8. Develop Deliverables
9. Demonstration materials and meetings

Types of urban intersection facilities to be evaluated are:

1. Urban Trunkline Three-Leg Minor Road Stop Control
2. Urban Trunkline Three-Leg Signalized
3. Urban Trunkline Four-Leg Minor Road Stop Control
4. Urban Trunkline Four-Leg Signalized

FISCAL YEAR 2013 ACCOMPLISHMENTS

Literature review and identification of sites began.

FISCAL YEAR 2014 ACCOMPLISHMENTS

Literature review identification of sites, data collection, data analysis, and SPF development

FISCAL YEAR 2015 ACCOMPLISHMENTS

This effort was completed in FY2015. Statistical regression models showed significantly different SPFs between regions, so region specific SPFs were developed. The research developed Safety Performance Functions (SPFs) for each Regional Prosperity Initiative area and traditional MDOT regions of Michigan. These SPFs were incorporated in the existing HSM spreadsheet for public use.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

The research advisory panel needed additional time to review deliverables so a no cost one month extension was approved.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

Findings from the research will be integrated in the Michigan Highway Safety Manual spreadsheet, published on the web along with utilization into Safety Analyst.

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2015**

PROJECT TITLE: Evaluating the Use of Tow Plows in Michigan			
FUNDING SOURCE: <input checked="" type="checkbox"/> SPR, Part II <input type="checkbox"/> OTHER (PLEASE EXPLAIN)			
PROJECT MANAGER: Tim Croze			
CONTRACT/AUTHORIZATION NO.	2013-0065 Z1	PROJECT START DATE	3/30/2013
PROJECT NO.	121362	COMPLETION DATE (Original)	3/30/2015
OR NO.	OR14-006	COMPLETION DATE (Revised)	12/31/2015
RESEARCH AGENCY	Lawrence Technological University		
PRINCIPAL INVESTIGATOR	Nishantha Bandara		

BUDGET STATUS			
FY 2015 Budget		Total Budget	
Vendor Budget FY 2015	\$130,733.01	Total Vendor Budget	\$186,661.15
MDOT Budget FY 2015	\$7,281.54	Adjusted MDOT Budget	\$8,563.08
Vendor FY 2015 Expenditures	\$57,090.98	Total Budget	\$195,224.23
MDOT FY 2015 Expenditures	\$0.00	Total Expenditures	\$114,300.66
		Total Amount Available	\$80,923.57

PURPOSE AND SCOPE

Due to the rising costs of winter maintenance and the environmental concerns related to usage of salt, MDOT has embarked on a number of innovative approaches to enhance winter maintenance operations. These include: Pre-wetting, alternative de-icing and anti-icing products, Road Weather Information Systems (RWIS), etc. One of the new pieces of equipment evaluated for the same purpose by other State DOT's and Canadian provinces includes the Tow Plow. A Tow plow is a trailer mounted snow plow with 26' blade. When attached to a traditional snow plow with 12' front plow, the combination can clear a 25' path. MDOT has purchased one Tow Plow and is in the process of purchasing more units and there is a need for assessing the effectiveness of the Tow Plow in terms of efficiency, cost-effectiveness and safety.

The scope of the project includes the following primary tasks:

1. Understand the current state of practice for Tow Plows across the nation
2. Learn the benefits/draw backs of utilizing Tow Plow
3. Understand the most efficient use of Tow Plows in Michigan
4. Development of training materials for operators on safe and effective use of Tow Plows

In order to fulfil the above, the following tasks will be completed at the conclusion of this project:

1. Conduct Comprehensive Literature Review
2. Perform a Survey of Winter Weather States
3. Compare the Effectiveness of Tow Plow to Traditional Truck/wing Plow Setup
4. Perform Benefit/Cost Analysis for Tow Plow to Truck/wing Plow Setup
5. Develop Recommendations for MDOT Management as to the Safest and Most Effective Areas to Utilize Tow Plows
6. Develop Training Materials for Operators and Recommendation for Changes to the Current Winter Maintenance Truck Specifications
7. Develop a Final Report describing major research results and implementation recommendations

FISCAL YEAR 2013 ACCOMPLISHMENTS

The following tasks were completed during Fiscal Year (FY) 2013:

Task 1: Conduct a comprehensive Literature Review

90 percent of this task has been completed during the first quarter and details were included in the Quarterly Report 1 (QR 1). This task will continue until the completion of the project.

Task 2: Perform a Survey of Winter Weather States

- a. The creation of survey distribution database has been completed.
- b. The survey was finalized and deployed through "Survey Monkey". A reminder e-mail was sent on 10/11/2013 and survey is closed on 10/31/2013. At the end of the survey period, there were 53 respondents. Analysis of survey responses is currently underway

Approximately 80 percent of this task is completed at this time.

Task 3: Compare the Effectiveness of Tow Plow to Traditional Plow

- a. A meeting was held on 9/4/2013 at Brighton Garage to finalize snow routes for the comparison study. It was determined that the I-96 Snow Route will be divided into two sections (M-59 to US-23 and US-23 to Oakland County line) for the comparison study and few more comparison sites are to be determined from the Lansing Transportation Service Center (TSC) area.
- b. Configuring Dynatest "Survey" program to measure the condition of the roadway behind the Tow Plow/Traditional Plow is underway.
- c. Comparison sites and pavement condition measuring technique will be presented to MDOT Project Manager (PM) and Research Advisory Panel (RAP) members during the progress meeting on November 20, 2013.

Approximately 15 percent of this task is completed at this time.

Task 4: Perform Benefit-Cost Analysis for Tow Plow to Truck/Wing Plow Setup

- a. Development of a benefit-cost analysis methodology is currently underway. The developed method will be presented to MDOT PM and RAP members during the progress meeting on November 20, 2013.
- b. Winter weather related accident database for the Livingston County has been completed. Assigning each accident to different snow routes in the county is underway.
- c. Creation of winter storm database for the Livingston County is currently underway.
- d. Update to the MDOT Winter Maintenance Activities Record Sheet was proposed by the Principal Investigator (PI). Currently, MDOT is considering the PI's request.

Approximately 15 percent of this task was complete at this time.

FISCAL YEAR 2014 ACCOMPLISHMENTS

Task1: Literature Review

This task was completed during the First Quarter; however, this task will continue throughout the project to include any new information related to Tow Plow research.

Task 2: Survey of Winter Weather States

This task was completed during the second quarter.

Task 3: Compare the effectiveness of Tow Plow to traditional truck/wing plow

This task was performed during three winter storms. The following types of data were collected during three winter storms:

- a. Friction Data behind Tow Plow and Regular Plow
- b. Surface Condition behind Tow Plow and Regular Plow
- c. Operating Speed of the Tow Plow/Regular Plow
- d. Traffic condition behind Tow Plow/Regular Plow
- e. Pictures of the pavement

Further analysis of collected data is in progress.

Task 4: Perform Benefit-Cost Analysis for Tow Plow to Truck/Wing Plow Setup

- a. Previously created winter storm database for Livingston County was checked for errors and updates were made.
- b. Winter weather related accident database for the Livingston County for year 2012-2013 has been completed and QA/QC was completed during the last quarter.
- c. MDOT Form 14100 data was used to get winter maintenance data for each snow route in Livingston County. Both 2012-2013 year data and 2013-2014 data were compiled and sorted for different maintenance segments for each winter storm.
- d. MDOT granted access to RITIS database to analyze traffic speed during winter storms and time to regain normal speed during winter storms. Analysis were completed for winter seasons 2012-2013 and 2013-2014.
- e. Currently developing a cost model to determine the benefit-cost of tow-plow to truck/wing plow setup.
- f. Approximately 60 percent of this task is completed at this time.

FISCAL YEAR 2015 ACCOMPLISHMENTS

Task1: Literature Review

Most of the activities related this task was completed last FY.

Task 2: Survey of Winter Weather States

This task was completed during the second quarter of last FY.

Task 3: Compare the effectiveness of Tow Plow to traditional truck/wing plow

This task was performed during 4 winter storms in 2014-2015. The following types of data were collected during those winter Storms:

- a. Friction Data behind Tow Plow and Regular Plow
- b. Surface Condition behind Tow Plow and Regular Plow
- c. Operating Speed of the Tow Plow/Regular Plow
- d. Traffic condition behind Tow Plow/Regular Plow
- e. Pictures of the pavement

During the 2014-2015 data collection was extended to I-96 in Williamston garage as well. This task was completed in March, 2015.

Task 4: Perform Benefit-Cost Analysis for Tow Plow to Truck/Wing Plow Setup

The following data items were compiled and QA/QC was performed for the purpose of benefit-cost analysis.

- a. Winter storm database for the Livingston County for years 2013-2014 and 2014-2015.
- b. MDOT winter maintenance data (MDOT Form 14100) for years 2012-2013, 2013-2014 and 2014-2015 for Livingston County, Williamston Garage, Grand Ledge Garage and Reed City Garage.
- c. Traffic speed during winter storms and time to regain normal speed during winter storms for winter seasons 2012-2013, 2013-2014 and 2014-2015.
- d. Benefit-cost of tow-plow to truck/wing plow setup for different snow routes in Grand Ledge, and Reed City garages. Livingston county and Williamston Garage are completed.

Approximately 75 percent of this task is completed at this time.

Task 7: Develop Draft Report

This task was completed during this quarter and draft final report was submitted to the MDOT PM on 9/30/2015.

FISCAL YEAR 2016 PROPOSED ACTIVITIES

Task 4: Continue with benefit/cost analysis methodology, cost analysis, and sensitivity analysis. This work will include results from the 2015/2016 winter season.

Task 5: Develop recommendations for MDOT management as to most effective areas to use Tow Plow.

Task 6: Develop training materials

Task 7: Develop Final report

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

July 16, 2015: Due to the lack of snow storms with snowfall totaling more than 4" in the University Region during the winter of 2014/15, the data collected for this project represented only smaller storm events. To reduce the potential for skewing the final results of the C/B analysis the researcher requested MDOT provide winter operations data from garages that received more significant snowfall. MDOT honored this request by providing data for the 2014-2015 season from the Reed City garage; however, the data was not provided until June and required significant manual input from the researcher to be able to use the data in this study. Extending the project 90 days allowed for the new data to be adequately scrubbed and entered into the C/B model.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

The results of the study will be used by MDOT to determine where best to place Tow Plows and how many additional Tow Plow units should be purchased.

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2015**

PROJECT TITLE: Bridge Design System Analysis and Modernization

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Sam Guerrazzi

CONTRACT/AUTHORIZATION NO.	2013-0506	PROJECT START DATE	11/1/2013
PROJECT NO.	121363	COMPLETION DATE (Original)	11/30/2015
OR NO.	OR14-029	COMPLETION DATE (Revised)	9/30/2016
RESEARCH AGENCY	Michigan Technological University		
PRINCIPAL INVESTIGATOR	Tim Colling		

BUDGET STATUS

FY 2015 Budget		Total Budget	
Vendor Budget FY 2015	\$360,380.40	Total Vendor Budget	\$551,176.40
MDOT Budget FY 2015	\$10,000.00	Adjusted MDOT Budget	\$10,000.00
Vendor FY 2015 Expenditures	\$226,477.53	Total Budget	\$561,176.40
MDOT FY 2015 Expenditures	\$0.00	Total Expenditures	\$417,273.14
		Total Amount Available	\$143,903.26

PURPOSE AND SCOPE

MDOT currently designs between 50 and 80 bridges a year using an in-house software tool called the Bridge Design System. The initial software was developed over 30 years ago in the Fortran programming language and it has been updated and improved to adapt to MDOT's design process changes and AASHTO standards. However, the evolutionary nature of desk top operating systems and accompanying programming languages has put MDOT's primary design tool at some risk. The bridge design calculations, procedures and methodology contained in the Bridge Design System must be documented and preserved, and the program must be modernized as needed to assure it will function on new operating systems and work integrally with third party programs. At the same time, existing bridge design calculations, processes, and procedures must be updated to meet AASHTO bridge design standards. The first steps in improving the software is an in depth analysis of the existing system to better understand its function followed by an alternative analysis evaluating various improvements.

Tasks include:

- Reviewing and documenting the bridge design calculations, procedures, and methodology contained in the MDOT Bridge Design System.
- Performing a risk assessment of the current system,
- Providing recommendations to modernize the system incorporating new efficiencies and/or other programming improvements.
- Executing appropriate recommendations

FISCAL YEAR 2014 ACCOMPLISHMENTS

The first year's proposed activities include reviewing and documenting the bridge design calculations, procedures, and methodology contained in the MDOT Bridge Design System. The reviewing and documentation activities progressed throughout the year such that draft documentation formats were presented.

FISCAL YEAR 2015 ACCOMPLISHMENTS

The project team finalized Interim Report's 1 and 2 taking into account all comments. Other tasks completed include instituting source control and an integrated test environment, building an automated test suite, splitting code into modules, removing common blocks, changing to "Free" source form, and eliminating proprietary extensions. Identifying recommended modifications to the BDS source code is 90% complete.

FISCAL YEAR 2016 PROPOSED ACTIVITIES

The primary goal will be to complete modifications to the BDS source code as directed by MDOT now that feedback and approval from MDOT for the supplemental work plan has been received.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

In June of 2015, the project was extended by 10 months, to September 30, 2016, to allow sufficient time to initiate software improvements identified in fiscal years 2014 and 2015.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

Project completion expected in fiscal year 2016.

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2015**

PROJECT TITLE: Advanced Applications of IntelliDrive Data Use Analysis and Processing 2 (DUAP 2)

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Collin Castle

CONTRACT/AUTHORIZATION NO.	2011-0316	PROJECT START DATE	8/9/2011
PROJECT NO.	121364	COMPLETION DATE (Original)	6/30/2014
OR NO.	OR10-044	COMPLETION DATE (Revised)	1/31/2017
RESEARCH AGENCY	Mixon Hill of Michigan, Inc.		
PRINCIPAL INVESTIGATOR	Lee Mixon		

PROJECT BUDGET STATUS

FY 2015 SPR II Budget/Expenditures		Total Project Budget/Expenditures	
Vendor FY 2015 Budget	\$341,178.50	Total Vendor Budget	\$4,783,379.81
MDOT FY 2015 Budget	\$76,650.00	Total MDOT Budget	\$76,650.00
Vendor FY 2015 Expenditures	\$843,781.80	Total Budget	\$4,860,029.81
MDOT FY 2015 Expenditures	\$0.00	Total Expenditures	\$4,227,771.99
		Total Amount Available	\$632,257.82

PURPOSE AND SCOPE

To support MDOT and its partners in the evaluation of the uses and benefits of vehicle-related data. Evaluate and determine how the connected vehicle program will impact how state and local departments of transportation, specifically MDOT, do business as a result of the significant quantity of additional data collected on all major (and eventually minor) roads. This information is anticipated to permit MDOT and MDOT's partners to more efficiently and effectively manage traffic on all facilities in the region, manage assets and road conditions, and respond to safety concerns.

The following table shows SPR II and ITS funding for this project:

Funding Source	FY 15 Expenditures	Total Expenditures	Total Budget
SPR II - JN 121364	\$843,781.80	\$3,456,819.73	\$3,687,062.65
ITS - JN 111941	\$69,519.47	\$160,923.57	\$194,191.51
Wx-TINFO - JN 122184	\$37,167.96	\$401,387.47	\$403,504.29
IMO 3 - JN 125655	\$208,641.20	\$208,641.20	\$498,621.36

FISCAL YEAR 2013 ACCOMPLISHMENTS

Task 1: Concept Review and Refinement

- Conducted ongoing research for development of white papers on applications
 - Discussed with Subject Matter Expert (SME) areas where data sharing can bring the most benefit to MDOT
 - Created modular-based domain diagrams based on SME input to communicate application ideas with SMEs
- Evaluated tentative application white papers

Task 2: User Needs Development

- Developed process to normalize the functions across regions and central office
- Conducted user meetings in Lansing, MI with SME; prepared meeting minutes for the meetings
 - Dec. 12 – SMEs from Asset Management/Planning
 - Dec. 12 – SMEs from Maintenance
 - Dec. 13 – SMEs from Construction
 - Dec. 13 – SMEs from Operations
 - Feb. 28 – SMEs from Design
 - Feb. 28 – SMEs from Asset Management
 - Mar. 1 – SMEs from Metro Region to discuss Performance Management and MAP-21
 - Jul. 11 – Meeting with Bob Miller
 - Jul. 11 – Meeting with E-Construction
 - Jul. 12 – Meeting with MDOT's Metro Region engineers
 - Jul. 12 – Meeting with Tony Kratofil regarding Performance Based Operating System (PBOS)
 - Jul. 12 – Meeting with OPUS regarding PBOS
 - Aug. 29 – Meeting with University of Michigan – Transportation Research Institute (UMTRI) in Ann Arbor, MI
- Began documenting user needs that will supplement application white papers
- Concept of Operations

Task 3: Design and Development

- System Requirements Specification (SRS)
 - Developed first draft DUAP system requirements
 - Began drafting requirements for user interface of the DUAP system
 - Drafted requirements for USDOT Safety Pilot Model Deployment data ingestion
 - Drafted requirements for USDOT Integrated Mobile Observation (IMO 2.0) data ingestion
 - Drafted DUAP system ingestion requirements
- System Architecture Description (SAD)
 - Developed first draft of system architecture description
 - Drafted generic ingestion architecture for DUAP system
 - Drafted generic data management architecture for DUAP system
 - Drafted generic consumption architecture for DUAP system
 - Drafted hardware architecture for DUAP system
- System Design Description (SDD)
 - Developed first draft SDD document
 - Began drafting the ingestion operation under software design
 - Designed Safety Pilot data ingestion
 - Designed IMO 2.0 data ingestion
 - Designed generic data ingestion
 - Draft the hardware design
- Designed and developed ingestion for data sources
 - Designed and developed ingestion for USDOT Safety Pilot Model Deployment (Safety Pilot) data
 - Developed preliminary design for ingestion of IMO 2.0 data and vehicle tracking
- Designed and developed map-based application for displaying Safety Pilot and IMO 2.0 data

Task 4: Implementation, Testing and Evaluation

- Implemented ingestion of data sources for the DUAP system
 - Implemented ingestion of Safety Pilot data
 - Implemented ingestion of IMO 2.0 data
- Implemented map-based application for displaying Safety Pilot and IMO 2.0 data
- Tested map-based application for displaying Safety Pilot and IMO data
- Evaluated performance of maps for use in map-based application
- Evaluated currently available hardware, software, operating systems and database systems for the DUAP system
 - Evaluated telecommunications requirements for DUAP system
 - Evaluated current state of the practice for computing platform
- Evaluated currently available mapping software for supporting DUAP applications
- Evaluated mapping tools, frameworks, and projections used for displaying data

Task 5: Procure and Deploy Data Sources

- Began integrating existing MDOT maps and data sources into DUAP system
 - Discussed integrating Advanced Traffic Management System (ATMS) Software data
 - Discussed integrating MiDrive data
- Collected and processed Safety Pilot data
- Collected and processed IMO data
- Collected and processed original Chrysler fleet data

Task 6: Data Management and Distributions Design

- Monitored and maintained data from Safety Pilot Model Deployment
- Monitored and maintained data from IMO 2.0
- Monitored and maintained data from Original Equipment Manufacturer (OEM) fleet

Task 7: Data Collection Method, Comparison and Exploration

- Evaluated and analyzed Safety Pilot data
- Evaluated and analyzed IMO 2.0 data

Task 8: Application Convergence and Sustained Operations

- No activity in this reporting period

Task 9: Outreach and Awareness

- Prepared for 2014 ITS World Congress in Detroit, MI
- Developed concepts for socializing project data among potential user groups
- Encouraged SMEs to collaborate with other MDOT personnel to identify areas to share data
- Prepared outreach and awareness materials as needed

FISCAL YEAR 2014 ACCOMPLISHMENTS

Task 1: Concept Review and Refinement

- Conducted ongoing research for development of white papers on applications
 - Discussed with SMEs areas where data sharing can bring the most benefit to MDOT
 - Evaluated tentative application white papers
 - Pavement application
 - Data capture through mobile device
 - Work flow development
 - Traffic application
 - Completed Application White Paper #1
 - Completed Application White Paper #2
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- Completed Application White Paper #3
- Completed Application White Paper #4
- Task 2:** User Needs Development
 - Conducted user meetings with SMEs as necessary for gathering user needs
 - Concept of Operations
 - Published DUAP 2 Concept of Operations
- Task 3:** Design and Development
 - System Requirements Specification (SRS)
 - Completed DUAP system requirements
 - Completed System Architecture Description (SAD)
 - System Design Description
 - Designed functional operation for the DUAP system
 - Designed hardware needs and hardware integration for the DUAP system
 - Designed monitoring operations for the DUAP system
 - Developed DUAP system applications as identified
 - Developed user interface for interfacing with the DUAP system and the system applications
- Task 4:** Implementation, Testing and Evaluation
 - Implemented components of the DUAP system
 - Implemented DUAP system applications as identified
 - Implemented user interface capabilities for enabling users to interfacing with the DUAP system and the system applications
 - Tested components of the DUAP system
 - Tested DUAP system applications for satisfying user needs
 - Tested user interface capabilities for displaying the correct information to system users
 - Evaluated DUAP system components for correct operation
 - Evaluated DUAP system applications, as determined necessary
 - Evaluated user interface capabilities for displaying the correct information to system users
 - Created System Test Plan (STP)
 - Developed Final DUAP STP document
 - Created Field Operational Test Plan (FOTP)
 - Developed Final DUAP FOTP document
- Task 5:** Procure and Deploy Data Sources
 - Continued to procure data sources for integration into the DUAP system
 - Integrated existing MDOT data sources into the DUAP system, as identified
 - Integrated other data sources into the DUAP system, as identified
 - Created Data Collection Plan (DCP)
 - Developed final DUAP DCP document
 - Created DUAP system Procurement Specification
 - Develop final DUAP Procurement Specification document
 - Created Configuration Management Plan (CMP)
 - Developed final DUAP CMP document
- Task 6:** Data Management and Distributions Design
 - Deployed prototype system
 - Continued collecting data for the DUAP system
 - Continued collecting Safety Pilot data for the DUAP system
 - Continued collecting IMO data for the DUAP system
- Task 7:** Data Collection Method Comparison and Exploration
 - Developed Application Data Needs and Evaluation Criteria
 - Developed White Paper on Comparison of DUAP 2 and Current Data Collection Practices
- Task 8:** Application Convergence and Sustained Operations
 - Developed Operational Policies and Procedures
 - Developed Application User Manual
 - Developed Application Training Material
- Task 9:** Outreach and Awareness
 - Prepared for 2014 ITS World Congress in Detroit, MI
 - Developed concepts for socializing project data among potential user groups
 - Prepared outreach and awareness materials as needed

FISCAL YEAR 2015 ACCOMPLISHMENTS

- Task 1:** Concept Review and Refinement
 - No activities in this reporting period
 - Task 2:** User Needs Development
 - No activities in this reporting period
 - Task 2.5:** Wx-TINFO Requirements Development
 - No activities in this reporting period
 - Task 2.6:** User Needs Development
 - Evaluated pavement analysis needs
 - Evaluated J2735 data usage integration within DUAP
 - Task 3:** Design and Development
 - No activities in this reporting period
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Task 3.5: Design and Development

- No activities in this reporting period

Task 3.6: Design and Development

- Modified DUAP infrastructure for additional system configurability
- Continued incorporating road segment data
- Continued developing pavement analysis processes
- Incorporated connected vehicle data visualization

Task 4: Implementation, Testing and Evaluation

- Continued implementation and testing of IMO components
 - Reported receipt of bad IMO files to UMTRI (missing lat/longs, speed, and header field information from some vehicles)
 - Reported to UMTRI that no IMO .csv files were being received
 - Reported to UMTRI that no IMO files were being received
- Implemented and tested weather data source components
 - Evaluation and further development of weather alerts and polygons
 - Created additional summarized views of polygons
 - Incorporating priority levels of weather events
 - Adjusted weather decision algorithms based on MDOT feedback
- Continued to develop and implement DUAP application functionality
 - Continued work with radar files and alerts
 - Continued work to assure stability and security of system
 - Continued work on further data analysis for use in reports
 - Configuration Management for VIDAS
 - Testing for configuration updates
 - Testing for software updates
 - Asset condition analysis
 - Incorporated DMS information
 - Incorporated AVL data
 - Collected feedback from MDOT users as they begin to use DUAP (questions, comments, issues and enhancement opportunities)
 - Working with stakeholders to help understand weather event and alert challenges and differences between ATMS operators and other functional area needs
- Worked on data archiving and purging processes

Task 4.5: Wx-TINFO System Testing

- No activities in this reporting period

Task 4.6: Implementation, Testing and Evaluation

- Continued to implement and test weather data source components
 - Evaluation and further development of weather alerts and polygons
 - Modified process pulling NWS data due to NWS changes
- Continued to develop and implement DUAP application functionality
 - Continued work to assure stability and security of system
 - Continued work on further data analysis for use in reports
 - Asset condition analysis
 - Continued working on user login/roles
 - For continued security enhancements
 - For functional area focus
 - User profiles
- Collected feedback from MDOT users as they begin to use DUAP (questions, comments, issues and enhancement opportunities)
- Worked with stakeholders to help understand weather event and alert challenges and differences between ATMS operators and other functional area needs
- Worked on integration of road segments
 - Relating data to road segments
 - Reporting information based on road segments
 - Continue work on interface to integrate with base VIDAS system
- Continued working on ingestion of DSRC data sources
- Incorporated functionality to display vehicle movements from DSRC data sources

Task 5: Procure and Deploy Data Sources

- Continued collecting Safety Pilot data for inclusion in DUAP
 - Continued collecting and processing Integrated Mobile Observations (IMO) data
 - Continued collecting and processing weather data sources
 - Continued work on MVDS data source
 - Completed process for ingesting data
 - Continued work to identify and implement other MVDS data feeds for inclusion in DUAP
 - Worked with DTMB to continue data retrieval due to issues with the data source
 - Continued work to incorporate VIDAS data for inclusion in DUAP
 - Continued work to secure interface and data for GPS/AVL project
 - Received balance of requested historical files
 - Capturing current files ("intraday") from ftp site
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- Worked to include DMS information
 - Began work to include CCTV image files
 - Coordinated with USDOT's Southeast Michigan Test Bed and data sources, as necessary
- Task 5.6: Procure and Deploy Data Sources**
- Continued collecting Safety Pilot data for inclusion in DUAP
 - Continued collecting and processing of IMO data
 - Continued collecting and processing weather data sources
 - Continued collecting and processing MVDS data source
 - Reviewed additional MVDS data files for inclusion into DUAP
 - Continued collecting and processing VIDAS data
 - Continued collecting and processing GPS/AVL data
 - Continued collecting and processing DMS information
 - Continued processing CCTV image files
 - Worked with USDOT's Southeast Michigan Test Bed and data sources, as necessary
 - Continued work on archiving and data purging processes
- Task 6: Data Management and Distributions Design**
- Monitored and maintained all data sources for use in DUAP on backend servers
 - Safety Pilot data for use in DUAP
 - IMO
 - Weather
 - MVDS
 - VIDAS
 - DMS
 - GPS/AVL
 - Receiving current "intraday" files
 - Received balance of historical files
 - Need 24-hour files
 - Worked with USDOT's Southeast Michigan Test Bed and data sources, as necessary
- Task 6.6: Data Management and Distributions Design**
- Monitored and maintained data sources on backend servers
 - Safety Pilot data for use in DUAP
 - IMO
 - Weather
 - MVDS
 - VIDAS
 - GPS/AVL (intraday files, 24 hour files, and images)
 - DMS
 - Worked with USDOT's Southeast Michigan Test Bed and data sources, as necessary
 - Worked with data source contacts concerning issues with data availability
- Task 7: Data Collection Method Comparison and Exploration**
- Evaluated and analyzed all data sources for use in DUAP
 - Safety Pilot data for use in DUAP
 - IMO
 - Weather
 - MVDS
 - VIDAS
 - GPS/AVL
 - Worked with USDOT's Southeast Michigan Test Bed and data sources, as necessary
 - Continued to attend weekly V-I Test Bed Interoperability meetings
- Task 8: Application Convergence and Sustained Operations**
- Documenting DUAP applications for future use
 - Continued analyzing the sustained functionality of the system
 - Continued analyzing data from data sources
- Task 8.6: Application Convergence and Sustained Operations**
- No activities in this reporting period
- Task 9: Outreach and Awareness**
- Prepared slide presentation for Steve Cook's use
 - Prepared outreach and awareness materials as needed
 - Prepared for and participated in Wx-TINFO Update/Feedback/Future Plans meetings
 - Discussion of future application implementation with SMEs

FISCAL YEAR 2016 PROPOSED ACTIVITES

- Task 1: Concept Review and Refinement**
- No activities in this period
- Task 2: User Needs Development**
- No activities in this period
- Task 2.5: Wx-TINFO Requirements Development**
- No activities in this period
- Task 2.6: User Needs Development**
- Finish evaluating user profile needs
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- Task 3:** Design and Development
 - No activities in this period
- Task 3.5:** Design and Development
 - No activities in this period
- Task 3.6:** Design and Development
 - Continued incorporating road segment data
 - Continued developing pavement analysis processes
- Task 4:** Implementation, Testing and Evaluation
 - No activities in this period
- Task 4.5:** Wx-TINFO System Testing
 - No activities in this period
- Task 4.6:** Implementation, Testing and Evaluation
 - Continue to implement and test weather data source components
 - Continue to develop and implement DUAP application functionality
 - Continue work to assure stability and security of system
 - Continue expanding pavement analysis processes and reporting
 - Continue work on further data analysis for use in reports
 - Continue work on asset condition analysis
 - Continue working on user login/roles
 - Continue implementing user profiles to increase usability
 - Collect feedback from MDOT users as they begin to use DUAP (questions, comments, issues and enhancement opportunities)
 - Continue work on integration of road segments
 - Continue working on ingestion of DSRC data sources
- Task 5:** Procure and Deploy Data Sources
 - No activities in this period
- Task 5.6:** Procure and Deploy Data Sources
 - Continue collecting Safety Pilot data for inclusion in DUAP
 - Continue collecting and processing weather data sources
 - Continue collecting and processing MVDS data source
 - Continue collecting and processing VIDAS data
 - Continue collecting and processing GPS/AVL data
 - Continue collecting and processing DMS information
 - Continue processing CCTV image files
 - Work with USDOT's Southeast Michigan Test Bed and data sources, as necessary
 - Continue work on archiving and data purging processes
- Task 6:** Data Management and Distributions Design
 - No activities in this period
- Task 6.6:** Data Management and Distributions Design
 - No activities in this period
- Task 7:** Data Collection Method Comparison and Exploration
 - Evaluate and analyze other data sources as identified
- Task 8:** Application Convergence and Sustained Operations
 - Continue documenting DUAP applications for future use
 - Continue analyzing the sustained functionality of the system
 - Continue analyzing data from data sources
- Task 8.6:** Application Convergence and Sustained Operations
 - Continue documenting DUAP applications for future use
 - Continue analyzing the sustained functionality of the system
 - Continue analyzing data from data sources
- Task 9:** Outreach and Awareness
 - Prepare outreach and awareness materials, as needed
 - Discussion of future application implementation with SMEs

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

The contract extension is in order to support the IMO 3 initiative. The time extension to January 31, 2017, is the proposed time line to deliver the additional IMO 3 scope per MDOT proposal to FHWA, as well as deliver the remaining components of the DUAP II scope.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

Project expected completion in fiscal year 2017.

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2015**

PROJECT TITLE: Statewide Overall Carbon Fiber Composite Cable Bridge Monitoring

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Matthew Chynoweth

CONTRACT/AUTHORIZATION NO.	2014-0043	PROJECT START DATE	10/01/2013
PROJECT NO.	121365	COMPLETION DATE (Original)	9/30/2020
OR NO.	OR14-039	COMPLETION DATE (Revised)	
RESEARCH AGENCY	Lawrence Technological University		
PRINCIPAL INVESTIGATOR	Nabil Grace		

BUDGET STATUS

FY 2015 Budget		Total Budget	
Vendor Budget FY 2015	\$439,473.85	Total Vendor Budget	\$395,549.00
MDOT Budget FY 2015	\$16,000.00	Adjusted MDOT Budget	\$96,000.00
Vendor FY 2015 Expenditures	\$61,964.85	Total Budget	\$491,549.00
MDOT FY 2015 Expenditures	\$0.00	Total Expenditures	\$98,040.00
		Total Amount Available	\$393,509.00

PURPOSE AND SCOPE

Carbon Fiber Composite Cable (CFCC), and other Carbon Fiber Reinforced Polymer (CFRP) materials are being used for prestressing applications in Michigan bridge rehabilitation and replacement projects. As this is still considered an innovative material, understanding and quantification of the long term behavior based on stress/strain gage readings of previous field deployments is essential for future design and construction considerations. Continued monitoring of the CFCC elements in already constructed bridges will provide information on the long term behavior, and allow for recommendations to be made for future designs, taking into account the behavior of current field deployments.

FISCAL YEAR 2014 ACCOMPLISHMENTS

Completed the setup of the monitoring website and data are now available for review and download. The research team at Lawrence Technological University (LTU) was successful at downloading data from the website and recordings from Bridge Street bridge, M-50 bridge, and M-39 bridge have been checked. Readings from M-50 and M-39 bridges had minor issues that were corrected later on. The system was then working properly in both bridges and the readings conformed to the theoretical calculations. At the close of the Fiscal Year (FY), work was continuing on connecting M-102 bridge to the website and making the data available. As part of the nearly completed construction project, a power system is to be installed on-site. Scheduled maintenance visits to Bridge Street bridge and M-50 bridge were postponed until the necessary power system for M-102 is available.

FISCAL YEAR 2015 ACCOMPLISHMENTS

Data from each bridge has been used for a separate research project, 2013-0065 - Evaluating Long Term Capacity and Ductility of Carbon Fiber Reinforced Polymer prestressing and post tensioning strands. There have been pieces of data collection equipment and sensors that have been noted as not functioning properly, and a meeting with the supplier will take place in early 2016. In the meantime, data received is being used to corroborate analytical calculations and responses.

FISCAL YEAR 2016 PROPOSED ACTIVITIES

Continue monitoring of the four bridges for analysis of performance trends and verify analysis done as part of the other research projects. Also, a meeting with the equipment supplier to troubleshoot malfunctioning sensors will be planned.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

None.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

Expected project completion in fiscal year 2020.

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2015**

PROJECT TITLE: Performance Evaluation of Subgrade Stabilization with Recycled Materials

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Mark Grazioli

CONTRACT/AUTHORIZATION NO.	2013-0065 Z3	PROJECT START DATE	10/1/2013
PROJECT NO.	121387	COMPLETION DATE (Original)	4/30/2015
OR NO.	OR14-009	COMPLETION DATE (Revised)	12/31/2015
RESEARCH AGENCY	Lawrence Technological University		
PRINCIPAL INVESTIGATOR	Nishantha Bandara		

BUDGET STATUS

FY 2015 Budget		Total Budget	
Vendor Budget FY 2015	\$169,909.70	Total Vendor Budget	\$213,535.18
MDOT Budget FY 2015	\$5,300.24	Adjusted MDOT Budget	\$6,157.30
Vendor FY 2015 Expenditures	\$95,517.05	Total Budget	\$219,692.48
MDOT FY 2015 Expenditures	\$426.85	Total Expenditures	\$140,426.20
		Total Amount Available	\$79,266.28

PURPOSE AND SCOPE

Perform thorough review of recycled materials available for potential soils stabilization in Michigan. Obtain representative soil samples throughout Michigan for laboratory testing after the recycled materials are mixed with the soils. Assess the long term performance of projects that have used soil stabilization techniques to date, make recommendations relative to pavement design support values. Develop a guidance matrix for MDOT Engineers to assist with the potential selection of soils stabilization techniques and materials on future projects.

FISCAL YEAR 2014 ACCOMPLISHMENTS

The project started at the beginning of the FY. Soil samples were obtained at three locations throughout the state; two in Metro Detroit and one in the upper peninsula. Laboratory testing began on the collected soils mixing the stabilization materials determined through literature and industry practice review. Field testing occurred on MDOT roadways that were stabilized in 2005, 2008 and 2010.

FISCAL YEAR 2015 ACCOMPLISHMENTS

Laboratory testing was most prevalent throughout this FY. This included the design and fabrication of freeze-thaw apparatus and the soil testing itself. Data was analyzed from the information collected in the laboratory and field. Mechanistic-Empirical design analysis occurred to try and categorize soil stiffness values. Writing of the final report commenced.

FISCAL YEAR 2016 PROPOSED ACTIVITIES

Some very last freeze-thaw soil testing remains. Review and completion of the final report.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

A no cost time extension was required because of material availability and needed adjustments to the freeze-thaw testing protocol.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

Expected completion date in fiscal year 2016.

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2015**

PROJECT TITLE: Improving of Michigan Climatic Files in Pavement ME Design

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Michael Eacker

CONTRACT/AUTHORIZATION NO.	2013-0067 Z3	PROJECT START DATE	10/1/2013
PROJECT NO.	121388	COMPLETION DATE (Original)	4/30/2015
OR NO.	OR14-010	COMPLETION DATE (Revised)	9/30/2015
RESEARCH AGENCY	Michigan Technological University		
PRINCIPAL INVESTIGATOR	Nhanping You		

BUDGET STATUS

FY 2015 Budget		Total Budget	
Vendor Budget FY 2015	\$40,496.40	Total Vendor Budget	\$177,159.40
MDOT Budget FY 2015	\$4,200.00	Adjusted MDOT Budget	\$7,052.03
Vendor FY 2015 Expenditures	\$40,509.34	Total Budget	\$184,211.43
MDOT FY 2015 Expenditures	\$3,927.34	Total Expenditures	\$184,194.37
		Total Amount Available	\$17.06

PURPOSE AND SCOPE

1. Review existing Michigan climatic data in the Pavement ME Design software for errors and missing data. Correct any errors and fill in missing data when found.
2. Conduct sensitivity analysis of pavement designs to individual weather data items.
3. Search for alternative sources of weather data to add to existing weather stations in the software or create new ones.
4. Develop a procedure for obtaining weather data for new stations and putting it in the correct format.
5. Determine where it would be beneficial to have additional weather stations for pavement design.
6. Provide additional weather data and new stations in the proper format for use in the Pavement ME Design software.

FISCAL YEAR 2014 ACCOMPLISHMENTS

- Literature review to see what other states are doing to improve on weather data used for pavement design.
- Created algorithms in Microsoft Excel that found errors and missing data in the weather station files currently in the Pavement ME Design software for Michigan. Decisions were made on how to replace errors and how to fill-in missing data.
- Conducted sensitivity analysis of pavement designs to changes in each of the five items of weather data used in Pavement ME Design. Each weather item was changed individually by small increments to see how each one affects the distress predictions in the software.
- A search was conducted to find additional sources of data for adding to existing stations and to add new stations. The review of sources included Road Weather Information System (RWIS) operated by MDOT.
- Started work on the procedure for obtaining new data and putting it in the correct format.

In addition to the above, quarterly meetings between MDOT and MTU were held to discuss work progress, make sure expected work was being accomplished, and provide guidance on future work.

FISCAL YEAR 2015 ACCOMPLISHMENTS

- Eight years of data were added to Michigan weather stations currently existing in the ME software.
- Fourteen new weather stations were added to fill in geographical gaps in the Michigan weather stations.
- The state was divided into climatic zones.
- The draft final report was delivered and was still being edited as of September 30.
- The new weather files for bullet points 1 and 2 above were delivered.
- The Microsoft Excel-based macros for putting raw weather data in the correct format for ME were delivered.

FISCAL YEAR 2016 PROPOSED ACTIVITIES

MDOT anticipates the project final acceptance and publishing of the final report to occur in October 2015.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

A no cost time extension was granted in the summer of 2015 to provide additional time for reviewing the final deliverables, which included weather station files and the final report.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

The new weather files will be distributed to MDOT designers for use in ME designs. Chapter 8 of the MDOT ME User Guide For Mechanistic-Empirical Pavement Design – Interim Edition, will be revised to reflect these new stations.

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2015**

PROJECT TITLE: Wireless Data Collection and Retrieval of Bridge Inspection/Management Information

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Rich Kathrens

CONTRACT/AUTHORIZATION NO.	2013-0067 Z2	PROJECT START DATE	10/1/2013
PROJECT NO.	121389	COMPLETION DATE (Original)	9/30/2015
OR NO.	OR14-021	COMPLETION DATE (Revised)	9/30/2016
RESEARCH AGENCY	Michigan Technological University		
PRINCIPAL INVESTIGATOR	Collin Brooks		

BUDGET STATUS			
FY 2015 Budget		Total Budget	
Vendor Budget FY 2015	\$187,735.24	Total Vendor Budget	\$356,497.90
MDOT Budget FY 2015	\$19,140.00	Adjusted MDOT Budget	\$20,939.54
Vendor FY 2015 Expenditures	\$153,602.55	Total Budget	\$377,437.44
MDOT FY 2015 Expenditures	\$154.64	Total Expenditures	\$324,319.39
		Total Amount Available	\$53,118.05

PURPOSE AND SCOPE

The overall goal is to help MDOT take advantage of the advances in portable data entry technologies, reduce the need for field staff time to collect bridge inspection data and thereby have a safer bridge inspection program, and provide a compatible path forward to a more efficient bridge inspection process that is available to all appropriate MDOT staff and managers.

Develop a wireless web/tables based bridge inspection data collection system. This system will use 2D and/or 3D models to help collect data and integrate with MDOT Michigan Bridge Reporting System and other current MDOT bridge inspection process and web applications.

FISCAL YEAR 2014 ACCOMPLISHMENTS

The following tasks were completed during 2014:

Task 1: Literature Search for ongoing and recently completed research (state-of-the-practice) which included a state-of-the-practice report identifying and evaluating existing commercial applications as well as developing research techniques. (Delivered to MDOT 2/15/2014)

Task 2: Review MDOT's existing (National Bridge Inventory) NBI and AASHTO Element data collection process which included coordination with MDOT bridge inspection management and field personnel to arrange for selected research staff to review the existing National and MDOT bridge inspection methods. Several meetings and workshops were completed on 12/17/2013, 2/25/2014, and 5/29/2014.

FISCAL YEAR 2015 ACCOMPLISHMENTS

A report was completed summarizing the evaluation of the current best practices and literature review for similar data collection methods. The project team met to several times to evaluate and document MDOT's bridge inspection process. This information was used to develop a detailed list of software and project requirements for developing the data collection application. Through this interactive design process the project team created a data collection application using MDOT's existing structure inventory and appraisal information and sophisticated gaming technology to generate 3D models of the structures that can be used to accurately collect quantity and location of bridge defects and deterioration.

FISCAL YEAR 2016 PROPOSED ACTIVITIES

Development and test the link between MDOT's Bridge Database and the 3D application data collection system to verify that data is being save correctly in MDOT's database and for retrieval with the MiBRIDGE web application. This includes reviewing security protocol to develop a method to upload data based on the user's id and security levels. Finalize the development of 3DWBIS application for use on multiple platforms and devices. Finalize the development of "user" input to better develop the 3D models and add the ability to collect NBI condition information to further make this an all-inclusive bridge inspection field application.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

A one year extension was approved to finalize the 3D data collection system for use on all bridges within the state of Michigan. This will provide an advance tool for inspectors to accurately and efficiently collect the required AASHTO element level data per FHWA requirements.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

- Project completion expected in fiscal year 2016.
- Task 1 – Develop/Test 3DWBIS Database Integration
- Task 2 – Finalize App Development for Cross Platform Use
- Task 3 – Finalize Development of 3D model customizations
- Task 4 – Collection of Additional Inspection Data

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2015**

PROJECT TITLE: A Method to Access the Use of New and Recycled Materials in Pavements

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Nathan Maack

CONTRACT/AUTHORIZATION NO.	2013-0066 Z1	PROJECT START DATE	10/1/2013
PROJECT NO.	121398	COMPLETION DATE (Original)	3/31/2015
OR NO.	OR14-008	COMPLETION DATE (Revised)	6/30/2015
RESEARCH AGENCY	Michigan State University		
PRINCIPAL INVESTIGATOR	Mohammed Emin Kutay		

BUDGET STATUS

FY 2015 Budget		Total Budget	
Vendor Budget FY 2015	\$103,740.98	Total Vendor Budget	\$198,655.00
MDOT Budget FY 2015	\$3,000.00	Adjusted MDOT Budget	\$0.00
Vendor FY 2015 Expenditures	\$79,465.35	Total Budget	\$198,655.00
MDOT FY 2015 Expenditures	\$0.00	Total Expenditures	\$174,379.37
		Total Amount Available	\$24,275.63

PURPOSE AND SCOPE

To develop a methodology to evaluate new and recycled materials for use in pavements.

FISCAL YEAR 2014 ACCOMPLISHMENTS

The research team completed a literature review of how other states evaluate new and recycled materials and what testing is performed. A framework was developed to evaluate any new and recycled materials for use in pavements. The team began to develop software incorporating the framework developed and started validation of the software using existing materials used by MDOT. The research team met twice with the advisory panel. The final report was started.

FISCAL YEAR 2015 ACCOMPLISHMENTS

The research team completed the NewPave Software. A training for the software was held with MDOT. The research team met twice with the advisory panel. The draft final report was submitted for review. The project manager and principal investigator met to discuss the draft final report. The final report was submitted and accepted.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

MDOT needed more time to review the draft final report.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

The NewPave Software is being evaluated by MDOT to determine the best way to incorporate it into the evaluation of new materials.

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2015**

PROJECT TITLE: Connected/Automated Vehicle and Infrastructure Research

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Paul Ajegba

CONTRACT/AUTHORIZATION NO.	2014-0006	PROJECT START DATE	10/1/2013
PROJECT NO.	122203	COMPLETION DATE (Original)	9/30/2015
OR NO.	OR14-053	COMPLETION DATE (Revised)	6/30/2017
RESEARCH AGENCY	University of Michigan		
PRINCIPAL INVESTIGATOR	Peter Sweatman		

BUDGET STATUS

FY 2015 Budget		Total Budget	
Vendor Budget FY 2015 (Revised)	\$1,659,840.00	Total Vendor Budget	\$3,000,000.00
MDOT Budget FY 2015 (Revised)	\$24.81	Adjusted MDOT Budget	\$200,000.00
Vendor FY 2015 Expenditures	\$1,659,840.00	Total Budget	\$3,200,000.00
MDOT FY 2015 Expenditures	\$24.81	Total Expenditures	\$1,659,864.81
		Total Amount Available	\$1,540,135.19

PURPOSE AND SCOPE

To construct a research test bed to investigate and evaluate technologies related to the interfacing of roadway infrastructure (including smart and connected technologies) and roadway vehicles (connected and automated vehicles). The safe operation of connected and automated vehicles requires technological advances in roadway infrastructure including, but not limited to, roadside communication equipment for connected vehicles, road weather information system (RWIS) technologies, Intelligent Transportation System (ITS) infrastructure, pavement delineation devices (reflectors, pavement markings, freeway lighting), sign supports, signs (dynamic and static) and intersection treatments (traffic signals, pedestrian signals/signing). Knowledge gained from research performed at this newly constructed UM Mobility Transformation Facility (Test Track) will help MDOT improve safety, mobility and efficiency of the public roadway system by accommodating and implementing connected and automated vehicle technologies.

FISCAL YEAR 2014 ACCOMPLISHMENTS

A construction project was awarded to Angelo Lafrate Construction Company. The anticipated completion of construction is on November 14, 2014.

Progress- To- Date:

- 1) UMTRI tours of the construction site were performed on September 10-12 for the 21st ITS World Congress held in Detroit, Michigan.
- 2) Detention Ponds 100% complete.
- 3) 95% completion of the storm sewer installations.
- 4) Approximately 95% completion of the mass earthwork balancing.
- 5) Began installation of the MSE wall along the creek on the south end of the job site.
- 6) Began electrical power supply installation with DTE coordination.

*Project payments are based on Milestones.

Since no milestone was 100% complete by September 30, 2014, no payments were made during Fiscal Year (FY) 2014.

FISCAL YEAR 2015 ACCOMPLISHMENTS

On July 20, 2015, UM/UMTRI held a very successful Open House at the newly constructed M-City/Test Track. The facility was open to the public during the evening hours the week of July 20th.

Completed both Milestones # 2 and #3 [Parts B & C respectively].

Both Milestones #4 and # 5 were near completion as of September 30, 2015.

Design consultant will prepare a set of as-constructed plans for delivery to MDOT by first quarter of FY 2016 [Oct/Nov. 2015].

FISCAL YEAR 2016 PROPOSED ACTIVITIES

Complete both Milestones # 4 and #5. Turn in to MDOT a set of as-constructed plans. Plan and develop the project final report.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

The project completion date was extended to June 30, 2017 to match the University's funding commitment time line and allow extra time to plan and develop the project final report.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

Project completion expected in fiscal year 2017.

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2015**

PROJECT TITLE: Performance of Michigan's Jointed Portland Cement Concrete (PCC) Pavements – Phase II

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Alan Robords

CONTRACT/AUTHORIZATION NO.	2006-0181 Z7	PROJECT START DATE	3/8/2007
PROJECT NO.	126181	COMPLETION DATE (Original)	9/30/2008
OR NO.	OR07-018	COMPLETION DATE (Revised)	
RESEARCH AGENCY	Soils and Materials Engineers		
PRINCIPAL INVESTIGATOR	Starr Kohn		

BUDGET STATUS

FY 2015 Budget		Total Budget	
Vendor Budget FY 2015	\$0.00	Total Vendor Budget	\$164,674.55
MDOT Budget FY 2015	\$0.00	Adjusted MDOT Budget	\$0.00
* Vendor FY 2015 Expenditures	\$415.00	Total Budget	\$164,674.55
MDOT FY 2015 Expenditures	\$0.00	Total Expenditures	\$164,674.55
		Total Contract Amount Available	\$0.00

PURPOSE AND SCOPE

Analyze collected data on 130 PCC pavements constructed between 1980 and 2000. Run multi-variant statistical analyses on collected data. Determine which components exert the most influence on pavement performance. Identify the best performing pavements and the factors contributing to the superior performance.

FISCAL YEAR 2007 ACCOMPLISHMENTS

Completed the separation and re-tabulation of data into usable spreadsheet.

FISCAL YEAR 2008 ACCOMPLISHMENTS

Identified portions of collected data with sufficient populations to complete multi-variant statistical analyses. Tried to isolate components influential on pavement performance.

FISCAL YEAR 2009-2014 ACCOMPLISHMENTS

None.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

* Cost Reimbursement Adjustment: The Office of Commission Audits Report 2013-245; issued in June 2013, reported the results of cost reviews performed on three (3) contracts/various authorizations executed between MDOT & SME. This project was under contract 2006-0181/Authorization #7. OCA findings in this case were that SME understated their cost reimbursement for fixed fees and overstated cost associated with Overhead and FCC. The net result was a final payment to SME in the amount of \$415 paid in FY 2015. The project total expenditures paid by MDOT equaled the total contract amount of \$164,674.55

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

Not applicable.

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2015**

PROJECT TITLE: Active Traffic Management (ATM) Technical Support

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Collin Castle

CONTRACT/AUTHORIZATION NO.	2013-0236/Auth. 4 R1	PROJECT START DATE	7/1/2015
PROJECT NO.	127937	COMPLETION DATE (Original)	12/1/2015
OR NO.	OR15-519	COMPLETION DATE (Revised)	04/15/2016
RESEARCH AGENCY	HNTB		
PRINCIPAL INVESTIGATOR	Morris		

BUDGET STATUS

FY 2015 Budget		Total Budget	
Vendor Budget FY 2015	\$49,857.00	Total Vendor Budget	\$49,857.00
MDOT Budget FY 2015	\$5,000.00	Adjusted MDOT Budget	\$5,000.00
Vendor FY 2015 Expenditures	\$14,613.15	Total Budget	\$54,857.00
MDOT FY 2015 Expenditures	\$0.00	Total Expenditures	\$14,613.15
		Total Amount Available	\$40,243.85

PURPOSE AND SCOPE

The development of an Active Traffic Management (ATM) Technical Agenda was requested based on an Office Memorandum, dated January 12, 2015, from Gregory C. Johnson, P.E. The purpose of the ATM Technical Agenda is to ensure MDOT is approaching ATM applications of technology and operational business practices in a cohesive manner throughout the state. The scope of the request included the following:

- Reviewing past and current experience with ATM applications, projects, and operations.
- Developing a guidance document to assist department staff in selecting and implementing ATM.
- Developing a methodology for monitoring and adjusting on-going operations for ATM applications.
- Providing an understanding and/or recommendation for the following topics:
 - Capital and operating costs and benefit/cost analysis
 - Use of tolling and High Occupancy Vehicle (HOV)
 - Legal or statutory restrictions or modifications necessary
 - Coordination with transit providers, emergency response agencies, and law enforcement
 - Relationship of ATM to existing statutory and regulatory provisions and recommendations for changes
 - Role and relationship of ATM decision making process to the Engineering Operations Committee (EOC), its subcommittees, and the Project/Program Review Board (PPRB)

FISCAL YEAR 2015 ACCOMPLISHMENTS

The following are Fiscal Year 2015 Accomplishments:

- Researching and documenting the requested ATM considerations (as defined in the scope of the office memorandum request)
- Development of a Draft Active Traffic Management Technical Agenda

FISCAL YEAR 2016 PROPOSED ACTIVITIES

The Fiscal Year 2016 Proposed Activities include finalizing the Active Traffic Management Technical Agenda, Task 5.2 for the ATM workshop, and task 5.4 for the guidance document. The final report's original planned completion date was December 1, 2015. Work is still underway and a final report is expected in early 2016.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

Contract No. 2013-0236; Authorization No. 4/R1 service completion date is April 15, 2016.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

Expected project completion in fiscal year 2016.

100% FEDERALLY FUNDED PROJECTS

Sequentially Listed by Job Number

**RESEARCH ADMINISTRATION
TRANSPORTATION POOLED FUND STUDY
ANNUAL REPORT - FISCAL YEAR 2015**

STUDY TITLE: Environmental Technical Assistance Program (ETAP)

FUNDING SOURCE: FHWA OTHER (PLEASE EXPLAIN)

TPF NO.	SPR 1284 (007)	MDOT START DATE	10/1/2010
PROJECT NO.	115024	MDOT COMPLETION DATE (Original)	9/30/2015
OR NO.	OR11-009	COMPLETION DATE (Revised)	9/30/2020
TECHNICAL CONTACT			
LEAD AGENCY	American Association of State Highway and Transportation Officials (AASHTO)		
PROJECT MANAGER	Margaret Barondess, 517-335-2621		
CONTRACTOR			

BUDGET STATUS					
FY 2015 Budget			Total Budget		
FY FUNDS	(Original)	\$8,000.00	TOTAL COST	(Original)	\$40,000.00
	(Revised)*			(Revised)	\$64,000.00
TOTAL FY 2015 EXPENDITURES *		\$8,000.00	Total Committed Funds Available		\$40,000.00

PARTICIPATING STATES

ABBREVIATE THE PARTICIPATING STATES. IF MDOT IS THE LEAD AGENCY, ALSO LIST THE CONTRIBUTION PERCENTAGE PER STATE.

Not applicable.

PURPOSE AND SCOPE

The Environmental Technical Assistance Program (ETAP) helps optimize the value of transportation investments by promoting sustainable solutions that reduce congestion, energy use, emissions, and life cycle costs. For the Efficiency and Effectiveness Goal, it identifies streamlining measures and supports faster, more efficient product delivery. This is the Fiscal Year (FY) 2015 annual membership fee for AASHTO's ETAP.

FISCAL YEAR 2012 ACCOMPLISHMENTS

MDOT supported the ETAP which supplied weekly newsletters distributed to 58 people, mostly MDOT employees. The newsletters provided current information on environmental research, policy, and procedure. This is a one-of-a-kind resource that would be difficult to replace. Membership also includes a scholarship to attend the annual AASHTO Standing Committee on the Environment.

FISCAL YEAR 2013 ACCOMPLISHMENTS

- MDOT received a weekly newsletter with recent information on environmental research, regulation, guidance, and laws as they related to transportation.
 - This product is shared via email to a list of 58 individuals within MDOT, FHWA, local agencies, and regulatory agency staff.
 - The newsletter is a high quality product that enables staff to act quickly on new information, along with facilitating discussions with outside entities.
 - ETAP also provides a scholarship for one staff person to attend the annual AASHTO Standing Committee on the Environment meeting in Virginia Beach, Virginia.
- Deliverables that benefit MDOT include continued delivery of the newsletter throughout the next FY.

FISCAL YEAR 2014 ACCOMPLISHMENTS

The weekly newsletter was successfully delivered via email to staff at MDOT, FHWA, local agencies, and regulatory agencies. One staff person attended the annual Standing Committee on the Environment meeting in Portland, Oregon.

FISCAL YEAR 2015 ACCOMPLISHMENTS

Continued to distribute the newsletter via email on a weekly basis and sent one MDOT staff person to the Standing Committee on the Environment in Salt Lake City, UT. One staff member also attended a special meeting on noise impacts of transportation projects in Baltimore, MD, also paid for by this membership.

FISCAL YEAR 2016 PROPOSED ACTIVITIES

Continue to distribute the newsletter and use the scholarship to attend the annual meeting of the AASHTO Standing Committee on the Environment.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

Since this is an on-going program, a decision was made this year to extend funding to 2020.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION

Project expected completion in fiscal year 2020.

**RESEARCH ADMINISTRATION
TRANSPORTATION POOLED FUND STUDY
ANNUAL REPORT - FISCAL YEAR 2015**

STUDY TITLE: AASHTO Engineering Technical Service Programs

FUNDING SOURCE: FHWA OTHER (PLEASE EXPLAIN)

TPF NO.	SPR 1284 (019)	MDOT START DATE	10/1/2014
PROJECT NO.	115193	MDOT COMPLETION DATE (Original)	9/30/2015
OR NO.	OR15-503	COMPLETION DATE (Revised)	
TECHNICAL CONTACT			
LEAD AGENCY	American Association of State Highway and Transportation Officials (AASHTO)		
PROJECT MANAGER	Andre Clover, 517-636-6053		
CONTRACTOR			

BUDGET STATUS

FY 2015 Budget			Total Budget		
FY Budgeted Funds	(Original)	\$100,000.00	TOTAL COST	(Original)	\$100,000.00
FY Billed Invoices	(Revised)	\$105,000.00		(Revised)	\$105,000.00
TOTAL FY 2015 EXPENDITURES		\$105,000.00	Total Committed Funds Available		\$0.00

PARTICIPATING STATES

ABBREVIATE THE PARTICIPATING STATES. IF MDOT IS THE LEAD AGENCY, ALSO LIST THE CONTRIBUTION PERCENTAGE PER STATE.
Not applicable.

PURPOSE AND SCOPE

The programs provide benefits to the member departments through the pooling of resources and expertise from across the country.

MDOT has the opportunity to support the development and continued operation of each of the following critical programs:

- AASHTO Innovation Initiative/Technology Implementation Group (TIG) - \$6,000
- Transportation Curriculum Coordination Council (TC3) - \$20,000
- Snow and Ice Cooperative Program (SICOP) - \$4,000
- Transportation System Preservation (TSP2) - \$20,000
- Equipment Management Technical Services Program (EMTSP) - \$3,000
- National Transportation Product Evaluation Program (NTPEP) - \$12,000
- Highway Safety Policy and Management Technical Service Program - \$10,000
- Load and Resistance Factor Design (LRFD) Bridges and Structures Specification Maintenance (LRFDSM) - \$10,000
- Operations Technical Service Program - \$15,000

FISCAL YEAR 2014 ACCOMPLISHMENTS

MDOT's financial support of the Technical Service Programs.

FISCAL YEAR 2015 ACCOMPLISHMENTS

MDOT paid all AASHTO TSP's invoices received in fiscal year 2015 to support their respective operations.

FISCAL YEAR 2016 PROPOSED ACTIVITIES

MDOT technical experts will review and recommend to the Director those TSP's that best benefit the products and services provided by MDOT in administering its business operations.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

None.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION

Each fiscal year MDOT will review and assess the return on its investment in the above list of AASHTO TSP programs. If value is served in a particular program, MDOT will continue its contribution to that program. If value is not being served from a particular program; MDOT may choose to discontinue its contribution.

**RESEARCH ADMINISTRATION
TRANSPORTATION POOLED FUND STUDY
ANNUAL REPORT - FISCAL YEAR 2015**

STUDY TITLE: Development of Maintenance Decision Support System

FUNDING SOURCE: FHWA OTHER (PLEASE EXPLAIN)

TPF NO.	TPF-5(054)	MDOT START DATE	06/01/2012
OR NO.	OR14-034	MDOT COMPLETION DATE (Original)	9/30/2015
		COMPLETION DATE (Revised)	9/30/2018
TECHNICAL CONTACT	David Huft, 605-773-3358		
LEAD AGENCY	South Dakota Department of Transportation		
PROJECT MANAGER	Steve Cook, 517-636-4094		
CONTRACTOR	Meridian Environmental Technology, Inc.		

BUDGET STATUS

FY 2015 Budget			Total Budget		
FY FUNDS	(Original)	\$25,000.00	TOTAL COST	(Original)	\$210,000.00
	(Revised)			(Revised)	
TOTAL FY 2015 EXPENDITURES		\$25,000.00	Total Committed Funds Available		\$75,000.00

PARTICIPATING STATES

ABBREVIATE THE PARTICIPATING STATES. IF MDOT IS THE LEAD AGENCY, ALSO LIST THE CONTRIBUTION PERCENTAGE PER STATE.

CA, CO, IA, ID, IN, KS, KY, MD, MI, MN, ND, NE, NH, NY, PA, SD, VA, WI, and WY

PURPOSE AND SCOPE

Develop a Maintenance Decision Support System (MDSS) winter maintenance operations forecasting tool (computer web-based) that helps reduce winter maintenance costs, increases level of service based on recommendations, and helps provide a reduction in damage to infrastructure and the environment. Also, pilot the MDSS winter maintenance forecasting tool in the Southwest Region during the 2012 & 2013 winter seasons.

FISCAL YEAR 2012 ACCOMPLISHMENTS

Meridian provided training in-person, via email, and over teleconference. The MDSS Graphical User Interface (GUI) manual was updated to reflect the new features that had been developed before the 2012 winter season. The development of a reference guide was also developed and distributed.

FISCAL YEAR 2013 PROPOSED ACTIVITIES

- Meridian, the MDSS vendor, will continue to provide training to any agency requesting training either in-person, via teleconferences, or with webinars. Meridian will also provide impromptu training sessions with those individuals that need additional information during the operational season.
- Develop a post recommendation survey compiled by the operator to document whether the MDSS recommendations match actual conditions.
- Develop a mobile (smartphone) MDSS application. Additional training materials will be created to assist with the release of the mobile application.
- Develop a Mobility Index Factor to give users an indication of level of service achieved using MDSS treatment recommendations.

FISCAL YEAR 2013 ACCOMPLISHMENTS (Benefits to MDOT)

1. The following products or services were delivered from study activities performed in 2013:
 - Refinement of GUI for quality forecasts
 - Refined interface/screen displays
 - Continued support for training in MDOT maintenance garages
 - MDSS smart phone application (app) for Android platform. (Currently working on an iPhone app.)
2. Deliverables that will benefit MDOT if implemented include:
 - Refined forecast and treatment recommendation
 - Better system functionality of the GUI
 - More efficient use of the MDSS program by staff as a result of training
 - Forecast and treatment recommendations providing anticipated savings on materials used
 - Collaboration with other states on better use of the program and changes needed

FISCAL YEAR 2014 ACCOMPLISHMENTS

- Continued refinement of GUI
- Development of MDSS website
- Refined interface/screen displays
- Continued support for training in MDOT maintenance garages
- Developed MDSS app for IOS

- Refined forecast and treatment recommendations
- Created dashboards
- More efficient use of MDSS program by staff as a result of training
- Forecast and treatment recommendations providing anticipated savings on materials used
- Collaboration with other states on better use of program and changes needed

FISCAL YEAR 2015 ACCOMPLISHMENTS

Iteris provided MDSS training to MDOT users across the state. They continued to refine the MDSS website by adding features and functions from the GUI that are useful to maintenance crews. Iteris continues to work on MDSS training videos and have completed 21 short videos for users. The intent is to provide short videos explaining a specific topic so users have access to training information whenever they need it. Iteris also developed 'dashboards' to allow users to very quickly see current and forecasted weather data for user defined locations.

FISCAL YEAR 2016 PROPOSED ACTIVITIES

Iteris will continue to update and improve the MDSS website to add functionality similar to the MDSS GUI. With help from the Technical Advisory Committee (TAC), the vendor will identify the most important functions of the GUI that would be most valuable in the web-based application. The study will examine the potential for using MDSS derived road conditions for estimating a coefficient of friction and use the data to activate warning systems. Finally, the vendor will work to compare actual maintenance treatments to MDSS recommendations.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

The pooled fund project is continuing for at least three additional years as the TAC has determined there are several areas where the MDSS can be upgraded to provide additional value to transportation agencies.

Tasks for the next three years include:

- Developing and refining the performance of the MDSS website
- Performing basic field research to improve MDSS forecasting accuracy
- Developing a module to include real-time traffic data into MDSS
- Improving the MDSS smart phone applications
- Designing and developing a dashboard like interface within the MDSS GUI

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION

1. Due to the success of the implementation in the Southwest Region, the department has expanded its use of MDSS to include all garages statewide. MDOT has recently selected a vendor to provide AVL/GPS as well as a fully functional MDSS for all maintenance garages. The MDSS will include snow route specific treatment recommendations as well as a detailed garage specific weather forecast. As of October 1, 2015, we have started implementing MDSS into our contract agency operations and will continue to roll-out MDSS to contract agencies throughout Fiscal Year (FY) 2016. All contract counties will have access to the MDSS website and will receive training from MDOT staff.
 2. Completion of this project is not expected until FY 2018.
-

**RESEARCH ADMINISTRATION
MDOT TRANSPORTATION POOLED FUND STUDY
ANNUAL REPORT - FISCAL YEAR 2015**

STUDY TITLE: Research Program to Support the Research, Development, and Deployment of System Operations Applications of Vehicle Infrastructure Integration (VII) [Old TPF-5(159)]

FUNDING SOURCE: FHWA OTHER (PLEASE EXPLAIN)

TPF NO.	TPF-5(206)	MDOT START DATE	10/1/2012
OR NO.	OR09-146	MDOT COMPLETION DATE (Original)	12/31/2016
		COMPLETION DATE (Revised)	
TECHNICAL CONTACT	Catherine McGhee Cathy.McGhee@VDOT.Virginia.gov Phone: 434-293-1973		
LEAD AGENCY	Virginia Department of Transportation		
PROJECT MANAGER	Matt Smith, 517-636-5009		
CONTRACTOR			

BUDGET STATUS

FY 2015 MDOT Budget			MDOT Total Budget		
FY FUNDS	(Original)	\$50,000.00	TOTAL BUDGET	(Original)*	\$200,000.00
	(Revised)			(Revised)**	
TOTAL FY 2015 EXPENDITURES		\$50,000.00	Total Committed Funds Available		\$50,000.00

PARTICIPATING STATES

ABBREVIATE THE PARTICIPATING STATES. IF MDOT IS THE LEAD AGENCY, ALSO LIST THE CONTRIBUTION PERCENTAGE PER STATE.

AZ, CA, FL, MI, MN, NJ, NY, PA, TX, UT, VA, WA, WI

PURPOSE AND SCOPE

- Development and evaluation of connected transportation system large scale systems level operations applications
- Support AASHTO's Strategic & Deployment Plans
- Support USDOT's connected vehicles programs and initiatives

FISCAL YEAR 2013 ACCOMPLISHMENTS (Benefits to MDOT)

1. The Pooled Fund Study embarked upon the following four defined initiatives in fiscal year 2013:
 - Development and review of the AASHTO Connected Vehicle Footprint and Deployment Analysis
 - Development of the study "Connected Vehicle Impacts on Traffic Management Center Operations"
 - Development of the "Use of DSRC for Road Weather Management" study
 - Second phase of the Multi-Modal Intelligent Traffic Signal System deployment
2. Deliverables from the above four initiatives will include guidelines, operational changes, and deployment lessons learned. All of these items will directly benefit MDOT with implementation.

FISCAL YEAR 2014 ACCOMPLISHMENTS

1. Completion of the development and review of the AASHTO Connected Vehicle Footprint and Deployment Analysis (MDOT is using this analysis as the framework for our Connected Vehicle deployment.)
2. Completion of the study, "Connected Vehicle Impacts on Traffic Management Center Operations"
This report can be used as a guideline for MDOT Traffic Operations Centers in handling and addressing the influx of data from a connected vehicle environment.
3. Continued development of the "Use of DSRC for Road Weather Management" study
4. Continued development of the second phase of the Multi-Modal Intelligent Traffic Signal System program.
When completed, MDOT can use this program as a basis for Vehicle-to-Infrastructure applications in a connected vehicle environment.
5. Initiation of a project to research accuracy requirements for GPS and mapping in a connected vehicle environment

FISCAL YEAR 2015 ACCOMPLISHMENTS

1. Completion of the "Use of DSRC for Road Weather Management" study
2. Initiation and completion of the "GPS Accuracy for Connected Vehicle Applications" study
3. Continued development of the second phase of the Multi-Modal Intelligent Traffic Signal System program
When completed, MDOT can use this program as a basis for Vehicle-to-Infrastructure applications in a connected vehicle environment.

FISCAL YEAR 2016 PROPOSED ACTIVITIES

1. Complete development of the second phase of the Multi-Modal Intelligent Traffic Signal System program
2. Start an initiative to coordinate with the Society of Automotive Engineers for the development of DSRC messaging standards
3. Begin development of a project to create a standard "Basic Infrastructure Message" to be used on uniform DSRC roadside unit installations

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

None.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION

1. MDOT will benefit from the information developed under phase two of the Multi-Modal Intelligent Traffic Signal System program and the "Use of DSRC for Road Weather Management" study. Results from these two initiatives will be used in the development of connected vehicle deployments in Lansing, MI and in SE Michigan.
 2. If this pooled fund study is approved to continue for two more years, MDOT would like to continue as an active partner state.
-

**RESEARCH ADMINISTRATION
MDOT TRANSPORTATION POOLED FUND STUDY
ANNUAL REPORT - FISCAL YEAR 2015**

STUDY TITLE: Transportation Engineering and Road Research Alliance (TERRA)

FUNDING SOURCE: FHWA OTHER (PLEASE EXPLAIN)

TPF NO.	TPF-5(215)	MDOT START DATE (FUNDING)	10/01/2009
OR NO.	OR10-012	MDOT COMPL. DATE (FUNDING)	09/30/2015
		PROJ.COMPL. DATE (Revised)	
TECHNICAL CONTACT	Glenn Engstrom Glenn.engstrom@state.mn.us 1-651-366-5531		
LEAD AGENCY	Minnesota Department of Transportation		
PROJECT MANAGER	Andre Clover, 517-636-6053		
CONTRACTOR			

BUDGET STATUS					
FY 2015 Budget			Total Budget		
FY FUNDS	(Original)	\$7,000.00	BUDGETED AMT.	(Original)	\$58,500.00
	(Revised)		BUDGETED AMT.	(Revised)**	
TOTAL FY 2015 EXPENDITURES		\$7,000.00	Total Committed Funds Available***		\$0.00

PARTICIPATING STATES

ABBREVIATE THE PARTICIPATING STATES. IF MDOT IS THE LEAD AGENCY, ALSO LIST THE CONTRIBUTION PERCENTAGE PER STATE.

MI, MN, ND, NY, WI, and IA

PURPOSE AND SCOPE

The Transportation Engineering and Road Research Alliance (TERRA) exists to:

- Guide future pavement research investments and activities
- Exchange information, share ideas, and learn research results
- Develop relationships, and provide a network for expanded collaboration and development of proposals
- Attract key public, industry, academic, and other program partners to contribute resources
- Expand entrepreneurial use of the capacity and capabilities of the MnROAD facility by pursuing opportunities to serve a broader research community

TERRA was formed in 2004 by a task force of government, industry, and academic representatives. TERRA's mission is to develop, sustain, and communicate a comprehensive program of research on pavement, materials, and related transportation engineering challenges. This includes issues related to cold climates. TERRA does not fund research, but its members have helped secure funding for a \$10M program of TERRA-initiated research.

All project funds are utilized to implement the strategic directions and action plans of TERRA, as defined and approved by the full TERRA board. Currently, a majority of TERRA's operating funds are being utilized to disseminate research results and help put these results into practice. Project funds will not be used for research projects. Tasks to be supported by these project funds include, but are not limited to:

- Planning and conducting three board meetings and multiple committee meetings each year to establish research priorities, share research findings, exchange information, and define the direction of the organization. Up to two representatives from each member organization can participate on the board.
- Discussing and screening potential research projects and seeking partners from the public, academic, and private sectors to collaborate on these projects. Also, utilizing available resources to ensure research is not duplicative.
- Communicate and disseminate TERRA research results and innovations through the use of communication products such as the website (www.TerraRoadAlliance.org), quarterly electronic newsletter, and fact sheets.
- Putting research results into practice through technology transfer events such as the TERRA Innovation Series.
- Communicating the impacts of the organization's activities to national leaders in transportation. (Organizational support to staff and management of these activities is outsourced.)

\$5,000 per year is requested from each organization for five years. In addition, organizations can cover travel to board meetings by adding \$2,500 per person per year for up to two people.

FISCAL YEAR 2010 ACCOMPLISHMENTS

TERRA board meetings were held on November 12, 2009, March 11, 2010, and August 19, 2010. Multiple meetings were held by the various TERRA committees throughout Fiscal Year (FY) 2010. A TERRA Innovation Series Event was held on August 20, 2010, in Madison, WI. This event highlighted sustainability in transportation and was held in conjunction with the 2010 Mid-Continent Transportation Research Forum. Topics included: Sustainability and Environmental Quality Improvements - Environmental review process, Best Management Practices and Construction Practices used in Wisconsin, Sustainability and Beneficial Reuse of Construction Materials

Used by the Wisconsin DOT, and a Hot-Mix-Asphalt Plant Tour - Incorporation of Post-Consumer Shingles and Recycled Asphalt Pavement (RAP) into Hot-Mix Asphalt (HMA) Pavement.

Following the General TERRA project selection process, a solicitation for research project ideas from partners and friends was conducted in April and May of 2010. Twenty-two projects were submitted in response to this solicitation. Nine project submissions are moving forward in the TERRA project selection process.

TERRA accomplishments in marketing new members resulted in the addition of three new DOT members: Wisconsin, North Dakota, and New York DOTs, as well as one new association; the American Traffic Safety Services Association (ATSSA).

TERRA was represented at the July 2010 Research Advisory Committee meeting in Kansas City by Andre Clover of MDOT. The meeting brought together 120 representatives of state DOTs, federal agencies, universities, and private consultants to see research results and discuss key issues facing the national transportation research community. A TERRA presentation was given at the session on *Breaking Out of the Silos: Coordinating and Collaborating Research Activities to Achieve Greater Strategic Benefits*.

FISCAL YEAR 2011 ACCOMPLISHMENTS

Hosted a TERRA Open House at the MnROAD facility in July of 2011. TERRA also plans to sponsor the Minnesota Pavement Conference in February, 2011. The Research and Implementation committee will provide topic ideas to the Marketing and Communications Committee for Fact Sheet topics and E-News articles. Three research fact sheets will be developed by May, 2011. In addition, a one-pager highlight of FY 2011 accomplishments will be prepared.

FISCAL YEAR 2012 ACCOMPLISHMENTS

TERRA board meetings were held on February 8, 2012 (Winter meeting), August 13, 2012 (Summer meeting), and a November 1, 2012 (Fall meeting) is scheduled. Multiple meetings (see below) were held by the various TERRA committees throughout FY 2012. At the winter meeting, Steve Krebs of the Wisconsin DOT gave a presentation on the Performance and Cost Effectiveness of Warranted HMA Pavements. The Board approved the FY 2012 Performance Measures and FY 2013 Business Plan. More discussion and work is necessary on the FY 2013 Strategic Plan. The Board devoted most of the summer meeting developing a new strategic plan for TERRA. At the summer meeting, the Board held a full-day session on Strategic and Operational Planning. This work will continue at the 2012 fall meeting.

- The Marketing and Communications Committee met on August 2, 2012.
- The Member and Partner Engagement Committee met on August 21, 2012.
- The Research and Implementation Committee that was scheduled for September was rescheduled for October 17, 2012.
- The August 2012 E-News (Vol. 6, No. 3) was distributed on August 1, 2012. A copy can be accessed via the following link: <http://www.terreroadalliance.org/publications/enews/2012/03/>.
 - Ideas were collected through the call for project ideas sent to partners and friends. A total of 15 project ideas were submitted that went through an initial review with the MPE Committee at their August meeting.
 - Work began on the next TERRA Fact Sheet on the topic of innovative diamond grinding. Board members were asked for their suggestions of innovative diamond grinding projects to highlight in the fact sheet, which will be completed in fall of FY 2013.
- The August TERRA Innovation Series event in partnership with Michigan Technological University was held in Houghton, MI. The Pavement Conference Planning Committee met twice to develop the agenda.
- Completed the low temperature cracking project.
- Hosted a webinar on Chip Seals with over 100 attendees.

FISCAL YEAR 2013 ACCOMPLISHMENTS (Benefits to MDOT)

The following products or services were delivered from study activities performed in 2013:

- Completed the fact sheet on innovative diamond grinding
- Completed the strategic plan and committee realignments
- Held Board and Subcommittee meetings
- 2013 Annual Pavement Conference was held on February 14, 2013
- Published E-News articles and technical summaries
- Conducted a webinar on chip seals

FISCAL YEAR 2014 ACCOMPLISHMENTS

The 2013 November TERRA meeting will be used to develop and finalize proposed activities for 2014.

FISCAL YEAR 2015 ACCOMPLISHMENTS

- The 19th Annual TERRA Pavement Conference was held February 12, 2015, in St. Paul, MN
- Held the Trunk Highway 24 Concrete Overlay Project Open House. This May 21st event showcased a 15 mile long, 4" thick BCOA project that was completed last year near Litchfield, MN. The primary goals of this open house were to share the lessons learned during the construction of the project.
- Ten reports were published about road research focusing on cold climates.

FISCAL YEAR 2016 PROPOSED ACTIVITIES

This project will sunset in 2015. A new organization named National Road Research Alliance (NRRRA) is currently posted under Solicitation No. 1410 on the FHWA TPF Program website. The new pooled fund is aimed at strategic implementation through cooperative pavement research with primary emphasis on local and state-sponsored research, implementation, technology transfer, and training.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

TERRA members accepted a plan to restructure the organization which was presented at the General Assembly Meeting in May 2015 by Minnesota Department of Transportation. The plan propose the establishment of a new pooled fund to focus on building a more robust road research and implementation program.

SUMMARY OF THE IMPLEMENTATION

TERRA members have helped secure funding for a \$10M program of TERRA-initiated research. Subcommittee work outcomes include the communication and dissemination of TERRA research results and innovations via the website (www.TerraRoadAlliance.org), producing publications like the quarterly electronic newsletter and fact sheets.

**RESEARCH ADMINISTRATION
MDOT TRANSPORTATION POOLED FUND STUDY
ANNUAL REPORT - FISCAL YEAR 2015**

STUDY TITLE: Clear Roads Winter Highway Operations Pooled Fund

FUNDING SOURCE: FHWA OTHER (*PLEASE EXPLAIN*)

TPF NO.	TPF-5(218)	MDOT START DATE	10/1/2009
OR NO.	OR13-015	MDOT COMPLETION DATE (Original)	9/30/2011
		COMPLETION DATE (Revised)	9/30/2017
TECHNICAL CONTACT	Debra Fick deb.fick@dot.state.mn.us Phone: 651-366-3759		
LEAD AGENCY	Minnesota Department of Transportation		
PROJECT MANAGER	Justin Droste, 517-636-0518		
CONTRACTOR			

BUDGET STATUS

FY 2015 Budget			Total Budget		
FY FUNDS	(Original)	\$50,000.00	TOTAL COST	(Original)	\$200,000.00
	(Revised)			(Revised)**	
TOTAL FY 2015 EXPENDITURES		\$50,000.00	Total Committed Funds Available		\$50,000.00

PARTICIPATING STATES

ABBREVIATE THE PARTICIPATING STATES. IF MDOT IS THE LEAD AGENCY, ALSO LIST THE CONTRIBUTION PERCENTAGE PER STATE.

CA, CO, IA, ID, IL, KS, MA, ME, MI, MN, MO, MT, ND, NE, NH, NY, OH, OR, PA, UT, VA, VT, WA, WI, WV, WY, AK, AZ, DE, and SD

PURPOSE AND SCOPE

This pooled fund project will maintain its focus on advancing winter highway operations nationally, but it will include a more pronounced emphasis on state agency needs, technology transfer, and implementation. State departments of transportation are aggressively pursuing new technologies, practices, tools, and programs to improve winter highway operations and safety while maintaining fiscal responsibility. This pooled fund is needed to evaluate these new tools and practices in both lab and field settings, to develop industry standards and performance measures, to provide technology transfer and cost benefit analysis, and to support winter highway safety. This project responds to research and technology transfer needs not currently met by other pooled fund projects. Existing partners make every effort to coordinate with other agencies to avoid duplication of efforts and to encourage implementation of results.

Objectives of this ongoing pooled fund project will include:

- Conducting structured field testing and evaluation across a range of winter conditions and different highway maintenance organizational structures to assess the practical effectiveness, ease of use, optimum application rates, barriers to use, durability, safety, environmental impact and cost-effectiveness of innovative materials, equipment, and methods for improved winter highway maintenance.
- Establishing industry standards and developing performance measures for evaluating and utilizing new materials and technologies.
- Supporting technology transfer by developing practical field guides and a training curriculum that will promote the results of research projects.
- Conducting cost-benefit analysis to ensure that new technologies, materials, or methods contribute to operational efficiency.
- Supporting the exchange of information and ideas via peer exchanges and collaborative research efforts that provide opportunities for maintenance specialists to share experiences related to winter maintenance.
- Promoting public education and outreach related to winter maintenance and winter driving safety.
- Conducting state of the practice surveys to share best practices on current operational issues. (For example: Salt shortages, level of service requirements, or other hot button issues).

Included in the Scope of work: Research reports, technical briefs, synthesis reports, field guides, specifications, PowerPoint presentations, video documentation, training materials, public safety messages, and software programs.

FISCAL YEAR 2012 ACCOMPLISHMENTS

Clear Roads closed out the following projects in Fiscal Year (FY) 2012:

- Mapping Weather Severity Zones
- Snow Removal At Extreme Temperatures
- Developing a Training Video for Field Testing of Deicing Materials
-

The following research projects either began or remained in progress during FY 2012:

- Environmental Factors Causing Fatigue in Snowplow Operators
- Cost-Benefit Analysis Toolkit - Phase II
- Determining the Toxicity of Deicing Materials
- Development of a Totally Automated Spreading System
- Understanding the True Costs of Snow and Ice Control Operations

MDOT staff will be incorporating results from some of these research projects into presentations given to our maintenance personnel at the Transportation Service Centers and contract agencies during Winter Operations Workshops in the fall.

FISCAL YEAR 2013 ACCOMPLISHMENTS (Benefits to MDOT)

1. The Clear Roads pooled fund study completed two research projects and several other projects commenced during the 2013 FY. The two completed projects and their respective deliverables are described below.

Cost-Benefit Analysis Toolkit - Phase II

An updated version of the cost-benefit analysis toolkit with enhanced features and expanded functionality to include additional materials, equipment, and methods was developed.

Snow Removal at Extreme Temperatures

The final report compiled strategies for winter maintenance during extreme cold events where salt is not an effective deicer. The strategies outlined in the report are currently used in other states and countries for maintaining an acceptable level of service during cold weather.

2. Deliverables that will benefit MDOT if implemented:

Cost-Benefit Analysis Toolkit - Phase II

MDOT has already used the toolkit to help justify instrumenting our winter maintenance truck fleet with AVL/GPS devices for monitoring the activities of our fleet, reporting the hours and miles driven, and operational data such as the amount of deicing material used, amount of hours the plow blade was down, etc. By inputting MDOT specific cost data in the cost-benefit toolkit, we were able to generate a cost-benefit (C/B) that is specific to MDOT. This C/B information was provided to management.

Snow Removal at Extreme Temperatures

Some of the strategies as outlined in the final report were incorporated into our winter maintenance training program for use by our direct-force garages and contract agencies.

FISCAL YEAR 2014 ACCOMPLISHMENTS

The Clear Roads pooled fund study completed two research projects and several other projects commenced during the 2014 FY. The two completed projects and their respective deliverables are described below.

Comparison of Materials Distribution Systems

This is a photographic catalog of all the different types of material distribution systems identified across the country. MDOT can use this catalog to see what others across the country are using for winter material application systems and examine them for potential use in Michigan.

Environmental Factors Causing Fatigue in Snowplow Operators

This project includes recommendations on some cost-effective solutions to mitigate driver fatigue and potential avenues for further research. The vendor for this project will be speaking on the subject at the 2015 LTAP winter conference. Methods to reduce fatigue is something that is important to MDOT.

FISCAL YEAR 2015 ACCOMPLISHMENTS

The Clear Roads pooled fund study completed two research projects and several other projects commenced during the 2015 FY. The two completed projects and their respective deliverables are described below.

Best Practices for the Prevention of Corrosion to DOT Equipment: A User's Manual.

This is a guide that summarizes, in layman's terms, the best practices to prevent corrosion to maintenance equipment. The MDOT Fleet team is highly interested in the information presented in the corrosion guide and plans to incorporate it into best practice procedures for winter equipment.

Weather Severity Mapping Enhancement

This includes a set of state-specific maps tailored to each member state's interest. MDOT's Office of Field Services has used the Michigan Winter Severity Map to show management how winter weather can impact operating costs in different parts of the state. The map was also used to convey a new winter severity measuring process that MDOT adopted.

FISCAL YEAR 2016 PROPOSED ACTIVITIES

The Clear Roads pooled fund study plans to complete two research projects and several other projects during the 2016 FY. These projects and their respective deliverables are described below.

Training Video and Manual for Best Practices and Techniques in Clearing Different Interchange Configurations and Other Geometric Layouts.

This will be a 15-20 minute video that showcases the most efficient pass sequences to properly clear various interchange and intersection layouts. MDOT plans to use this to instruct operators on the best way(s) to safely clear various intersection geometries.

Plug and Play Initiative

Establishment of this protocol will mutually benefit Clear Roads member states and their vendors by standardizing how critical operational data is shared on modern snow and ice vehicles, namely between compatible Automatic Vehicle Location (AVL) devices and anti-icing/deicing Joystick and Spreader Controller systems. MDOT could use this proposed protocol to make sure that future AVL vendor products are self-certified to communicate AVL information correctly.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

During the last week in September of 2015, the TAC held a Fall Meeting. One topic discussed was that this pooled fund project needs to be closed. MnDOT plans to close the current study after FY 16. In FY 2017, a 'new' TPF federal project number will be created and will carry beyond FY 2017.

All remaining study funds will transfer to the new study number and all Clear Roads project aspects will be performed in the same manner as before. MDOT will commit FY 2017 funds to the new number once it's assigned.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION

1. Expand the use of the Cost-Benefit toolkit to justify implementation of other best practices and technologies.
 2. Recommendation to RAC to use the toolkit for other practices and/or technology deployments.
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**RESEARCH ADMINISTRATION
MDOT TRANSPORTATION POOLED FUND STUDY
ANNUAL REPORT - FISCAL YEAR 2015**

STUDY TITLE: ITS Pooled Fund Program (ENTERPRISE)

FUNDING SOURCE: FHWA OTHER (PLEASE EXPLAIN)

TPF NO.	TPF-5(231)	MDOT START DATE	10/01/2009
PROJECT NO.	111159	MDOT COMPLETION DATE (Original)	09/30/2014
OR NO.	OR10-015	COMPLETION DATE (Revised)	09/30/2019
TECHNICAL CONTACT	Lee Nederveld nederveldl@michigan.gov 517-335-5317		
LEAD AGENCY	Michigan Department of Transportation		
PROJECT MANAGER	Lee Nederveld, 517-335-5317		
CONTRACTOR	Athey Creek Consultants		

TOTAL PROJECT BUDGET STATUS

* MDOT Project Total Budget		Project Total Budget			
FY 2015 MI-BUDGET	(Original)	\$35,000.00	TOTAL COST	(Original)*	\$1,565,000.00
	(Revised)			(Revised)**	\$2,030,000.00
TOTAL FY 2015 MDOT EXPENDITURES		\$0.00	Total Committed Funds Available		\$865,888.00

Year	Cumulative MDOT Expenditures	Project Total Expenditures
2014	\$ 175,000.00	N/A
2015	\$ 175,000.00	\$1,164,112.00

PARTICIPATING STATES

ABBREVIATE THE PARTICIPATING STATES. IF MDOT IS THE LEAD AGENCY, ALSO LIST THE CONTRIBUTION PERCENTAGE PER STATE.

GA (5.5%), ID (6.9%), IL (6.9%), IA (5.5%), KS (9.1%), MI (8.0%), MN (6.9%), MS (4.1%), Netherlands (5.7%), OK (5.5%), ON (23.7%)
PA (1.4%), TX (6.9%), VA (1.4%), and WA (2.7%)

PURPOSE AND SCOPE

The objectives of the project include the following:

- Investigate and promote Intelligent Transportation Systems (ITS) approaches and technologies that are compatible with other national and international ITS initiatives.
- Support the individual ITS program plans of ENTERPRISE participants.
- Provide a mechanism to support multi-state and international project cooperation and technical information interchange.
- Facilitate the formation of public-private partnerships for appropriate program activities.
- Pursue emerging ITS project opportunities in areas of interest to the group.
- Provide test beds in a variety of environments and locations for emerging ITS technologies.
- Identify common needs within the group and proceed with appropriate technical activities.

Scope of Work

The tasks to be completed as part of the program vary from year to year, and are decided through an annual project selection process, as established by the ENTERPRISE member agencies. As a direct result of this selection process, a work plan is developed annually for the ENTERPRISE program, detailing the projects that will be pursued in the upcoming year.

Program Management and Administration

- Michigan DOT received official approval from FHWA and assignment of a TPF number to accept State Planning and Research funds for the ENTERPRISE Pooled Fund to complete the transition of the administration of the program from the Iowa DOT to Michigan DOT. We began to receive funds from member states for Fiscal Year (FY) 2010.
- A Request for Proposal (RFP) was distributed from Michigan to solicit a program management consultant for the ENTERPRISE Program. Athey Creek Consultants was selected to provide administrative and technical project support. They were authorized to start work on September 10, 2010.

FISCAL YEAR 2011 ACCOMPLISHMENTS TO DATE

New Members

Two new members joined the ENTERPRISE Program (Georgia and Mississippi) in FY 2011.

Program Management and Administration

Michigan DOT received funds from the ENTERPRISE member states for their financial contributions to FY 2011.

Meetings

The ENTERPRISE Executive Board held nine meetings during FY 2011.

- November 8 and 9, 2010 in Phoenix, Arizona – The group discussed the background and accomplishments of the ENTERPRISE Program, discussed program communications (program website, Wikipedia and brochures), discussed the 2011 projects in detail, and provided updates on the 2010 projects.
- January 6, 2011 Conference Call – The group reviewed the management structure of ENTERPRISE, launched a new program website, and discussed the administrative details for Michigan DOT to authorize projects.
- February 3, 2011 Conference Call – The group reviewed the ENTERPRISE budget and provided comments to update the ENTERPRISE management plan, charter, and operating rules.
- March 3 and 4, 2011 in Austin, Texas - The group approved the revised management plan, charter, and operating rules for ENTERPRISE, discussed coordination with other pooled fund efforts, toured the Austin, Texas Combined Transportation and Emergency Management Center (CTECC), and discussed the process of developing future work plans.
- April 7, 2011 Conference Call – A summary of a Connected Vehicle Workshop in Toronto, Canada was given and the group discussed the process and documentation needed to submit 2012 projects ideas.
- May 5, 2011 Conference Call – The group reviewed the submitted 2012 project ideas and discussed support for Non-ENTERPRISE business trips. Project 1 - Developing Consistency in ITS Safety Solutions: Intersection Warning Systems was authorized to begin work on May 13, 2011.
- June 2, 2011 Conference Call – The group approved a document describing how ENTERPRISE would support non-ENTERPRISE business trips.
- July 7, 2011 Conference Call – The group discussed the detailed project scopes for the 2012 projects, and a project update was provided on Project 1 - Developing Consistency in ITS Safety Solutions: Intersection Warning Systems.
- August 28, 2011 in Coeur d' Alene, Idaho – The group reviewed the goals and objectives of the ENTERPRISE program, finalized the proposed 2012 project proposals, voted on the projects, and approved the 2012 Work Plan. The group also voted on and determined the order of starting the approved 2010, 2011 and 2012 projects as well as developed a 2010 – 2012 Work Plan that identifies priorities.

Project Update for Project 1 - Developing Consistency in ITS Safety Solutions: Intersection Warnings Systems

- Project 1 was authorized by ENTERPRISE on May 13, 2011. FHWA agreed to provide further funding in late May to support non-ENTERPRISE states to attend project workshops.
- Webinar 1 was held on June 23, to compile and assess lessons learned from systems that have been developed and field-tested, and then identify challenges with deploying such systems more permanently.
- Workshop 1 was held on July 28-29, to discuss the content of a preliminary standard that builds off the challenges identified during Webinar 1 and to develop a roadmap for reaching standardization.
- Participants have included ENTERPRISE states (ID, IA, KS, MI, MN and WA), other states that have deployed systems (MO, NC, PA, ME and WI), FHWA, NCUTCD, AASHTO and NACE.
- Workshop 2 was held on September 15-16, to review the preliminary standards (guidance) proposed for MUTCD consideration, develop an evaluation framework that may be used in future deployments for experimentation, and discuss plans for future experimentation and coordination.

FISCAL YEAR 2012 ACCOMPLISHMENTS TO DATE

Administrative/Management:

Nine conference calls were held in FY 2012. Two in-person meetings were also held in this FY: One in Kansas City, Missouri in conjunction with the ITS Heartland Annual Meeting, and one in Biloxi, Mississippi in conjunction with the National Rural ITS Conference. Due to the MFOS system FY end process, funding obligations for FY 2012 were not performed; FY 2012 and 2013 transfers will be made during FY 2013.

Projects:

Low-Cost ITS Safety Solution System: Intersection Conflict Warning Systems

Project Goal: Develop a consistent approach for accelerated, uniform deployment and further evaluation of intersection warning systems, and to recommend preliminary standards for MUTCD consideration

- Final Design and Evaluation Guidance for Intersection Conflict Warning System was distributed on December 16, 2011.
- Contacts have been made with several organizations (FHWA MUTCD, 2012 ATSSA Convention and Expo, Evaluation of Low Cost Safety Improvements pooled fund, Traffic Control devices pooled fund) in the roadmap for standardization of ICWS.
- Project completed. The final report is available at: <http://enterprise.prog.org/projects.html>

Impacts of Travel Information on the Overall Network

Project Goal: To understand the impacts of travel information dissemination (at what thresholds of travel times do more travelers begin to divert) on the overall operations of an urban transportation network.

- Project was authorized by ENTERPRISE on October 20, 2011.
 - A project kick-off meeting was held during the November 3, 2011 monthly ENTERPRISE conference call. The group discussed the project concept: compare volume and travel times at selected locations in Minneapolis/St. Paul and Seattle and survey travelers to learn how they use travel time displays and how and why they divert.
 - A draft of the data collection plan was completed.
 - A draft traveler survey was developed and reviewed by the ENTERPRISE Board at the January 2012 monthly board meeting. The survey will be modified for each ENTERPRISE state that would like to distribute the survey.
-

- Surveys were developed and links to the Minnesota and Washington website. The purpose of the surveys is to learn how travelers use travel time displays and how often they divert and why they divert.
- Project completed. The final report is available at: <http://enterprise.prog.org/projects.html>

Understanding Utilization of 3rd Party Data and Information

Project Goal: Document the experiences of public agencies with using 3rd party data and learn from the 3rd party providers.

- Project was authorized by ENTERPRISE on October 20, 2011.
- A project kick-off meeting was held during the November 3, 2011 monthly ENTERPRISE conference call. The group discussed the project which includes identifying public agencies with 3rd party data experience, identifying 3rd party data providers and then identifying what the ENTERPRISE members would like to learn from each other and from the providers. This will be accomplished through webinars and/or in-person discussions.
- A survey was developed and distributed on January 9, 2012 to the ENTERPRISE states to gather interests and focus of the project. The feedback from the ENTERPRISE members was used to develop a Data Collection Plan for presenting the 3rd party data as part of this project. The Data Collection Plan was distributed on 1/23/12.
- Each ENTERPRISE state with 3rd Party Data experience shared information at the March 28 and 29, 2012 ENTERPRISE in person meeting.
- 3rd Party vendors were contacted in order to gain an understanding of the private sector perspective in providing data. A summary of 3rd Party vendor information was shared at the March 28 and 29, 2012 ENTERPRISE in person meeting.
- Project completed. The final report is available at: <http://enterprise.prog.org/projects.html>

The Next Era of Traveler Information

Project Goal: understand how real-time traveler information technology and use is changing and how the changes are impacted by current and emerging trends with dissemination mechanisms and data management practices.

- Project was authorized by ENTERPRISE on March 2, 2012.
- A survey was developed and distributed to the 511 Deployment Coalition contacts to gather high-level information about the current state of practice with real-time traveler information programs around the country. The information was summarized and shared, along with a detailed project schedule, during the ENTERPRISE annual meeting on March 28-29.
- Highlights of the survey and an overview of the project was presented during the ITS Heartland conference on March 27, 2012
- Continued the information exchange of the project by scheduling webinar speakers on the following topics: dissemination tools, cost management, customer needs and wants, data management, and performance targets.
- Webinar 1 was held on 8.16.12. Over 20 states participated in the first webinar featuring trends in dissemination tools and practices in the states of Washington and Wisconsin.
- Webinar 2 was held on 9.13.12. It featured cost management practices – specifically sponsorship – in the states of Georgia and Missouri. It also featured a brief update on USDOT’s effort to define a data exchange format for Real-Time System Management Information Programs.

ICWS Coordination and Systems Engineering – Phase 2

Project Goal: An extension of Project 1, this project will further support the standardization of ICWS by coordinating among the various national standards and association groups, and by developing a concept of operations and system requirements for the four types of ICWS identified in the Design and Evaluation Guidance for Intersection Conflict Warning Systems.

- AASHTO SCOTE passed a resolution to recommend NCUTCD establish a task force, to assess ICWS work by the three pooled funds, and to endorse “Design and Evaluation Guidance for Intersection Conflict Warning Systems.” The resolution will proceed on to the Standing Committee on Highways and AASHTO Board of Directors for final approval in November.
- Following the recommendation from AASHSTO SCOTE, the NCUTCD Regulatory/Warning Sign Technical Committee created a task force on ICWS. The task force will determine what may be needed for ICWS in the MUTCD.
- An email update was distributed to the group of ICWS stakeholders on 7.13.12 highlighting SCOTE and NCUTCD meeting outcomes and ENTERPRISE plans to develop a draft concept of operations in July.
- Draft concept of operations was developed and reviewed with stakeholders by webinar on 9.11.12. An overview of the draft and comments was shared with the ENTERPRISE board on 9.19.12.

FISCAL YEAR 2013 ACCOMPLISHMENTS (Benefits to MDOT)

Administrative/Management:

Eight conference calls were held in FY 2013. Two in person meetings were also held, one in Phoenix, Arizona in conjunction with an AASHTO-sponsored meeting to evaluate the re-establishment of the 511 coalition, and one in Saint Cloud, Minnesota in conjunction with the National Rural ITS Conference.

Projects:

All remaining projects from the 2010-12 Work Plan were started during FY 2013. Two additional projects were completed as follow:

The Next Era of Traveler Information

Over the last decade, 511 telephone and web services have been deployed in many states and provinces. Some agencies have already deployed ‘second-generation’ 511 systems with the intent of adding functionality, improving content or reducing operating costs. Agencies are also expanding their dissemination of real-time traveler information using push services like Constant Contact and social media tools like Twitter. Many agencies have also developed partnerships to reduce operating costs through sponsorship or outsourcing.

It is increasingly challenging to plan, evaluate, operate and enhance real-time traveler information services because of limited resources, overwhelming information and rapidly changing dynamics.

The ENTERPRISE Transportation Pooled Fund sponsored this project – Next Era of Traveler Information – to help agencies understand how real-time traveler information technology and use is changing and how the changes are impacted by current and emerging trends.

Emphasis was placed on sharing lessons learned by agencies that have experience related to current trends. The areas of interest that were explored during this project are described as follows.

- Dissemination tools. The project facilitated an exchange of experiences with push information services and social media to help agencies understand new options for delivering information without relying on incoming phone calls. In addition to describing the tools being used, agencies described their philosophy and goals for traveler information to provide a context for how their dissemination tools support them.
- Data management. Managing the availability, variety and formatting of a growing number of data sources creates a complex environment for delivering traveler information. The project explored data requirements outlined in the Code of Federal Regulations, Title 23: Highways, Part 511—Real-Time System Management Information Program (23 CFR 511) and the data format specifications being developed by USDOT to support the exchange of information from highway and transit monitoring systems.
- Cost management. Managing traveler information program costs continues to be challenging, particularly with increasing demands for information to be timely, accurate and delivered in a variety of formats. The project supported a peer exchange of alternative funding approaches, specifically sponsorships, to manage and optimize the costs of operating traveler information services.
- Customer needs. Understanding and meeting customer needs in an era when information is a premium commodity is especially problematic in government culture where market research is still rarely used to understand customer needs. The project facilitated a discussion of how agency approaches to understanding customer needs and presented findings from a nation-wide study conducted by the National Cooperative Highway Research Program to understand what information and services travelers find most useful.
- Performance targets. A key feature of the 2012 legislation, Moving Ahead for Progress in the 21st Century (MAP-21), is the establishment of a performance- and outcome-based program that will encourage states to invest resources in projects that will make progress toward national goals. The project facilitated an exchange of information about states' approaches to establishing practical performance measures and targets for traveler information programs, particularly as they relate to meeting requirements in 23 CFR 511

A copy of the final report is available from the ENTERPRISE website at: <http://enterprise.prog.org/projects.html>

Use and Impacts of Camera Images and Other Displays of Traveler Information

The overall objective of this project was to understand the use and impacts of camera images and other “unverified” displays of information that can be interpreted by travelers, especially when compared to the use of “verified” reports such as traffic maps, incident reports, and other information that is formulated and/or verified by agencies. Results from this project could be used by agencies to help make decisions about what types of information to display and whether or not to increase/decrease current displays (e.g. add more cameras for display to the public). The focus of the project was on traveler information websites hosted by transportation agencies. A public survey, analysis of web usage statistics, and interviews with agency staff were used to inform project findings.

A copy of the final report is available from the ENTERPRISE website at: <http://enterprise.prog.org/projects.html>

FISCAL YEAR 2014 PROPOSED ACTIVITIES

Administrative/Management:

Ten conference calls and two in-person meetings are scheduled for FY 2014. The project will continue to receive funds from the ENTERPRISE member states and start new projects as funds are available.

Projects:

All current projects will be completed in FY 2014. All projects in the ENTERPRISE 2013 Work Plan will be started, and projects in the 2014 Work Plan may begin as funds are available. Approved work plans will be posted on the ENTERPRISE website at: <http://enterprise.prog.org>

FISCAL YEAR 2014 ACCOMPLISHMENTS (Benefits to MDOT)

Administrative/Management:

Nine conference calls were held in FY 2014. Two in person meetings were also held in FY 2014, one in San Antonio, Texas and one in Branson, Missouri in conjunction with the National Rural ITS Conference.

Projects:

All remaining projects from the 2010-12 Work Plans were completed during FY 2014.

ICWS Coordination and Systems Engineering

In the previous ICWS ENTERPRISE effort, [Developing Consistency in ITS Safety Solutions – Intersection Conflict Warning Systems](#), the project concluded with a preliminary design guidance and an evaluation framework for intersection conflict warning system (ICWS) deployments. The project engaged several national standards groups and industry associations including the National Committee on Uniform Traffic Control Devices, AASHTO Subcommittee on Traffic Engineering, and the Traffic Control Devices and Evaluation of Low Cost Safety Improvements pooled funds.

This project further supported the standardization of intersection conflict warning systems by coordinating among the various national standards and association groups, and by developing a concept of operations and system requirements for the four types of ICWS identified in the Design and Evaluation Guidance for Intersection Conflict Warning Systems.

A copy of the final report is available from the ENTERPRISE website at: <http://enterprise.prog.org/projects.html>

Next Generation Traffic data and Incident Detection from Video (Video Analytics Evaluation)

The objective of this project was to conduct “proof of concept” evaluation to document the potential for Video Analytics as a tool for traffic operations centers (TOCs) and for traffic data collection. The project reported results from testing of several Video Analytics Systems in the United States (Iowa, Missouri) and in Ontario, Canada, under real-world environments. Components of the project evaluation included:

- Traffic Data Collection - Compared Video Analytics outputs to trusted agency detectors, for traffic volumes, speeds, and vehicle classifications.
- Incident Detection – Compared Video Analytics alerts to still images, video clips, and agency-reported incidents, to validate accuracy for detection of incidents including stopped vehicles, debris in the road, and slow traffic/congestion.
- Wrong-Way Vehicle Controlled Test – Conducted a controlled test to test the ability of Video Analytics systems to detect wrong-way movements on freeway ramps.
- Observations from Agency Staff: Representatives from participating agencies provided feedback on the value and usefulness of the Video Analytics systems to assist with managing road networks.

Results indicate that Video Analytics is ready to support a number of operational uses in its current state of practice. The final report includes several use case scenarios, along with procurement guidance and readiness of the state of practice to support each scenario tested as a part of this project. Lastly, a number of lessons learned are documented, which agencies can use as they plan for and procure Video Analytics systems.

A copy of the final report is available from the ENTERPRISE website at: <http://enterprise.prog.org/projects.html>

Transitioning ITS Warrants to a Permanent Home

This project builds off a series of projects ([ITS Warrants - Phase 1 and Phase 2](#)) that have been conducted by the ENTERPRISE Pooled Fund Study to develop preliminary warrants for ITS devices. The warrants were designed to assist agencies with deployment decisions and site selection. ENTERPRISE continues to test and refine the warrants while exploring industry acceptance for the concept. The overall approach to developing the ITS warrants was modeled after the Manual on Uniform Traffic Control Devices (MUTCD) warrants for traffic signal installations.

Ideally, the ENTERPRISE Program envisioned that a National or International agency would embrace the concept of technology device warrants and carry the concept forward in order to support traffic engineers for years to come. In order to move towards this vision, ENTERPRISE approved this project “Supporting the Transition of ENTERPRISE ITS Warrants to a Permanent Home”. The objective of this project was to document activities ENTERPRISE had conducted as owner and maintainer of the warrants to assist in identifying potential organizations for transitioning the warrants to a new owner.

As ENTERPRISE documented the details of each task that was involved with owning the warrants, a number of options were suggested as potential organizations to transition the ownership and maintenance of the warrants. However after the ENTERPRISE Board reviewed the different options for one organization to maintain the warrants, it was agreed that ENTERPRISE should continue to own and maintain the warrants and partner with organizations to review the warrants. This approach was based on the understanding that it would be easier to find agencies willing to review and comment on one or more warrants periodically than it would be to find an organization willing to accept the entire workload of all the warrants. Given this, ENTERPRISE as part of this project developed a warrants review process to assist with review and modifications of the warrants.

A copy of the final project summary is available from the ENTERPRISE website at: <http://enterprise.prog.org/projects.html>

Crashworthiness and Protection of ITS Field Devices

Many Intelligent Transportation System (ITS) deployments include signs and other traffic control device displays that require locating them and other ITS components within the roadway clear zone. The [Manual on Uniform Traffic Control Devices](#) (MUTCD) requires these devices to be crashworthy.

Agencies wishing to deploy ITS devices within the clear zone are responsible for ensuring that the device is either protected by a longitudinal barrier or mounted on a breakaway support in a configuration that is crashworthy. The ENTERPRISE Pooled Fund Program completed a research project to document available resources to assist state, provincial, and local agencies in the process of designing and deploying ITS devices in the clear zone. The final report summarizes the large number of resources available from federal and state agencies.

A copy of the final project summary is available from the ENTERPRISE website at: <http://enterprise.prog.org/projects.html>

HAR – Best Practices and Future Direction

Highway Advisory Radio (HAR) is a communication tool that has been used since the late 1970s by government organizations to deliver public information over short ranges by radio. Systems typically consist of a transmitter, antenna, recording device and power. Most modern systems use control software and wireless communication options that allow messages to be recorded or activated remotely. HAR is often used by departments of transportation, in particular, to deliver information about road conditions, construction and other traffic conditions.

The overall intent of this project was to provide ENTERPRISE member states with guidance to help them better understand how they should pursue HAR technologies and approaches in the future. To accomplish this, the project goals of the project were defined as follows:

- Goal #1: To help members understand how HAR is being used by transportation agencies today;
- Goal #2: To help members understand the potential value of HAR; and
- Goal #3: To help members understand the current and potential future state of HAR technology practices.

The final document for this project presents a general background of HAR, a summary of HAR uses and value, as well as the state of HAR technology and operational practices. Information for this project was gathered through literature reviews and interviews with transportation agencies operating HAR and manufacturers of HAR systems.

A copy of the final project summary is available from the ENTERPRISE website at: <http://enterprise.prog.org/projects.html>

Intelligent Work Zones – Synthesis of Best Practices

The ENTERPRISE Pooled Fund Program initiated a project to document the resources available as well as uses and benefits regarding the following Intelligent Work Zone (IWZ) technologies: queue warning systems, dynamic merge systems, alternate routes and variable speed limits in work zones. A detailed literature search was conducted to summarize work zone materials available related to the four work zone technologies. In addition, intelligent work zone representatives from transportation agencies were contacted to provide details on recent related deployments and provide input to the project.

The purpose of the final report is to understand the current status of work on IWZ activities by combining the resources gathered through a literature search with the information collected from the transportation agencies on recent deployments. Also included is a summary of the four IWZ technologies, including examples of successes, any guidance possible when technologies are most effective, and the configurations that demonstrated the best results. Separate documents were then created from the final report highlighting the summary of uses and benefits for each IWZ technology as a quick reference for the specific technology of interest.

A copy of the final report is available from the ENTERPRISE website at: <http://enterprise.prog.org/projects.html>

Connected Vehicles Data Element Concept of Operations

This effort examined the opportunities for state DOT's to improve highway operations and safety through the use of Connected Vehicles sourced data. This included the following:

- Compiling a list of data elements
- Surveying state DOTs to determine which of these data elements could be useful for incident detection, incident management, traffic management, winter maintenance, special events management, EMS dispatch, and 511 entry. Also the surveying w state DOT representatives on preferred locations for IntelliDrive roadside equipment.
- Prepared a high level Concept of Operations that describes the data elements available from Connected Vehicles, the acquisition of the data from network servers, and the options for integrating the relevant vehicle sourced data into existing ITS software applications.

A copy of the final report is available from the ENTERPRISE website at: <http://enterprise.prog.org/projects.html>

Assessment of Emergency Service Providers Data Feeds

ENTERPRISE established a working relationship with [General Motors' OnStar](#) during the [Multi-Jurisdictional Mayday \(MJM\)](#) project in the late 1990s to explore how automatic collision notification (ACN) technology could enhance roadway safety and traveler information if data from such systems were available to emergency medical staff and transportation agencies. In the years since, OnStar has worked diligently with the [Association of Public Safety Communications Officials](#) (APCO) and the [National Emergency Number Association](#) (NENA) to establish parameters around the crash data that they can provide. Using those parameters, OnStar has published a data stream for emergency services and transportation agencies to use.

In addition to the safety and convenience services offered by OnStar, similar services are being offered by other automobile manufacturers. For example, Ford provides a service called [SYNC](#) that literally syncs your mobile phone with your vehicle to provide various safety functions, and Hyundai offers [Assurance Connected Care](#) as a standard feature for three years on most of their new vehicles. Insurance companies are also providing similar safety and rate reduction services such as [In-Drive](#) offered by State Farm.

Given the evolution and potential value of crash notification technology, this project researched the current data available from OnStar and similar telematics service providers, suggested the value of such data for transportation operations, and worked with ENTERPRISE member agencies to understand how they could use this type of data. This summary report provides information about the data currently available from telematics service providers and suggests the potential value of such data for transportation agency operations.

A copy of the final project summary is available from the ENTERPRISE website at: <http://enterprise.prog.org/projects.html>

FISCAL YEAR 2015 PROPOSED ACTIVITIES

Administrative/Management Support Task:

- Monthly webinars will be held in January, February and March, 2015.
- Continue to plan for the April 2015 in-person meeting in Arizona.

Technical Task:

- Additional projects from the 2013-2014 Work Plan will begin to commence during the next quarter.
 - Continue to complete project tasks for the active work plan projects.
-

FISCAL YEAR 2015 ACCOMPLISHMENTS (Benefits to MDOT)

Project 15: ITS Warrants Review Support

- December 2014 – An update on the project tasks was provided during the monthly board meeting. A conference call was held with FHWA on December 17 to discuss planning guidance for connected vehicles.

Project 16: Investigating Distribution Mechanisms for ENTERPRISE Technical Products

- December 2014 – Overall project findings and recommendations were presented during the December monthly Board meeting call. The proposed action plan was revised per comments received during the meeting. The draft project summary report was distributed to Board members on December 16.

Project 17: ICWS Support and Outreach

- December 2014 – An overall schedule of project activities was prepared and shared during the December board meeting.

December 2014:

Authorized the following three (3) studies-

- Project 19: Performance Measures and Reporting
- Project 21: Traffic Safety and Traveler Information Mobile Apps
- Project 22: Communications to Support Rural ITS

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

The original budgeted amount of \$175,000.00 was for FYs 2010-2014 at \$35,000.00 each FY. The revised budget amount increased to \$350,000.00 to cover FYs 2015-2019 at \$35,000.00 each year.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION

1. There are many lessons to be learned from these research projects that could be used by MDOT, now and in the future. Specifically, there are several recommendations from the Next Era of Traveler Information project that could influence the direction MDOT takes with new enhancements to the Mi Drive website, the possible development of a Mi Drive app, and other traveler information initiatives.
 2. When taking over as the administrative agency in FY 2010, MDOT committed to participating in ENTERPRISE for five years. Although this is the final year of that initial five-year commitment, it is strongly recommended that MDOT continue to be an active part of the ENTERPRISE program, contribute to the program at current levels, and continue to serve as lead agency.
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**RESEARCH ADMINISTRATION
MDOT TRANSPORTATION POOLED FUND STUDY
ANNUAL REPORT - FISCAL YEAR 2015**

STUDY TITLE: Transportation Library Connectivity and Development

FUNDING SOURCE: FHWA OTHER (PLEASE EXPLAIN)

TPF NO.	TPF-5(237)	MDOT START DATE (FUNDING)	05/01/2011
OR NO.	OR13-017	MDOT COMPLETION DATE (FUNDING)	09/30/2015
		PROJECT COMPLETION DATE (Revised)	
TECHNICAL CONTACT	Renee McHenry renee.mchenry@sos.mo.gov Phone: 573-522-1948		
LEAD AGENCY	Missouri Department of Transportation		
PROJECT MANAGER	Alexandra Briseno, 517-373-8548		
CONTRACTOR			

BUDGET STATUS

FY 2015 MDOT Budget			Total MDOT Budget		
FY FUNDS	(Original)	\$5,000.00	TOTAL BUDGET	(Original)	\$25,000.00
	(Revised)			(Revised)	
TOTAL FY 2015 EXPENDITURES		\$5,000.00	Total Committed Funds Available *		\$0.00

PARTICIPATING STATES

ABBREVIATE THE PARTICIPATING STATES. IF MDOT IS THE LEAD AGENCY, ALSO LIST THE CONTRIBUTION PERCENTAGE PER STATE.

AZ, CA, CT, IA, ID, IL, KS, LA, MI, MN, University of Minnesota-Center for Transportation Studies, MO, MS, NC, NJ, NM, NV, NY, OH, OR, PA, TN, WA, WI, University of Wisconsin-Madison, Alaska University Transportation Center (AUTC)

PURPOSE AND SCOPE

Traditionally, a small group of libraries have been responsible for providing information services within the transportation community. They have managed collections while supporting practitioners and decision-makers. Yet today, a vast amount of industry information is not collected or posted to the internet without a management plan. User research habits are also changing. Recognizing this, a national effort has been made over the past five years to advocate for the development of improved library and information centers.

Unfortunately, stakeholders have been hampered by time and funding constraints. To overcome these constraints, this Transportation Pooled Fund (TPF) supports and evaluates collaborative library development. It also enhances existing efforts to develop a national transportation information infrastructure using Transportation Knowledge Networks (TKNs).

While facilitating coordination among federal, state, academic, and private sector libraries, this study provides technical and promotional support. Moreover, it capitalizes on previously developed networking initiatives to implement research tools and analyzes their effectiveness. Library services can be supported locally, but collaboration allows for shared problem solving and resources, as well as potential time and cost savings through best practices, defrayed costs, and collective purchasing power. All of these things are critical in an era of real-time communication.

FISCAL YEAR 2011 ACCOMPLISHMENTS

The Transportation Pooled Fund started on April 1, 2011, and the Fiscal Year (FY) ends December 31, 2011. Special projects are underway for individual member libraries in New Mexico, Illinois, and North Carolina to catalog important transportation information and research resources so that they are accessible to researchers and decision makers. The pooled fund lead consultant has coordinated all phases of the project planning and subcontracting.

Group special projects were selected. Through these projects, members will pursue the development of a return on investment assessment strategy for transportation information services, develop a unified web presence for the regional TKNs, host email lists for the Eastern TKN and the Western TKN, develop a new acquisitions awareness tool to help librarians share resources and plan collection development more effectively, and a project has been selected to investigate and acquire a multisite license to a research tool of the Transportation Advisory Committee's choice. Using pooled funds to pursue these projects will benefit the study partners and the wider transportation information and research community by increasing access to research tools and materials, improving communication and collaboration, and enabling librarians to allocate resources more effectively for their departments.

Website development has been ongoing to provide members and the transportation library community a central place to access important project information and monitor happenings in the on the TKN landscape. All members and partners are registered users of the WordPress site and many are participating in the collaborative features of the site.

Essential subscription access was maintained by pooled fund payments to On-Line Computer Library Catalog (OCLC), Inc. These subscriptions are indispensable tools for librarians in providing services to department researchers and decision makers. The FY 2011 annual meeting was planned and took place on October 19, 2011, as a four-hour web-meeting with featured speakers and a business meeting.

FISCAL YEAR 2012 ACCOMPLISHMENTS

- Create and implement a National TKN marketing plan that coordinates National Transportation Library (NTL), NTKN, regional TKNs and the pooled fund
- Investigate and coordinate special project for subscription access for Oregon DOT (individual member project) and group access to selected resource. Evaluation of resources within budget will begin at the FFY2011 annual meeting;
- Continue developing and updating the Web site, develop project resources and librarian resources page, develop statistical reporting tool
- Continue facilitating subcontracting process and managing selected individual member and group projects
- Coordinate development of partnership and project scope with NTL on selected project, RFP and subcontract
- Facilitate development of ROI project with project team, develop RFP and subcontract
- Implement cataloging subscription tools at agreed upon consortium pricing with the Library of Congress
- Begin planning FFY2012 annual meeting on location
- Continue management of OCLC subscriptions and payment of invoices
- Schedule and plan FFY2012 quarterly TAC teleconferences with continuing education and networking opportunities

FISCAL YEAR 2013 PROPOSED ACTIVITIES

- Projects that will benefit transportation research were selected for implementation in FFY2013.
- A group subscription was approved, discount secured and will be enacted ASCE Library with access to all staff at member agencies.
- Valuation Toolkit will assist librarians and managers leverage the organization's information assets and plan for sustainable library services in our member departments.
- Coordinated regional TKN sites and integration of NTKN web sites and projects will assist with branding and access to transportation information.
- Professional development opportunities at TRB will be highlighted and shared by attendees with study partners.
- Further collaborative applications and tools will be added to the project Web site.

FISCAL YEAR 2013 ACCOMPLISHMENTS (Benefits to MDOT)

- Added the University of Alaska - Transportation Research Center as a new member.
- Manage marketing campaign of ASCE Library with materials and other promotions. Run quarterly usage reports and distribute to TAC, post in 'Members Only' section of website.
- Completed special project: Proving Your Library's Value: a Toolkit for Transportation Librarians was published in January. 2013. 125 print copies were disseminated among members, partner organizations and other transportation libraries and information centers. An announcement / press release was sent to TRANLIB-L and the AASHTO RAC list with a link to the web version (PDF), which is prominently displayed on the project website at: <http://libraryconnectivity.org/files/Proving-Your-Librarys-Value.pdf>
- Continued developing website, new content includes more licensed content behind the password on the Members Only page (trials, workshop registrations, ALA materials, presentations), new pages for Outreach and Marketing and Administration resources and project and librarian resources pages; promoted RSS feed and technical support with feed readers.
- Conducted a free 45-day trial of EBSCO EBooks for Engineering.
- Continued facilitating and managing selected individual member and group projects, including subcontracts and vendor relations.
- Provided travel support documentation for requests for out of state travel and expenses to 75% of the membership.
- Set up subscription and paid invoice for the RDA Toolkit, an essential cataloging tool to work within new RDA guidelines for bibliographic records. The subscription is a companion to existing subscriptions to Cataloger's Desktop and Classification Web, also provided through the pooled fund. (Vendor: American Library Association)
- Held quarterly TAC meeting on March 21, 2013. Provided professional development session: EBSCO EBooks for Engineering – product demonstration and Q&A session. The regular business meeting also took place.
- Attend regional TKN meetings, chairs meetings and TLCat committee meetings.
- Developed collaborative opportunities with new members and partner agencies. Continuing project with NTL for New Acquisitions list with assistance from WisDOT staff and lead team member AZDOT.
- Consulted with TAC on pooled fund hosting of the NTKN Cataloging Workgroup's wiki and NTKN web site. TAC voted and approved. The wiki data has been moved to the UW-Madison server. It has not gone live, per a pending decision by the Workgroup.
- Special Projects: New projects for FY13 team meetings held.
 - Cataloging: NM, IL, NC – all contracts renewed by HS InFocus LLC
 - Multistate Cataloging – conducting a search for a professional cataloger for subcontract;
 - Report Documentation – discussing best avenue to desired result (this may entail another subcontract);
 - Report Distribution - discussing best avenue to desired result (this may entail another subcontract);
 - Marketing Toolkit – scoped, outline complete, shu shu design retained for layout and graphics;
 - Reference Tracking Tool – began investigating software/subscription products currently on the market.
 - TKN Web Project – KKL Info contract was renewed, new KM calendar project scoped.
- Continued development of the Marketing and Outreach toolkit. Sections were sketched out and team members were assigned responsibility for development.
- Purchased group access to the ALA Web seminar The DIY Patron: Library Instruction at the Point of Need as a professional development opportunity for members. The recorded session and materials are permanently available behind the password on the Members Only page on the project website.
- Selected host sites for FY2013 annual meeting – the pooled fund meeting will take place at The Commons Hotel on the University of Minnesota campus. A draft agenda has been distributed to members and we have secured a block of rooms at the Missouri state rate at The Commons Hotel.
- Continued managing selected individual member and group projects, including subcontracts and vendor relations.

- All registration, travel and reimbursements for the Special Libraries Association annual meeting in San Diego was completed. The conference was June 9-11, 2013. • Provided travel support documentation for requests for out of state travel and expenses to 75% of the membership. A pooled fund meeting was held on June 10 to discuss the annual meeting agenda in the Twin Cities.
- Continued website enhancements, including project documents, updates and librarian resources and other resources.
- Held a June quarterly TAC meeting on 6/19/13. *Special topic: SLA takeaways to help us do serve our customers better and help our departments fulfill their missions.*
- Held the Annual Meeting on September 18-19th in the Twin Cities, MN

FISCAL YEAR 2014 ACCOMPLISHMENTS

Meetings & Professional Development

- Quarterly TAC meeting, 3/20/14. Special topic: Data curation and the libraries' role in compliance with the OSTP data policy.
- Quarterly TAC meeting, 6/19/14. Special topic: 2014 Special Libraries Association Conference.
- Quarterly TAC meeting, 12/19/14. Special Topic: MnDOT Library Valuation Study
- Members attended the Special Libraries Association Annual Meeting and Conference in Vancouver, BC. June 8-10, 2014.
- Annual Meeting, Ann Arbor, MI, September 8-9, 2014. Special Topics: LibGuides Workshop, Data Curation, Connected Vehicle Technology.

Library/Research Resources

- Product trials for standards with vendors IHS, Techstreet and ASTM to provide engineers with optimal access to standards in their work at a significant negotiated discount by leveraging the size of our group.
- LibGuides subscription was purchased for the membership. <http://guides.libraryconnectivity.org/index.php>
- NTKN working group wikis are being hosted on our domain, www.libraryconnectivity.org, at the request of the National Transportation Knowledge Network, regional TKNs and approval by the NTKN Steering Committee and the TPF-5(237) TAC. Two wikis have been developed.
- Data Management: http://libraryconnectivity.org/datamgt/index.php/Main_Page (live, public)
- Cataloging: http://libraryconnectivity.org/catwiki/index.php/Main_Page (live, not public yet)
- Cataloging Resources
 - Cataloger's Desktop, Classification Web (Library of Congress) – subscriptions renewed, paid with pooled funds.
 - RDA Toolkit (American Library Association) subscription renewed with pooled funds. These tools assist librarians in creating standards compliant bibliographic records for increased access to library resources (print and digital) and as part of the collection management aspects of running a library.
- Continued ASCE Library product marketing and renewals for participating members receiving consortium discount.
- Continued CMS website development, including project documents, updates and librarian tools and other resources. <http://www.libraryconnectivity.org>.

Special Projects

- Improvement of research report distribution and access and promotion of more effective use of Technical Report Documentation page, USDOT Form 1700.7 will be complete by 30 September, 2014 by subcontractor, Transanalytics.
- KM Calendar project: Phase I – design, build – complete. <http://clients.robotkittendesigns.com/events> (temporary URL). The calendar will be deployed in Phase I with a video tutorial and accompanying user guide.
- Connecticut DOT Library website – built with pooled funds. <http://ctdotlibrary.org/>
- Cataloging Projects:
 - Illinois – 2,190 TRB Highway Research Records series and Transportation Research Records.
 - North Carolina - 292 total: Original = 49; Copy = 243
- Multistate Cataloging – Complete.
 - o Michigan – 106 total: Original = 49; Copy = 57
 - o Minnesota – 103 total: Original = 103; Copy = 5
 - o California – 404 total: Original = 304; Copy = 100
 - o Idaho – 300 subject headings into Excel.
 - o New York – 11 total: Original = 11; Copy = 0
- TKN Brochures were completed and will be distributed among members for marketing the value of library services. Links:
 - o MTKN - <http://www.mtkn.org/sites/default/files/MTKNBrochure.pdf>
 - o ETKN – Not published on website.
 - o WTKN- Not published on website.

FISCAL YEAR 2015 ACCOMPLISHMENTS

Meetings & Professional Development

- Quarterly TAC meeting, 12/18/14. Special Topic: New York Library Association Library Innovation Award – Jane Minotti, 2014 Recipient
- Quarterly TAC meeting, 3/19/15. Special topic: Library Transformation: Strategies for Laying out a Path Forward.
- Quarterly TAC meeting, 6/24/15. Special topic: 2015 Special Libraries Association Conference.
- Some members attended the Special Libraries Association Annual Meeting and Conference in Boston, MA. June 14-16, 2015.
- Annual Meeting, WebEx, August 17-18, 2015. Special Topics: Geek Squad for Libraries, Open Access Compliance, EOS/SirsiDyNex Demo

Library/Research Resources

- The Springshare LibGuides subscription was continued for the second year for the membership. <http://guides.libraryconnectivity.org/index.php> - 13 LibGuides have been created.
 - NTKN working group wikis are being hosted on our domain, www.libraryconnectivity.org, at the request of the National Transportation Knowledge Network, regional TKNs and approval by the NTKN Steering Committee and the TPF-5(237) TAC.
-

- Two wikis that were developed last year are still in use.
 - Data Management: http://libraryconnectivity.org/datamgt/index.php/Main_Page (live, public)
 - Cataloging: http://libraryconnectivity.org/catwiki/index.php/Main_Page (live, public)

Cataloging Resources

- Cataloger’s Desktop, Classification Web (Library of Congress) – subscriptions renewed, paid with pooled funds.
- RDA Toolkit (American Library Association) subscription renewed with pooled funds. These tools assist librarians in creating standards compliant bibliographic records for increased access to library resources (print and digital) and as part of the collection management aspects of running a library.
- Continued ASCE Library product marketing and renewals for participating members receiving consortium discount.
- Continued CMS website development, including project documents, updates and librarian tools and other resources. <http://www.libraryconnectivity.org>

Special Projects

- The Eastern Transportation Knowledge Network (ETKN) published the Transportation Sustainability Guide: <http://guides.libraryconnectivity.org/sustainabletransportation>
- Funds were used to buy a copy of the book “Data Management for Researchers” for each Pooled Fund agency.

Cataloging Projects:

- Illinois – 2,190 TRB Highway Research Records series and Transportation Research Records still in progress
- North Carolina – Over 3,000 items have been cataloged

FISCAL YEAR 2016 PROPOSED ACTIVITIES

The lead agency of this TPF study plans to post a new solicitation in 2016 to continue to improve and use emerging technology to better serve its member state partners.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

*The remaining balance of MDOT’s original budgeted amount is zero. MDOT programmed \$5,000 for FY 2016 to cover either an extension of the current project or a solicitation for a new pooled fund project in 2016.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION

If this is the last year of MDOT participation; please note implementation recommendations resulting from the study that MDOT plans to incorporate into an implementation action plan to improve the operations or how we do business.

The MDOT Library will continue to use all tools (LibGuides, Data Management, RDA Toolkit, and the Cataloger’s Desktop) made available through previous project initiatives. These tools are helpful in reducing human resources time to perform research literature reviews/searches and improves the number of research outlets that can benefit MDOT employees with their research needs. The list serve will still be utilized to give the MDOT Library and other DOT Libraries a way to reach out and collaborate with their peers.

**RESEARCH ADMINISTRATION
MDOT TRANSPORTATION POOLED FUND STUDY
ANNUAL REPORT - FISCAL YEAR 2015**

STUDY TITLE: Traffic and Data Preparation for AASHTO MEPDG Analysis and Design

FUNDING SOURCE: FHWA OTHER (PLEASE EXPLAIN)

TPF NO.	TPF-5(242)	MDOT START DATE	6/1/2012
OR NO.	OR14-035	MDOT COMPLETION DATE (Original)	9/30/2016
		COMPLETION DATE (Revised)	
TECHNICAL CONTACT	Doc Zhang doc.zhang@la.gov Phone: 225-767-9162		
LEAD AGENCY	Louisiana Department of Transportation		
PROJECT MANAGER	Michael Eacker, 517-322-3474		
CONTRACTOR	Kelvin Wang, Oklahoma State University		

BUDGET STATUS

FY 2015 Budget			Total Budget		
FY FUNDS	(Original)	\$0.00	TOTAL COST	(Original)	\$50,000.00
	(Revised)			(Revised)	
TOTAL FY 2015 EXPENDITURES			Total Committed Funds Available		\$0.00

PARTICIPATING STATES

ABBREVIATE THE PARTICIPATING STATES. IF MDOT IS THE LEAD AGENCY, ALSO LIST THE CONTRIBUTION PERCENTAGE PER STATE.

HI, KY, LA, MD, MI, NC, NH, and WI

PURPOSE AND SCOPE

This project was initiated to further develop the Prep-ME software. Prep-ME is designed to assist states with data preparation and storage for mechanistic-empirical (ME) pavement design.

The scope of the project includes:

1. Estimating the axle load spectra from weigh-in-motion (WIM) data
2. Creating algorithms to check WIM data for errors or inconsistencies and to repair the data where possible
3. Adding functions as directed by the participating states
4. Customizing the software for each participating state
5. Training for participating states
6. Technical support for participating states

FISCAL YEAR 2012 ACCOMPLISHMENTS

This project began in September, 2011. The contractor, Oklahoma State University (OSU), purchased two DARWin-ME licenses.

The previous version of Prep-ME was developed for the previous version of the ME software (pre-commercial version called MEPDG). The contractor began working with DARWin-ME (commercial version of ME) to learn the differences between MEPDG and DARWin-ME. One difference is the formats of files for importing into and exporting from DARWin-ME. The contractor began working on changes that will allow importing and exporting in these new file formats.

DARWin-ME was designed to work with SQL or Oracle databases. The contractor began developing tools to allow software users to utilize data and files stored in these two database formats.

An update meeting was held on September 5 and 6, 2012, in Romulus, Michigan. Most of the participating states were in attendance as well as FHWA representatives. The OSU team provided a working version of the Prep-ME software to the participating states for their review. Training was provided at the meeting by OSU.

FISCAL YEAR 2013 ACCOMPLISHMENTS (Benefits to MDOT)

1. Version 3.0 of the PrepME software was delivered for the participating states to review. An updated user manual was provided with this new version.
2. With the new version, the Michigan DOTs process for clustering weigh-in-motion sites was incorporated. If the software is producing the correct results using MDOT's process, it will allow MDOT personnel to perform the clustering process rather than using a consultant to do it through a research project.

FISCAL YEAR 2014 ACCOMPLISHMENTS (Benefits to MDOT)

A workshop was held at the 2014 TRB meeting in Washington DC this past January. The workshop successfully demonstrated the PrepME software to several other states who were in attendance.

A new version of PrepME was delivered with the following enhancements:

- Functionality for quality control checks on truck classification data was enabled
- A materials database module was added. This module will allow storage of pavement material test data that can be utilized as inputs for the mechanistic-empirical (ME) pavement design software.
- A climate module was added. This module will allow for storage and retrieval of climate data outside the data already embedded in the ME software.

With this new version of the software, MDOT will be able to begin utilizing PrepME for the traffic inputs necessary to do ME designs.

FISCAL YEAR 2015 ACCOMPLISHMENTS

The final report was published in February, 2015. A work plan for phase three of the pooled fund was drafted and approved by the participating states. The lead state (Louisiana) initiated the contract with the principal investigator (OSUniversity) to begin phase three.

FISCAL YEAR 2016 PROPOSED ACTIVITIES

Phase three of the project will utilize money left over from phase two to assist the participating states with implementation of the software. A portable version of the software is planned that will assist states with on-site verification/calibration of permanent traffic recorder sites. The traffic module of the software will also continue to be enhanced based on states' needs. The principal investigator will be providing individualized training and support as each state works on implementation.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

None.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION

Implementation of the PrepME software has already begun with the following tasks:

- Raw permanent traffic recorder data was requested and received from the Asset Management Division
- The raw data was imported in to PrepME
- A team was assembled to help make decisions on the acceptance/rejection of data flagged by the software as not passing quality control checks. The team has met three times and completed analysis of truck weight and classification data from 2011 to 2013.

Next, the Pavement Management Section will begin utilizing PrepME to prepare traffic inputs that will be utilized by MDOT pavement designers for ME designs. They will also review the capabilities of the materials and climate modules. Because of existing software already in place, it is expected that these two modules will not be needed.

It is recommended that MDOT fully implement the use of PrepME in the following manner:

- After the end of each calendar year, the permanent traffic recorder truck weight and classification data from the previous year should be assembled and imported in to PrepME.
- The PrepME QA team will meet after the latest year's data has been loaded and the quality control checks have been run. The QA Team will review all the data that did not pass the quality control checks to see if it can be accepted.
- After the QA Team has completed its work, the Pavement Management Section will use the export function of PrepME to update the ME traffic files used for pavement designs.

Update 10/6/2015: Permanent traffic recorder data from 2011 through 2013 was imported in to the Prep-ME software. All permanent traffic recorders gathering weight and vehicle classification data were run through a QA check and the results analyzed by a team of traffic data and pavement design specialists. Inputs for the ME design software were pulled from Prep-ME for all sites that passed the QA check. These input files are currently stored on a central server which is available to pavement designers to utilize when using the ME design software.

**RESEARCH ADMINISTRATION
MDOT TRANSPORTATION POOLED FUND STUDY
ANNUAL REPORT - FISCAL YEAR 2015**

STUDY TITLE: Evaluation and Analysis of Decked Bulb T Beam Bridge

FUNDING SOURCE: FHWA OTHER (PLEASE EXPLAIN)

TPF NO.	TPF-5(254)	MDOT START DATE	09/19/2011
PROJECT NO.	114419	MDOT COMPLETION DATE (Original)	09/30/2014
		PROJ. COMPLETION DATE (Rev.)	6/30/2015
TECHNICAL CONTACTS	Dr. Nabil Grace, (LTU- PI), 248-204-2400 Benjamin Graybeal (FHWA), 202-493-3122		
LEAD AGENCY	Michigan Department of Transportation		
PROJECT MANAGER	Dave Juntunen, 517-749-8036 and Matthew Chynoweth, 248-483-5102		
CONTRACTOR	Lawrence Technological University		

TOTAL PROJECT BUDGET STATUS

* MDOT Project Total Budget			Project Total Budget		
FY 2015 MI-BUDGET	(Original)	\$173,000.00	TOTAL COST	(Original)	\$ 349,000.00
MDOT Share Pd. Inv.	(Revised)	\$152,832.18		(Revised)	\$ 367,200.00
TOTAL FY 2015 MDOT EXPENDITURES		\$6,813.73	Project Total Committed Funds Available		\$0.00

Year	MDOT Expenditures	Project Expenditures
2012	\$55,500.72	\$132,495.94
2013	\$53,811.36	\$128,462.96
2014	\$36,706.37	\$ 87,628.51
2015	\$ 6,813.73	\$ 18,612.59

PARTICIPATING STATES

ABBREVIATE THE PARTICIPATING STATES. IF MDOT IS THE LEAD AGENCY, ALSO LIST THE CONTRIBUTION PERCENTAGE PER STATE.

IA, MN, OR, and WI; each at a 14.5% contribution percentage. MDOT is the lead agency, at a 42% contribution percentage.

PURPOSE AND SCOPE

The purpose of this project is to analyze and evaluate the decked bulb-T beam (or decked I- beam) as a viable replacement for the side-by-side box-beam bridge. The project's description uses the term bulb-T beam as a general description of an I-beam shape, with a wide top flange that can serve as a deck surface. For this type of beam to be a viable replacement to a box beam, it must have a very robust cross-section designed to have a shallow depth-to-span ratio, which makes it very different than the standard AASHTO section used by some states. The use of a bulb-T beam cross section would eliminate inherent problems associated with the ability to inspect and repair box-beam type structures. The bulb-T beam cross-section will provide enough space at the section bottom for ease of periodical inspections and maintenance of critical elements such as beam web and the soffit of the bridge deck slab.

Another purpose of this study is to collaborate and share common interests with other state DOTs in the Midwest area and other research stakeholders, regarding alternative/innovative solution(s) to environmental and structural challenges in building and maintaining a sustainable transportation infrastructure. In correlation with analyzing the bulb- T beam, this study includes comparing alternative non-corrosive materials, including, but not limited to carbon fiber, stainless steel and stainless clad reinforcement materials. The study's analysis will include the evaluation of top flange connection details, including the use of ultra-high performance concrete (UHPC) to fill the joint between the adjacent decked bulb-t beams (as used in New York).

FISCAL YEAR 2011 ACCOMPLISHMENTS

Project started 9/19/2011.

FISCAL YEAR 2012 ACCOMPLISHMENTS

Theoretical analysis, construction of decked bulb T beams.

FISCAL YEAR 2013 ACCOMPLISHMENTS (Benefits to MDOT)

- Completed construction of a ½ scale bridge model with CFRP materials.
- Completed instrumentation and testing of control beam.
- Completed pre-stressing of decked bulb-T beams.

FISCAL YEAR 2014 ACCOMPLISHMENTS (Benefits to MDOT)

- 1- Completed analysis and testing of one-half-scale decked bulb-T beam bridge
- 2- RAP meeting in the spring, 2014
- 3- Assembled laboratory test results and completed analysis of the experimental and numerical investigations.

FISCAL YEAR 2014 ACCOMPLISHMENTS (Benefits to MDOT)

The Principal Investigator (PI) performed a more thorough review of the Finite Element Analysis, results of the parametric study, and the experimental investigation work results. The PI completed the final report, which was reviewed by the Technical Advisory Committee (TAC) and MDOT Research Advisory Panel (RAP), and subsequently accepted by MDOT.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

MDOT, as lead agency, initially budgeted/obligated project funds using MDOT's SPR-II research funds. Early project invoice billings were paid using these obligated funds to cover the initial cost of the research while waiting to receive the partner states' transfer of funds. After these funds were transferred, MDOT decreased its FY 2012 obligation amount to \$146,000 and subsequently increased its total budgeted/obligated amounts to \$173,000 in FY 2014 to cover its share of the anticipated total project cost.

The project's Fiscal Year (FY) 2011 incurred expenditures were \$1,041.75; these expenditures were paid in FY 2012 and are included in the FY 2012 total invoices paid amount of \$132,495.94. MDOT's 2012-2014 expenditures shown above represent its actual pro-rata share of the project cost reimbursements made in each respective year.

Subsequent to completing the FEA analysis and results of the parametric study and extensive experimental work, the PI requested a no cost time extension to allow additional time for careful documentation and clear presentation of the research study. MDOT's project manager approved this request. The project completion date was extended through June 30, 2015.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION

MDOT will identify one or more demonstration projects to evaluate several of the findings of this research.

**RESEARCH ADMINISTRATION
MDOT TRANSPORTATION POOLED FUND STUDY
ANNUAL REPORT - FISCAL YEAR 2015**

STUDY TITLE: Accelerated Performance Testing for the NCAT Pavement Test Track

FUNDING SOURCE: FHWA OTHER (PLEASE EXPLAIN)

TPF NO.	TPF-5(267)	MDOT START DATE	4/15/2015
PROJECT NO.		MDOT COMPLETION DATE (Original)	9/30/2017
OR NO.	OR15-520	COMPLETION DATE (Revised)	
TECHNICAL CONTACT	Michelle Owens, 334-353-6942 owensm@dot.state.al.us		
LEAD AGENCY	Alabama DOT		
PROJECT MANAGER	Curtis Bleech, 517-322-5769 BleechC@michigan.gov		
CONTRACTOR			

BUDGET STATUS

FY 2015 MDOT Budget			MDOT Total Budget		
FY FUNDS	(Original)	\$330,000	TOTAL BUDGET	(Original)	\$990,000.00
	(Revised)			(Revised)	
TOTAL FY 2015 EXPENDITURES		\$0.00	TOTAL COMMITTED FUNDS AVAILABLE		\$990,000.00

PARTICIPATING STATES

ABBREVIATE THE PARTICIPATING STATES. IF MDOT IS THE LEAD AGENCY, ALSO LIST THE CONTRIBUTION PERCENTAGE PER STATE.

AL, CO, FL, GA, IL, KY, MN, MO, NY, NC, OK, SC, TN, VA, and WI

PURPOSE AND SCOPE

This is a partnership to address National needs for research in Pavement Preservation and Asphalt Mixture Performance Testing. The National Center for Asphalt Technology (NCAT) is partnering with MnROAD for the first time in the 2015 research cycle to execute pavement preservation and asphalt mixture performance testing experiments with a nationwide implementation impact. Research sponsors will have decision making authority on the targeted use of the funding they provide, meaning that states can choose which facility (either NCAT or MnROAD) will be the focus of their research investment. It is expected that many treatments/pavements will be studied at both locations. Background information on the scope of the NCAT/MnROAD partnership is provided as an attachment. Positive experiences with implementable findings that reduce the life cycle costs of pavements and facilitate rapid deployment of sustainable technologies have made past research at both NCAT and MnROAD an outstanding investment for numerous state DOTs. The yield will broaden the scope of implementable findings, while at the same time expand the capabilities of both facilities on complementary research through close collaboration.

The scope of work for the pooled fund project will include:

1. Hauling materials to the project from offsite locations. Material donations are typically secured by state sponsors, while reasonable hauling expenses are handled by the pooled fund.
2. Rebuilding sections in accordance with sponsors' directives via competitively bid subcontracts administered by NCAT. It is anticipated that equipment rental, aggregate hauling, liquid asphalt supply and delivery, plant production, and mix placement may all be procured via competitively bid subcontracts. Additional preservation treatment sections will be applied to a nearby highway as well as at the MnROAD test facility.
3. Installing both environmental (i.e.: multi-depth pavement temperature probes) and response instrumentation (e.g.: high speed stress and strain gages) in new experimental sections.
4. Operating a 5-truck heavy triple-trailer fleet on the NCAT test oval in order to apply accelerated truck traffic following the completion of construction. Actual human drivers operate the vehicles in order to provide realistic vehicle wander.
5. Measuring field performance each week when the fleet is parked to fully document the changes in surface condition as a function of traffic and temperature. High-speed pavement response will also be measured on a weekly basis in structural sections. Surface friction will be measured on a monthly basis. Performance will be measured on off-Track pavement preservation sections on at least a monthly basis.
6. Conducting laboratory testing to quantify basic material and mix performance properties, which will serve as the basis of performance model development.
7. Comparing predicted and measured pavement response, as well as predicted and measured cumulative pavement damage, in order to validate then calibrate prevailing M-E methodologies and to quantify the life extending benefit of various pavement preservation alternatives

FISCAL YEAR 2015 ACCOMPLISHMENTS (Benefits to MDOT)

Conference call meetings to discuss and select the roads in Minnesota to perform the treatments on, and selecting the various treatments to be applied. MDOT had direct input on the sections selected.

FISCAL YEAR 2016 PROPOSED ACTIVITIES

Construct the various pavement treatments and begin monitoring their performance.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

None.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION

Expected project completion in fiscal year 2017.

**RESEARCH ADMINISTRATION
MDOT TRANSPORTATION POOLED FUND STUDY
ANNUAL REPORT - FISCAL YEAR 2015**

STUDY TITLE: Development of an Improved Design Procedure for Unbonded Concrete Overlays

FUNDING SOURCE: FHWA OTHER (PLEASE EXPLAIN)

TPF NO.	TPF-5(269)	MDOT START DATE (FUNDING)	4/13/2012
OR NO.	OR14-036	MDOT COMPLETION DATE (FUNDING)	5/31/2016
		PROJECT COMPLETION DATE (Revised)	5/31/2017
TECHNICAL CONTACT	Debra Fick, 651-366-3759 deb.fick@dot.state.mn.us		
LEAD AGENCY	Minnesota Department of Transportation		
PROJECT MANAGER	Benjamin Krom, 517-322-6855		
CONTRACTOR	University of Minnesota		

BUDGET STATUS

MDOT FY 2015 Budget			MDOT Total Budget		
FY FUNDS	(Original)	\$0.00	TOTAL COST	(Original)	\$60,000.00
	(Revised)			(Revised)	
TOTAL FY 2015 EXPENDITURES		\$0.00	Total Committed Funds Available		\$0.00

PARTICIPATING STATES

ABBREVIATE THE PARTICIPATING STATES. IF MDOT IS THE LEAD AGENCY, ALSO LIST THE CONTRIBUTION PERCENTAGE PER STATE.

GA, IA, KS, MI, MN, MO, NC, and OK

PURPOSE AND SCOPE

It is the goal of this project to develop a stand-alone national design procedure that will result in improved performance and life-span prediction of unbonded concrete overlays constructed over existing concrete or composite pavements. The procedure should be based on mechanistic-empirical principals, and developed in a way such that it could be easily adopted into future versions of the MEPDG or DARWin-ME design procedures. The new procedure must incorporate the best features from existing UCOCF designs, as well as develop improved structural and fatigue models that consider the effects from the environment and the behavior of the wide range of interlayer systems currently in use.

FISCAL YEAR 2012 ACCOMPLISHMENTS

The participating states met via conference call and web conference on June 28, 2012, to discuss the contents of the Request for Proposals (RFP). Based on that input, the Lead Agency developed the final RFP and posted it on September 4, 2012, with proposals due by October 2, 2012.

FISCAL YEAR 2013 ACCOMPLISHMENTS

1. The contract with the University of Minnesota was executed on June 17, 2013 and began with a literature review and the creation of a database of existing unbonded concrete overlay projects.

FISCAL YEAR 2014 ACCOMPLISHMENTS (Benefits to MDOT)

Two Technical Advisory Panel meetings occurred via web-conference this Fiscal Year (FY), on December 16, 2013, and May 27, 2014, with the purpose of keeping all member states informed on project progress. Task 1 was completed this FY, which included a literature review of existing unbonded concrete overlay design procedures. A survey to states was also sent out and MDOT provided a lot of detailed information on our existing unbonded overlay projects as part of this survey. The research team also met with Minnesota DOT pavement experts to gather information about the historical performance of unbonded concrete overlays in Minnesota. Extensive pavement management system records and personal knowledge/experience with unbonded overlays were transferred to the research team. The University of Minnesota's subcontract with the University of Pittsburgh was not executed until May of 2014, so the Task 2 work is behind schedule. For the laboratory testing in Task 2, the University of Pittsburgh requested that member states provide material samples for testing (concrete specimens with open-graded & dense-graded interlayer asphalt attached). MDOT has acquired concrete samples with both asphalt interlayer types, and is in the process of delivering them to the University of Pittsburgh. MDOT staff has also hosted some members of the research team (University of Pittsburgh), touring the Michigan unbonded concrete overlay projects that were of interest to them.

Website Updates:

- Work continued on the development of a longitudinal cracking model, which will be used in the UBOL design procedure being developed.
- Task 2 was the major focus during July-September, 2014. The TAC members began securing/sending material samples for testing characterization of the interlayer.
- Selection of projects for supplementary non-destructive testing is underway. Some of the selected sites were visited by the research team in 2014.

FISCAL YEAR 2015 ACCOMPLISHMENTS

One Technical Advisory Panel meeting occurred via web-conference this FY (June 24, 2015) to keep all member states informed on the status of the project. A lot of progress has been made on Task 2 by the University of Pittsburgh. Work consisted of laboratory testing of beam samples to characterize the behavior of various interlayer materials in relation to reflective cracking. This work was documented in a draft report submitted for review by the TAP. All Task 2 work (lab testing) is scheduled to be complete by September 30, 2015.

FISCAL YEAR 2016 PROPOSED ACTIVITIES (Benefits to MDOT)

Testing results from Task 2, as well as pavement condition data from in-service concrete overlays will be used to develop and refine the cracking and other models for the new design procedure.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

On April 22, 2015, the contract was amended to accommodate additional testing and add time needed to complete the project. The entire project is now scheduled for a May 31, 2017 completion date.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION

Expected project completion FY 2017.

**RESEARCH ADMINISTRATION
MDOT TRANSPORTATION POOLED FUND STUDY
ANNUAL REPORT - FISCAL YEAR 2015**

STUDY TITLE: Reorganization of Section 5, Concrete Structures, of the AASHTO LRFD Bridge Design Specifications

FUNDING SOURCE: FHWA OTHER (PLEASE EXPLAIN)

TPF NO.	TPF-5(271)	MDOT START DATE	10/1/2012
OR NO.	OR14-033	MDOT COMPLETION DATE (Original)	9/30/2015
		COMPLETION DATE (Revised)	
TECHNICAL CONTACT	Susan Barker, 785-291-3847 Email: SusanB@ksdot.org		
LEAD AGENCY	Kansas Department of Transportation		
PROJECT MANAGER	Matt Chynoweth, 248-483-5102		
CONTRACTOR			

BUDGET STATUS

FY 2015 MDOT Budget			MDOT Total Budget		
FY FUNDS	(Original)	\$10,000.00	TOTAL BUDGET	(Original)	\$30,000.00
	(Revised)			(Revised)	
TOTAL FY 2015 EXPENDITURES		\$10,000.00	Total Committed Funds Available		\$0.00

PARTICIPATING STATES

ABBREVIATE THE PARTICIPATING STATES. IF MDOT IS THE LEAD AGENCY, ALSO LIST THE CONTRIBUTION PERCENTAGE PER STATE.

FL, IA, ID, KS, LA, MI, MN, NE, NJ, OH, OR, PA, TX, UT, VA, and WA

PURPOSE AND SCOPE

Since the adoption of the AASHTO LRFD Bridge Design Specifications, 1st Edition in 1992, yearly interim revisions have been written to Section 5, Concrete Structures. These revisions were made by members of the AASHTO technical committee T-10, Concrete Design researchers, or other friends of the committee.

Much care was taken by the original National Cooperative Highway Research Program (NCHRP) project 12-33 team to maintain organizational, philosophical, and technical consistency throughout the specifications. The yearly interim revisions since 1992, while well meaning, have not always maintained the desired consistency. However, this situation is not unique to Section 5. AASHTO technical committee T-14, Structural Steel Design, had the opportunity to reorganize Section 6, Steel Structures, during the recent integration of straight and horizontally curved steel girders. In addition, Section 5 is ready to be re-organized after the many years of interim revisions.

FISCAL YEAR 2013 ACCOMPLISHMENTS (Benefits to MDOT)

1. Survey monkey results were reviewed and participants started putting together a revised annotated table of contents.
2. The eventual re-organization and re-write of Section 5 into a more concise, easier to use document, will be of benefit to MDOT.

FISCAL YEAR 2014 ACCOMPLISHMENTS (Benefits to MDOT)

Task 5, *Develop new revised and reorganized draft Section 5, Concrete Structures*, continues with periodic revisions. There have been ten to date, with the seventh revision being the latest submitted for review by the panel. On April 27, during PCI Committee Days, and on June 24, during the annual meeting of the AASHTO Subcommittee on Bridges and Structures, the research team met with the panel to review drafts of Section 5. Work will continue on Task 5 based upon review comments.

FISCAL YEAR 2015 ACCOMPLISHMENTS

The revised Section 5 of the AASHTO LRFD Bridge Design Specifications has been released in draft form for review by the pool fund states. A webinar on the organization and methodology was scheduled for the fourth quarter of 2015, and the ballot item to introduce to the AASHTO Subcommittee on Bridges and Structures (SCOBS) will be developed by technical subcommittee T-10 at the 2016 annual SCOBS meeting.

FISCAL YEAR 2016 PROPOSED ACTIVITIES

Finalization of the proposed Section 5, and preparation by the AASHTO SCOBS Technical subcommittee on concrete (T-10) for balloting. MDOT's involvement will be limited in 2016, other than providing final review comments and possibly voting on the ballot item for formal adoption if it is brought to the AASHTO SCOBS 2016 annual meeting.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

None.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION

Nothing has been implemented to date. MDOT participation has been limited, other than providing comments at the 2015 AASHTO SCOBs annual meeting. The Section 5 re-write will most likely be formally adopted by AASHTO SCOBs for inclusion into the AASHTO LRFD Bridge Design Specification. This is more of a re-organization and streamlining of the specification, as opposed to new design procedures that will need to be implemented. Fiscal year 2015 was the last year of MDOT's funding contribution; however, our active participation will be limited to providing review/comments in 2015/2016 on the final product.

**RESEARCH ADMINISTRATION
MDOT TRANSPORTATION POOLED FUND STUDY
ANNUAL REPORT - FISCAL YEAR 2015**

STUDY TITLE: Standardizing Lightweight Deflectometer Measurements for QA and Modulus Determination in Unbound Bases and Subgrades

FUNDING SOURCE: FHWA OTHER (PLEASE EXPLAIN)

TPF NO.	TPF-5(285)	MDOT START DATE	10/01/2013
OR NO.	OR14-037	MDOT COMPLETION DATE (Original)	12/31/2015
		COMPLETION DATE (Revised)	
TECHNICAL CONTACT	Allison Hardt, 410-545-2916 ahardt@sha.state.md.us		
LEAD AGENCY	Maryland State Highway Administration		
PROJECT MANAGER	Richard Endres, 517-322-1207 endres@michigan.gov		
CONTRACTOR			

BUDGET STATUS

FY 2015 MDOT Budget			MDOT Total Budget		
FY FUNDS	(Original)	\$0.00	TOTAL BUDGET	(Original)	\$50,000.00
	(Revised)			(Revised)	
TOTAL FY 2015 EXPENDITURES		\$0.00	TOTAL COMMITTED FUNDS AVAILABLE		\$0.00

PARTICIPATING STATES

ABBREVIATE THE PARTICIPATING STATES. IF MDOT IS THE LEAD AGENCY, ALSO LIST THE CONTRIBUTION PERCENTAGE PER STATE.

FL, MD, MI, MO, NC, NY, SC, and VA

PURPOSE AND SCOPE

The primary purpose of this study is to provide state DOT and local government engineers with a practical and theoretically sound methodology for the evaluation of in-place elastic modulus of unbound layers, subgrades, and other earthwork from Light Weight Deflectometer (LWD) field test data.

FISCAL YEAR 2014 PROPOSED ACTIVITIES

Funding was requested and approved in Fiscal Year (FY) 2013; however, the project did not begin until FY 2014.

FISCAL YEAR 2014 ACCOMPLISHMENTS (Benefits to MDOT)

The Project was in the early stages and approximately 15% complete. Two states, Indiana and Minnesota, have implemented LWD into their specifications. Methodology from those states has been documented during literature review phase. In addition to the Literature Review phase, which continues, work has begun on Equipment Evaluation. Three devices were selected for further study, including the Zorn ZFG 3000 that MDOT tested as part of the Intelligent Compaction pilot project last summer in Iron River. Further study of this device was a key goal from MDOT's perspective.

FISCAL YEAR 2015 ACCOMPLISHMENTS

Model Refinement/Development continued in conjunction with controlled trials. Work is progressing with a focus on identifying field sites to test models.

FISCAL YEAR 2016 PROPOSED ACTIVITIES

Completion of both model development/refinements and the controlled trials is expected. Work activities will include completion of field validations and drafting of a specification. Final accomplishments in 2016 will be a workshop and the completion of a final report.

JUSTIFICATION(S) FOR REVISION(S) – (List the approval date for the revision(s))

None

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION

MDOT Geotechnical will stay current on progress and findings from this pooled fund study. Once standardized procedures for using LWD for modulus/stiffness-based compaction control is available; MDOT plans to develop a specification for use in a pilot project with recycled materials. Expanded use beyond recycled materials may be possible but will depend on a successful pilot project and widely accepted procedures that are suitable for practical implementation by field inspection personnel. Investment in additional LWD equipment is desired and will be necessary to conduct the pilot project and implement the research result at MDOT.

**RESEARCH ADMINISTRATION
MDOT TRANSPORTATION POOLED FUND STUDY
ANNUAL REPORT - FISCAL YEAR 2015**

STUDY TITLE: Next Generation Concrete Pavement Road Map

FUNDING SOURCE: FHWA OTHER (PLEASE EXPLAIN)

TPF NO.	TPF-5(286)	MDOT START DATE	10/1/2012
OR NO.	OR09-144	MDOT COMPLETION DATE (Original)	9/30/2015
		COMPLETION DATE (Revised)	
TECHNICAL CONTACT	Linda Narigon, 515-239-1471 Linda.Narigon@dot.iowa.gov		
LEAD AGENCY	Iowa Department of Transportation		
PROJECT MANAGER	John Staton, 517-322-5701		
CONTRACTOR			

BUDGET STATUS

FY 2015 MDOT Budget			MDOT Total Budget		
FY FUNDS	(Original)	\$15,000.00	TOTAL BUDGET	(Original)	\$75,000.00
	(Revised)*			(Revised)	
TOTAL FY 2015 EXPENDITURES		\$15,000.00	Total Committed Funds Available		\$30,000.00

PARTICIPATING STATES

ABBREVIATE THE PARTICIPATING STATES. IF MDOT IS THE LEAD AGENCY, ALSO LIST THE CONTRIBUTION PERCENTAGE PER STATE.

GA, IA, MI, OK, and PA

PURPOSE AND SCOPE

This project is for the establishment of a Next Generation Concrete Pavement Road Map (Next Gen CP Road Map) to carry on the work started by FHWA's initial Concrete Pavement Roadmap Pooled Fund, TPF-5(185), which ended in June, 2012. This initial pooled fund was developed to guide concrete pavement research investments identified as critical for accomplishing customer-driven goals. This Next Gen CP Road Map pooled fund will continue the effort to identify needed research to help the concrete pavement community meet today's paving needs and tomorrow's pavement challenges.

FISCAL YEAR 2013 ACCOMPLISHMENTS (Benefits to MDOT)

On a bimonthly basis, the Next Gen CP Road Map E-newsletter was developed featuring national highlights on research, including specific state Portland Cement Concrete (PCC) pavement updates.

A continuation of the PCC pavement project database, monitoring the Transportation Advisory Council's (TAC's) progress towards the CP Road Map research priorities, is moving forward from the previous CP Roadmap pooled fund project.

A Next Gen CP Road Map website with general information on the road map, the 12 tracks and a library of the pooled fund deliverables is being transferred from the previous CP Roadmap pooled fun project.

The pooled fund is continuing facilitation of the Next Gen CP Road Map Track Leadership Committees, comprised of leading national experts and organized around the specific research tracks.

FISCAL YEAR 2014 PROPOSED ACTIVITIES

The Fiscal Year (FY) 2013 tasks carried forward into FY 2014.

FISCAL YEAR 2014 ACCOMPLISHMENTS (Benefits to MDOT)

- Contacted states to determine dates and topics for training.
- Developed outline for PCC overlay specification.
- FHWA's contribution was added to the pooled fund. Scope was expanded to include E-new and MAP Briefs.
- First E-news and MAP Brief were distributed. The MAP brief topic was "Mix Design and Proportioning for Concrete Pavements".
- The research database was updated with information gathered from state interviews.
- A TAC meeting was held on January 7, 2014.

FISCAL YEAR 2015 ACCOMPLISHMENTS

- October E-news and MAP Brief were distributed. The MAP brief topic was "Aggregate Gradations for Concrete Pavement Mixtures". Link to it: <http://www.cproadmap.org/publications/MAPbriefOctober2014.pdf>.
- December E-news and MAP Brief were distributed. The MAP brief topic was "Relating Transport Properties to Performance". Link to it: <http://www.cproadmap.org/publications/MAPbriefDecember2014.pdf>.
 - Coordination with Iowa DOT for development of the upcoming E-News.
 - Completed draft PCC overlay guide specification.
 - A TAC meeting was held November 25th.

- January E-News and MAP Brief were distributed. The MAP brief topic was “Producing Freeze-Thaw Durable Concrete”. Link to it: <http://www.cproadmap.org/publications/MAPbriefJanuary2015.pdf>
 - Coordinated with Nebraska for development of the upcoming E-News.
 - Continued work on the final draft of the PCC overlay guide specifications.
 - Completed 3D workshop training in Oklahoma in January.
 - Completed 3D workshops for Michigan in February.
 - Completed workshops on PCC pavement preservation for Iowa in March.
 - A TAC meeting was held on March 2nd.
- April E-News and MAP Brief were developed and distributed. The MAP Brief topic was “Concrete Pavement Curling and Warping”. Link to it: <http://www.cproadmap.org/publications/MAPbriefApril2015.pdf>
 - Coordinated with Nebraska for development of the April E-News.
 - Wrote five summaries on research projects for April E-News.
- June 2015 E-News and MAP Brief were developed and distributed. The MAP Brief topic was “Concrete Pavement Joint Deterioration”. Link to it: <http://www.cproadmap.org/publications/MAPbriefJune2015.pdf>
 - Coordinated with South Dakota for development of the June E-News.
 - Wrote five summaries on research projects for June E-News.
 - Continued work on the final draft of the PCC overlay guide specifications.
 - Reviewed the specifications with the CP Tech Center Overlay Committee.
 - Set up training with Pennsylvania and Georgia for Fall 2015.
 - Held TAC meeting on June 18, 2015.
- Finalized dates, locations, and topics for training events for Penn DOT and Georgia DOT.
- Issued next new E-News and MAP Briefs.
- Finalized new PCC overlay specifications.
- Continued to update research database as further state interviews are completed.
- Submitted a plan to NCC for support of the CP Road Map program as requested by TAC.

FISCAL YEAR 2016 PROPOSED ACTIVITIES

- Finalize dates, locations, and topics for 2016 on-site training events.
- Issue new E-News and MAP Briefs.
- Continue to update research database as further state interviews are completed.
- Schedule and conduct quarterly TAC meetings.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

None.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION

The year to year tasks associated with this pooled fund project (Next Gen CP Road Map E-newsletter, PCC pavement project database, Next Gen CP Road Map website, Next Gen CP Road Map Track Leadership Committees) are continuing and implementation of deliverables will be disseminated accordingly. This is the first fiscal year quarter of the Next Gen CP Roadmap pooled fund project. Additional Deliverables to be prioritized by the TAC as funding allows.

**RESEARCH ADMINISTRATION
MDOT TRANSPORTATION POOLED FUND STUDY
ANNUAL REPORT - FISCAL YEAR 2015**

STUDY TITLE: Aurora Program

FUNDING SOURCE: FHWA OTHER (PLEASE EXPLAIN)

TPF NO.	TPF-5(290)	MDOT START DATE	10/1/2013
OR NO.	OR14-057	MDOT COMPLETION DATE (Original)	9/30/2016
		COMPLETION DATE (Revised)	
TECHNICAL CONTACT	Brian Worrel, 515-239-1471		
LEAD AGENCY	Iowa Department of Transportation		
PROJECT MANAGER	Dawn Gustafson, 906-293-5168		
CONTRACTOR			

BUDGET STATUS					
FY 2015 MDOT Budget			MDOT Total Budget		
FY FUNDS	(Original)	\$25,000.00	TOTAL BUDGET	(Original)	\$50,000.00
	(Revised)			(Revised)	
TOTAL FY 2015 EXPENDITURES		\$25,000.00	TOTAL COMMITTED FUNDS AVAILABLE		\$25,000.00

PARTICIPATING STATES

ABBREVIATE THE PARTICIPATING STATES. IF MDOT IS THE LEAD AGENCY, ALSO LIST THE CONTRIBUTION PERCENTAGE PER STATE.

AK, CA, CO, IA, IL, KS, MI, MN, NY, ND, OH, PA, UT VA, WI, and Ontario Ministry of Transportation

PURPOSE AND SCOPE

The purpose of this project is to:

1. Improve dissemination of road weather information to transportation providers and end users, ultimately increasing safety by reducing potential weather-related incidents and improving transportation safety, reliability, and mobility in both urban and rural areas.
2. Improve the efficiency of maintenance operations.
3. Aid in the development of technologies that seamlessly integrate to facilitate the formation of partnerships between maintenance and operations and facilitate the dissemination of road weather information.
4. Develop initiatives that assist public agencies in deploying Road Weather Information System (RWIS) technologies and methodologies.
5. Encourage greater cooperation and information exchange between transportation agencies and the other agencies and groups.
6. Support development of expanded uses of RWIS technologies.

The program's mission is to support cooperative research, evaluation, and deployment of innovative technologies that advance road weather monitoring and forecasting in highway design, construction, maintenance and operations and to serve as an international advocate for expanded uses of these technologies

FISCAL YEAR 2014 ACCOMPLISHMENTS

Completion of project 2009-01: Summary and Comparison of Agency Experience with Sensors.

This project was funded to compile a summary of various environmental sensors and the experience agencies have had with each sensor. This information will be utilized by MDOT when selecting sensor types and models.

Completion of project 2007-05: Multiple Use ITS Data Collection Practices.

This project was funded to summarize the previous experience of other states when combining Intelligent Transportation Systems (ITS), traffic devices, etc., at one location. MDOT participated in this survey and continues to strive to combine as many of these devices at one location as possible.

Completion of project 2013-01: National Winter Maintenance Peer Exchange.

This project was completed and finalized a gathering to allow agencies to network and share ideas and innovations. MDOT is an active participant in this meeting.

FISCAL YEAR 2015 ACCOMPLISHMENTS

Completion of project 2015-02 2015: National Winter maintenance Peer Exchange.

This conference had excellent attendance. State best practices were again well received.

Completion of project 2012-03: Cameras and Operational Impact of Remote Road Condition Monitoring

This study in Utah evaluates the benefit of cameras in winter weather remote monitoring.

FISCAL YEAR 2016 PROPOSED ACTIVITIES

Completion of project 2014-01: Seasonal Weight Restrictions Demonstration, Phase 2.

MDOT is collecting and providing information to be analyzed to improve application of seasonal weight restrictions.

Completion of project 2010-04: RWIS Sensor Density and Location

MDOT is looking to expand their RWIS system.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION

Project expected completion in fiscal year 2016.

**RESEARCH ADMINISTRATION
MDOT TRANSPORTATION POOLED FUND STUDY
ANNUAL REPORT - FISCAL YEAR 2015**

STUDY TITLE:

Improving Specifications to Resist Frost Damage in Modern Concrete Mixtures

FUNDING SOURCE: FHWA OTHER (PLEASE EXPLAIN)

TPF NO.	TPF-5(297)	MDOT START DATE	10/1/2013
OR NO.	OR14-038	MDOT COMPLETION DATE (Original)	9/30/2015
		COMPLETION DATE (Revised)	9/30/2017
TECHNICAL CONTACT	Ron Curb, 405-522-3795 rcurb@odot.org		
LEAD AGENCY	Oklahoma Department of Transportation		
PROJECT MANAGER	Tim Stallard, 517-322-6448 stallardt@michigan.gov		
CONTRACTOR			

BUDGET STATUS

FY 2015 MDOT Budget			MDOT Total Budget		
FY FUNDS	(Original)	\$17,500.00	TOTAL BUDGET	(Original)	\$35,000.00
	(Revised)			(Revised)	\$70,000.00
TOTAL FY 2015 EXPENDITURES		\$17,500.00	TOTAL COMMITTED FUNDS AVAILABLE		\$35,000.00

PARTICIPATING STATES

ABBREVIATE THE PARTICIPATING STATES. IF MDOT IS THE LEAD AGENCY, ALSO LIST THE CONTRIBUTION PERCENTAGE PER STATE.

CT, IA, ID, IL, IN, KS, MI, MN, ND, NE, OK, PA, WI

PURPOSE AND SCOPE

The purpose of this project is to establish new test methods and specifications for fresh and hardened concrete to determine frost durability and field performance.

- Task 1: Literature Review and Development of the Testing Matrix
- Task 2: Sample Preparation
- Task 3: Validation of the Super Air Meter
- Task 4: Use of X-Ray Tomography of Air Voids and Frost Damage
- Task 5: ASTM C 666
- Task 6: Absorption and Desorption
- Task 7: Degree of Saturation and Damage Development
- Task 8: Rate of Damage Analysis
- Task 9: Technology Transfer
- Task 10: Final Report

FISCAL YEAR 2014 ACCOMPLISHMENTS

Literature Review and Development of the Testing Matrix, 50% complete.
 Samples will be prepared at Oklahoma State University (OSU) and a subset of these mixtures will be prepared at a local ready mix plant to replicate these mixtures in the field, 10% complete.
 Validation of the Super Air Meter, 20% complete.
 Creation of an AASHTO Test Method and Specification for the Super Air Meter (SAM), 35% complete.
 Degree of Saturation and Damage Development, 10% complete.

FISCAL YEAR 2015 ACCOMPLISHMENTS

Literature review and development of the testing matrix is 88% complete. Over 80 mix designs have been investigated. Preparation of lab mixes for evaluation at OSU is 45% complete. Validation of the SAM is 50% complete. Creation of an AASHTO test method for the SAM test is 70% complete. X-ray tomography of air voids and frost damage is 33% complete. Comparison of ASTM C666 freeze thaw durability testing with SAM results is 45% complete. Absorption and desorption testing is 50% complete. Determination of damage development vs. degree of saturation is 60% complete.

FISCAL YEAR 2016 PROPOSED ACTIVITIES

The teams will continue preparing concrete mixtures to be investigated with the SAM and processing materials that were previously produced. ASTM C666 testing will continue as will ASTM C457 sample preparation for samples provided by other states. The rate of absorption desorption, rate of damage, and degree of saturation level on the damage with the concrete provided by OSU will be examined. Work will continue with the mCT and neutron work.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION

The lead agency has requested state partners to continue their fund contributions for two more years (fiscal years 2016 and 2017).

**RESEARCH ADMINISTRATION
MDOT TRANSPORTATION POOLED FUND STUDY
ANNUAL REPORT - FISCAL YEAR 2015**

STUDY TITLE: The Use of Bridge Management Software in the Network Analysis of Big Bridges

FUNDING SOURCE: FHWA OTHER (PLEASE EXPLAIN)

TPF NO.	TPF-5(308)	MDOT START DATE	10/1/2013
PROJECT NO.	125276	MDOT COMPLETION DATE (Original)	9/30/2017
		COMPLETION DATE (Revised)	
TECHNICAL CONTACT	David Juntunen, 517-749-8036		
LEAD AGENCY	Michigan Department of Transportation		
PROJECT MANAGER	Rebecca Curtis, 517-449-5243		
CONTRACTOR	Modjeski and Masters		

TOTAL PROJECT BUDGET STATUS

FY 2015 MDOT Budget			Total Project Budget		
FY FUNDS	(Original)	\$47,500.00	TOTAL BUDGET	(Original)	\$374,018.00
	(Revised)	\$0.00		(Revised)	\$0.00
TOTAL FY 2015 EXPENDITURES		\$98.65	Project Total Committed Funds Available		\$373,919.35

Year	Total MDOT Expenditures	Project Total Expenditures
2014	\$ 0.00	\$ 0.00
2015	\$ 98.65	\$ 98.65

PARTICIPATING STATES

ABBREVIATE THE PARTICIPATING STATES. IF MDOT IS THE LEAD AGENCY, ALSO LIST THE CONTRIBUTION PERCENTAGE PER STATE.

IA (16%); MI (21%), MN (16%), NJ (16%), NY (16%), PA (9%), and WI (8%)

PURPOSE AND SCOPE

Current financial outlay plans for a network of standard bridges are managed by scheduling preservation and replacement projects based upon whole bridge needs. This is viewing element condition as an entirety for the bridge on complex, long span, or large deck bridges (Big Bridges). It may make more sense fiscally to view contiguous element groups, structure components, or bridge spans as a series of interactive networks. The AASHTO National Bridge Elements, Bridge Management Elements, and Agency Defined Elements were developed for standard structures and should be reviewed to see if the elements and their units are appropriate for the management of Big Bridges. Big Bridges are those that, because of their size, complexity, or importance, have dedicated maintenance and management staff or programs. Big bridges may include slab on girder bridges of significant length as well as other structures including suspension bridges, cable stay, trusses, movable bridges, arches, or boxes. Using element level bridge inspection data, engineers and managers of Big Bridges need to develop short, medium, and long-range preservation management plans. They must predict when partial or full replacement of elements or components are most cost effective, and they need to develop maintenance budgets, business plans, and capital outlay plans accordingly. Management of the decks of Big Bridges is of particular interest.

FISCAL YEAR 2014 ACCOMPLISHMENTS

This project was in a solicitation status during Fiscal Year (FY) 2014. On November 24, 2014, the project manager held an initial meeting with the Technical Advisory Committee (TAC) to discuss the project goals and objectives.

FISCAL YEAR 2015 ACCOMPLISHMENTS

MDOT updated the original problem statement after review/discussion by the TAC members during FY 2015. MDOT initiated a nationwide request for proposal during the summer of 2015. Modjeski & Masters, Inc. was selected and awarded a Research Services Contract in 2015.

FISCAL YEAR 2016 PROPOSED ACTIVITIES

Work activity will start in FY 2016.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

None

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION

Project expected completion in FY 2018.

**RESEARCH ADMINISTRATION
TRANSPORTATION POOLED FUND STUDY
ANNUAL REPORT - FISCAL YEAR 2015**

STUDY TITLE: Technology Transfer Concrete Consortium (TTCC) [Old: TPF-5(159)]

FUNDING SOURCE: FHWA OTHER (PLEASE EXPLAIN)

TPF NO.	TPF-5(313)	MDOT START DATE	10/01/2014
OR NO.	OR08-020	MDOT COMPLETION DATE (Original)	09/30/2019
		COMPLETION DATE (Revised)	
TECHNICAL CONTACT	Linda Narigon, 515-239-1471 Linda.Narigon@dot.iowa.gov		
LEAD AGENCY	Iowa Department of Transportation		
PROJECT MANAGER	John Staton, 517-322-5701		
CONTRACTOR	Iowa State University (PI-Tom Cackler)		

BUDGET STATUS

FY 2015 Budget			Total Budget		
FY FUNDS	(Original)	\$12,000.00	TOTAL COST	(Original)*	\$60,000.00
	(Revised)			(Revised)**	
TOTAL FY 2015 EXPENDITURES		\$12,000.00	Total Committed Funds Available		\$48,000.00

PARTICIPATING STATES

ABBREVIATE THE PARTICIPATING STATES. IF MDOT IS THE LEAD AGENCY, ALSO LIST THE CONTRIBUTION PERCENTAGE PER STATE.

AL, CA, GA, IA, IL, IN, KS, LA, MI, MN, MO, ND, NE, NY, OH, OK, PA, SD, TX, WI, CO, NC, UT, and WA

PURPOSE AND SCOPE

The purpose of this pooled fund project is to identify, support, facilitate, and fund concrete research and technology transfer initiatives. This pooled fund project allows for state representatives to continue the collaborative efforts of TPF-5(159) that originally began in TPF-5(066) Materials and Construction Optimization. The Technology Transfer Concrete Consortium (TTCC) is open to any state agency desiring to be a part of new developments in concrete.

FISCAL YEAR 2010 ACCOMPLISHMENTS

The fall 2009 meeting of the National Concrete Consortium (NCC) was held in St Louis, Missouri. The theme for this meeting was Cement Standards and Technology for Sustainable Concrete Paving and included a tour of the new Holcim Cement Plant. Approximately 80 participants from government agencies, industry, and academia, including 20 different state DOT representatives, attended. The Spring 2010 workshop was held in Savannah, GA with 85 participants. The theme for this meeting was overlays, including state reports on overlays and the new roller compacted concrete guide.

FISCAL YEAR 2011 ACCOMPLISHMENTS

The Spring 2011 workshop was held in April 2011 in Indianapolis, IN. Approximately 80 participants from government agencies, industry, and academia, including 20 different state DOT representatives, attended. The Fall 2011 workshop was held in Rapid City, SD with approx. 85 participants. The theme for this meeting was the Mechanistic-Empirical Pavement Design Guide, including state reports.

FISCAL YEAR 2012 ACCOMPLISHMENTS

The Spring 2012 NCC meeting was held in Oklahoma City, OK. The theme for this meeting was non-destructive testing of concrete. The fall meeting was held in Seattle, WA, in conjunction with the International Conference on Concrete Pavements. This NCC meeting provided updates on several pooled fund projects related to Task 1 of the current CP Roadmap. There were also discussions relative to a proposed future pooled fund project focused on the development of new protocol for durability-based testing and acceptance of concrete. This initiative will be further discussed in future meetings.

FISCAL YEAR 2013 ACCOMPLISHMENTS (Benefits to MDOT)

The Spring 2013 NCC meeting was held in Philadelphia, PA. The theme for this meeting was pavement smoothness and ride quality. The fall meeting was held in Asheville, NC. Its theme was life-cycle cost and pavement type selection. This NCC meeting provided updates on several pooled fund projects related to Task 1 of the current CP Roadmap. There were also discussions relative to a proposed future pooled fund project focused on development of new protocol for durability-based testing and acceptance of concrete. This initiative will be further discussed in future meetings. The total number of participating state agencies increased from 24 to 27.

FISCAL YEAR 2014 ACCOMPLISHMENTS (Benefits to MDOT)

The Spring 2014 meeting was held in Jacksonville, FL on April 21-24. Topics included state reports, rethinking concrete delivery, a SHRP2 update, sustainability, bridge deck cracking, and others. The Fall 2014 meeting was held in Omaha, Nebraska on September 9-11. Topics included state reports on aggregate quality, MnRoad update, Microspheres, Quality paving, FHWA Update, pavement repairs, and others.

FISCAL YEAR 2015 ACCOMPLISHMENTS

The Spring 2015 meeting was held in Reno, NV on April 21-24. Topics included state reports on concrete curing, internal curing, performance based durability specifications, and others. The Fall 2015 meeting will be held in Milwaukee, WI on September 15-17. Topics include state report on concrete pavement joint sealing practices, There were also sessions on the Super Air Meter, Formation Factor, performance engineered mixes, FHWA Update, and others.

FISCAL YEAR 2016 PROPOSED ACTIVITIES

The Spring and Fall 2016 meetings date and location are to be determined.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

\$3,000 was approved in amendments in FY12 for a synthesis report and \$7,000 was approved in the Fiscal Year (FY) 13 amended program. FY12 and FY13 budgeted funds were expended in FY13. In 2014 the lead agency requested all partner states to transfer all 2015 and beyond fund commitments from TPF-5(159) to the new TPF-5(313); Solicitation No. 1363.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION

This is a continuing pooled fund study focused on being an ongoing forum to identify, support, facilitate and fund concrete research and technology transfer initiatives. It serves as a forum to transfer technology and current state of practice amongst participating state DOTs, industry, and academia. Discussions and dialogue presented often serve as a springboard for further in-depth studies and pooled efforts.

**RESEARCH ADMINISTRATION
MDOT TRANSPORTATION POOLED FUND STUDY
ANNUAL REPORT - FISCAL YEAR 2015**

STUDY TITLE: Transportation Management Center (TMC) Pooled Fund Study [Previously SPR-2(207)]

FUNDING SOURCE: FHWA OTHER (PLEASE EXPLAIN)

TPF NO.	TPF-5(319)	MDOT START DATE (FUNDING)	10/1/2014
OR NO.	OR14-040	MDOT COMPL. DATE (FUNDING)	9/30/2017
		PROJ. COMPL. DATE (Revised)	9/30/2017
TECHNICAL CONTACT	Jimmy Chu, 202-366-3379 jimmy.chu@dot.gov		
LEAD AGENCY	Federal Highway Administration (FHWA)		
PROJECT MANAGER	Suzette Peplinski, 616-451-8448		
CONTRACTOR			

BUDGET STATUS

FY 2015 Budget			Total Budget		
FY FUNDS	(Original)	\$25,000.00	BUDGETED AMT.	(Original)	\$175,000.00
	(Revised)		BUDGETED AMT.	(Revised)	
TOTAL FY 2015 EXPENDITURES		\$25,000.00	Total Committed Funds Available*		\$50,000.00

PARTICIPATING STATES

ABBREVIATE THE PARTICIPATING STATES. IF MDOT IS THE LEAD AGENCY, ALSO LIST THE CONTRIBUTION PERCENTAGE PER STATE.

Not applicable.

PURPOSE AND SCOPE

The purpose of the Transportation Management Center (TMC) Pooled Fund Study is to assemble regional, state, and local transportation management agencies and FHWA to (1) identify human-centered and operational issues, (2) suggest approaches to addressing identified issues, (3) initiate and monitor projects intended to address identified issues, (4) provide guidance and recommendations and disseminate results, (5) provide leadership and coordinate with others with TMC interests, and (6) promote and facilitate technology transfer related to TMC issues nationally.

FISCAL YEAR 2014 PROPOSED ACTIVITIES

A conference call with the members was held in early October to discuss the plan for initiating projects that were selected at the annual meeting in May 2013. Members would review the scopes of the projects and discuss additional issues and topics to be included, and determine the priority for moving them forward.

FISCAL YEAR 2014 ACCOMPLISHMENTS

Studies included: Best Practice for Road Condition Reporting Systems, Guidebook for Developing Virtual TMCs, Effectiveness of Safety and Public Service Announcement (PSA) messages on Dynamic Message Signs (DMS), Roles of Transportation Management Centers in Incident Management on Managed Lanes, and Travel Time Displays prior to Freeway Entrances. A webinar was also held: Effectiveness of Disseminating Traffic Messages on Dynamic Message Signs

FISCAL YEAR 2015 ACCOMPLISHMENTS

Several webinars were held on current, relevant TMC topics that MDOT staff attended. Studies included: Human Factors Guidelines for TMCs, Next Generation Traveler Information System - A 5-Year Outlook Project, and Public Perception of PSA on DMS in Rural Areas.

FISCAL YEAR 2016 PROPOSED ACTIVITIES

Topics to cover include: TMC Video Recording and Archiving Best General Practice, Freeway Service Patrol Prioritization and Best Practice, Capability and Usage Guidelines for Color DMS, Synthesis of Variable Speed Limit Signs – Operations, and Roadmap to Address MAP-21 Performance Measures on Highway Operations.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION

- Implementation Recommendations
 - Travel Time Displays prior to Freeway Entrances reports are being used for a current project being implemented in West Michigan and for planning other operations throughout the state.
 - MDOT staff previously attended the PFS webinar and will use information obtained, along with the related study, for developing statewide messaging guidelines.
 - Roles of Transportation Management Centers in Incident Management on Managed Lanes reports are being used for planning processes for managed corridors statewide.
- The following recommendations resulting from the study are those that MDOT plans to incorporate into an implementation action plan to improve the operations or how we do business.
 - Transportation Operations Center staff will use the guidelines related to DMS messaging to develop and improve the MDOT Standard Operation Procedures.
 - Research provided in Next Generation Traveler Information System (TIS) project is being reviewed to improve MDOT's own TISs (such as Mi Drive, email traffic alerts, etc.).

**RESEARCH ADMINISTRATION
MDOT TRANSPORTATION POOLED FUND STUDY
ANNUAL REPORT - FISCAL YEAR 2015**

STUDY TITLE: Base Funding for the North Central Superpave Center

FUNDING SOURCE: FHWA OTHER (PLEASE EXPLAIN)

TPF NO.	TPF-5(320)	MDOT START DATE	6/1/2015
PROJECT NO.		MDOT COMPLETION DATE (Original)	9/30/2016
OR NO.	OR15-521	COMPLETION DATE (Revised)	
TECHNICAL CONTACT	Kevin Kennedy, 517-322-6043 KennedyK@michigan.gov		
LEAD AGENCY	Indiana Department of Transportation		
PROJECT MANAGER	Steve Bower, 517-636-7777		
CONTRACTOR			

BUDGET STATUS

FY 2015 MDOT Budget			MDOT Total Budget		
FY FUNDS	(Original)	\$0.00	TOTAL BUDGET	(Original)	\$50,000.00
	(Revised)			(Revised)	
TOTAL FY 2015 EXPENDITURES		\$0.00	TOTAL COMMITTED FUNDS AVAILABLE		\$50,000.00

PARTICIPATING STATES

ABBREVIATE THE PARTICIPATING STATES. IF MDOT IS THE LEAD AGENCY, ALSO LIST THE CONTRIBUTION PERCENTAGE PER STATE.

IA, IL, IN, KS, MI, MO, and WI

PURPOSE AND SCOPE

This pooled fund project will provide for continued operation of the North Central Superpave Center (NCSD) to assist agencies and industry with Superpave implementation and hot mix asphalt issues. The NCSC will provide technical assistance, training, communication, and research and development to meet the needs of the region.

FISCAL YEAR 2015 ACCOMPLISHMENTS (Benefits to MDOT)

There was a conference held in 2015 prior to MDOT committing funds. Planning for the 2016 conference is ongoing. A teleconference was held to discuss states' experience with premature cracking on Hot Mix Asphalt (HMA). Additional technical conference calls will be held throughout the coming year.

FISCAL YEAR 2016 PROPOSED ACTIVITIES

The 2016 technical conference will be held in March and ongoing teleconferences are being held to discuss various technical issues. The NCSC will provide technical assistance, training, communication, and research and development work to meet the needs of the region.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

None.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION

MDOT has already implemented the use of low tracking bond coat based on testing done by the NCSC. The plan is for MDOT to continue to participate in the pooled fund study so that they can participate in the North Central Asphalt Users Producer Group and continue to use the SuperPave center as a resource.

**RESEARCH ADMINISTRATION
MDOT TRANSPORTATION POOLED FUND STUDY
ANNUAL REPORT - FISCAL YEAR 2015**

STUDY TITLE: TRB Core Program Activities - Period Covering Fiscal Year 2015 (TRB Fiscal Year 2016)

FUNDING SOURCE: FHWA OTHER (PLEASE EXPLAIN)

TPF NO.	TPF-5 (321)	MDOT START DATE	10/01/2014
PROJECT NO.	n/a	MDOT COMPLETION DATE (Original)	09/30/2015
		PROJECT COMPLETION DATE (Revised)	
TECHNICAL CONTACT	Jean Landolt, 202-493-3146 Jean.Landolt@dot.gov		
LEAD AGENCY	Federal Highway Administration (FHWA)		
PROJECT MANAGER	André Clover, 517-636-7777		
CONTRACTOR			

BUDGET STATUS

FY 2015 Budget			Total Budget		
FY FUNDS	(Original)	\$181,766.00	BUDGETED AMT.	(Original)	\$181,766.00
	(Revised)		ACTUAL COST	(Revised)	
TOTAL FY 2015 EXPENDITURES		\$175,602.00	Total Committed Funds Available		\$6,164.00

PARTICIPATING STATES

ABBREVIATE THE PARTICIPATING STATES. IF MDOT IS THE LEAD AGENCY, ALSO LIST THE CONTRIBUTION PERCENTAGE PER STATE.

AK, AR, CA, CT, FL, IA, ID, IL, IN, ME, MI, MN, MS, KMT, NC, ND, NJ, NM, OR, PA, SC, SD, TX, and WV

PURPOSE AND SCOPE

The Michigan Department of Transportation provides annual financial support for the Transportation Research Board's (TRB's) Core Program technical activities. This support helps to operate TRB annual meetings, the committee structure, State visits by TRB, and the TRB publication program.

FISCAL YEAR 2013 ACCOMPLISHMENTS (Benefits to MDOT)

MDOT has a representative on the TRB Executive Committee that serves as an official representative and liaison. This representative negotiates the fees and services that best serve its particular needs and provides support for the Board's programs and activities of interest to the entire transportation community.

FISCAL YEAR 2014 ACCOMPLISHMENTS (Benefits to MDOT)

- **TR News**
TRBs bimonthly news magazine features timely articles and state-of-the-art research and practices in all modes of transportation.
- **Transportation Research Record: Journal of the Transportation Research Board (TRR Journal)**
TRB publishes approximately 70 volumes of the TRR Journal each year, which contain more than 900 papers grouped by subject. TRR Journals are available in print format and are also available through an online service.
- **TRR Journal Online**
TRB's [TRR Journal Online website](#) has provided 24/7 electronic access to the full text of more than 13,900 peer-reviewed papers that have been published as part of the TRR Journal series since 1996. The site includes the latest in search and analysis technology, and is updated as new TRR Journal papers become available.
- **TRB Full Collection**
Includes all of the regular serial publications of TRB in print format, such as TRB books and reports covering 36 transportation functions and modes. Annually, TRB produces approximately 200 titles in its [serial publications \(pdf\)](#) that include the TRR Journal; TR News; Special Reports; Conference Proceedings; Transportation Research Circulars; National Cooperative Highway Research Program (NCHRP), Transit Cooperative Research Program (TCRP) Reports, Airport Cooperative Research Program (ACRP) Reports, National Cooperative Freight Research Program (NCFRP), Hazardous Material Cooperative Research Program (HMCRRP), Research Results Digests, Legal Research Digests and Syntheses, Commercial Truck and Bus Safety Synthesis Program (CTBSSP) Syntheses and Research Results Digests; and SHRP2 Reports.

FISCAL YEAR 2015 ACCOMPLISHMENTS

MDOT fund contributions in fiscal year 2015 continue to support TRB's cost of operations. This support includes, but is not limited to, TRB's Annual Meeting, its bimonthly news magazines, the TRR Journal publications, website operations, and other annual publications printed and distributed nationwide.

FISCAL YEAR 2016 ACCOMPLISHMENTS

MDOT's plan is to continue to support TRB's cost of operations in 2016.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

None.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION

MDOT technical experts have access to all TRB publications to review and share internally as appropriate.

**RESEARCH ADMINISTRATION
MDOT TRANSPORTATION POOLED FUND STUDY
ANNUAL REPORT - FISCAL YEAR 2015**

STUDY TITLE: No Boundaries Roadway Maintenance Practices

FUNDING SOURCE: FHWA OTHER (PLEASE EXPLAIN)

TPF NO.	TPF-5(330)	MDOT START DATE	5/29/2015
PROJECT NO.	Not Applicable	MDOT COMPLETION DATE (Original)	9/30/2017
OR NO.	OR15-518	COMPLETION DATE (Revised)	
TECHNICAL CONTACT	Tim Croze, 517-322-3394 CrozeT@michigan.gov		
LEAD AGENCY	Ohio Department of Transportation		
PROJECT MANAGER	Steve Bower, 517-636-7777		
CONTRACTOR			

BUDGET STATUS

FY 2015 MDOT Budget			MDOT Total Budget		
FY FUNDS	(Original)	\$0.00	TOTAL BUDGET	(Original)	\$30,000.00
	(Revised)			(Revised)	
TOTAL FY 2015 EXPENDITURES		\$0.00	TOTAL COMMITTED FUNDS AVAILABLE		\$30,000.00

PARTICIPATING STATES

OH, MO, PA, FL, MI, ND, SC, and WA

PURPOSE AND SCOPE

This pooled fund study covers all aspects of maintenance, except for winter maintenance. The purpose of the study is to share innovative maintenance practices through websites, a searchable database, meetings, trainings, etc.

FISCAL YEAR 2015 ACCOMPLISHMENTS (Benefits to MDOT)

MDOT joined the pooled fund and are just beginning to get involved in pooled fund activities.

FISCAL YEAR 2016 PROPOSED ACTIVITIES

A kick-off teleconference will be held with all member states in October. It is expected that an in-person meeting will be held so the Transportation Advisory Council (TAC) can discuss the development of implementation materials for maintenance innovations that have been selected by the TAC as being worthy of implementation.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

None.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION

Project expected completion in fiscal year 2017.

**RESEARCH ADMINISTRATION
MDOT TRANSPORTATION POOLED FUND STUDY
ANNUAL REPORT - FISCAL YEAR 2015**

STUDY TITLE: National Cooperative Highway Research Program (NCHRP) for FY 2015

FUNDING SOURCE: FHWA OTHER (PLEASE EXPLAIN)

TPF NO.	TPF-5(415)	MDOT START DATE	10/01/2014
PROJECT NO.	Not applicable	MDOT COMPLETION DATE (Original)	09/30/2015
OR NO.		COMPLETION DATE (Revised)	
TECHNICAL CONTACT			
LEAD AGENCY	Federal Highway Administration (FHWA)		
PROJECT MANAGER	Andre' Clover, 517-636-6053		
CONTRACTOR			

BUDGET STATUS

FY 2015 Budget			Total Budget		
FY FUNDS	(Original)	\$1,100,000.00	BUDGETED AMT.	(Original)	\$1,100,000.00
	(Revised)		ACTUAL COST	(Revised)	
TOTAL FY 2015 EXPENDITURES		\$915,038.00	Total Committed Funds Available		\$184,962.00

PARTICIPATING STATES

ABBREVIATE THE PARTICIPATING STATES. IF MDOT IS THE LEAD AGENCY, ALSO LIST THE CONTRIBUTION PERCENTAGE PER STATE.

Not Applicable.

PURPOSE AND SCOPE

Every federal fiscal year, State Departments of Transportation are solicited to contribute 5.5 percent of their State Planning and Research (SP&R) Program federal funds to the National Cooperative Highway Research Program (NCHRP) to ensure its continued successful operation. The NCHRP is a federal program in place to develop and fund national transportation research in acute problem areas that affect highway planning, design, construction, operation, and maintenance nationwide. The NCHRP disseminates information throughout the transportation community and conducts independent research that benefits various transportation agencies throughout the country.

FISCAL YEAR 2013 ACCOMPLISHMENTS (Benefits to MDOT)

Lawrence Technological University was awarded NCHRP Project 12-97: Design Guidelines for Field Deployment of Carbon Fiber Reinforced Polymer (CFRP) Prestressed Means in Bridge Construction with a \$500,000 allocation. The purpose of this project is to investigate a full-depth CFRP deck panel system that greatly simplifies the construction process. The developed design system will need to be fully investigated before being implemented on a bridge project.

A successful implementation for CFRP reinforcement in the bridge industry calls for the development of standards that address all design and construction aspects, such as flexural strength, shear strength, bond strength, development length, creep, shrinkage, durability, handling, and erection. With such standards in hand, it is expected that the construction of CFRP/prestressed concrete bridges will grow to be a general practice rather than a demonstration practice.

FISCAL YEAR 2014 ACCOMPLISHMENTS (Benefits to MDOT)

- Thirty-two (32) new NCHRP Research Project Reports (January - October 2014) were published.
- Fourteen (14) new NCHRP Synthesis Reports (March - July 2014) were published.
- Four (4) new NCHRP Research Results Digests (January - July 2014) were published.
- NCHRP [announced its FY 2015 projects](#). Requests for Proposals (RFPs) were released in the fall.
- NCHRP's [2013 Summary of Progress](#) was published, highlighting the more than 161 projects completed in 2013. It includes a listing of the more than 2,800 other projects undertaken by the program since 1962. Information on all projects initiated under the NCHRP from its inception in 1962 through 1988 is included in [NCHRP Web Document 7: Special Edition of Summary of Progress through 1988](#).

FISCAL YEAR 2015 ACCOMPLISHMENTS

The MDOT fund contribution in Fiscal Year (FY) 2015 provided support to NCHRP cost of operations. Deliverables included, but were not limited to the publications of NCHRP Research Reports, Synthesis Reports, Research Results Digests, National RFPs, and the production of the NCHRP 2015 Summary of Progress report.

FISCAL YEAR 2016 PROPOSED ACTIVITIES

MDOT plans to continue its annual funding support to NCHRP operations in FY 2016.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

None.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION

Research findings are published in the NCHRP Reports series and the NCHRP Synthesis of Highway Practices series. MDOT technical experts have access to all NCHRP productions and continually review and share/incorporate NCHRP research findings and recommendations into its business operations as appropriate.

**RESEARCH ADMINISTRATION
MDOT TRANSPORTATION POOLED FUND STUDY
ANNUAL REPORT - FISCAL YEAR 2015**

STUDY TITLE: AASHTOWare Development Project – Project Bids Software (AASHTO PBS)

FUNDING SOURCE: FHWA OTHER (PLEASE EXPLAIN)

TPF NO.	Not Applicable	MDOT START DATE	10/1/2014
PROJECT NO.	126199	MDOT COMPLETION DATE (Original)	9/30/2016
OR NO.	OR15-101	COMPLETION DATE (Revised)	

TECHNICAL CONTACT

LEAD AGENCY: Federal Highway Administration (FHWA) / American Association of State Highway Transportation Officials (AASHTO)

PROJECT MANAGER: Jill Mullins, 517-373-1576
MullinsJ@michigan.gov

CONTRACTOR

BUDGET STATUS

FY 2015 MDOT Budget			MDOT Total Budget		
FY FUNDS	(Original)	\$81,000.00	TOTAL BUDGET	(Original)	\$162,000.00
	(Revised)			(Revised)	
TOTAL FY 2015 EXPENDITURES		\$81,000.00	TOTAL COMMITTED FUNDS AVAILABLE		\$81,000.00

PARTICIPATING STATES

ABBREVIATE THE PARTICIPATING STATES. IF MDOT IS THE LEAD AGENCY, ALSO LIST THE CONTRIBUTION PERCENTAGE PER STATE.

MI, FL, GA, MN, MT, OH, CO, MS, VA, KY, WV, NE, LA, AZ, MO

PURPOSE AND SCOPE

The purpose of this project is to develop a newly enhanced AASHTOWare Project Bids Software application to replace AASHTOWare Project Expedite, including a functional redesign of the software to better accommodate bidding needs.

FISCAL YEAR 2015 ACCOMPLISHMENTS (Benefits to MDOT)

MDOT was selected as a beta testing agency for Project Bids.

FISCAL YEAR 2016 PROPOSED ACTIVITIES

The implementation process will include re-writing MDOT's bidding configuration files to XML format used by the AASHTOWare Project Bids software and other software leveraging the interface format standard.

- Beta testing to begin in November 2015
- Implementation of new software expected in December of 2015
- Begin Implementation of Phase Two during this Fiscal Year (FY)

Agency Enhancements Planned:

- Enhance configurability
- Improve security with the use of X.509 certificates
- Increase flexibility in bidder responses in the miscellaneous folders based on agency requirements
- Enhance printing functionality
- Process decrypted bid files to make them readable, eliminating the need of maintaining legacy software
- Increase stability and develop a more robust framework for future enhancements
- Improve flexibility with the use of open standards, e.g.: XML (GEN, LOAD, CONFIG), X.509, and ZIP file format vs. EBLIB

Bidders Enhancements Planned:

- Improve error visibility when completing bids
- Create one bidding application for all agencies that auto-updates
- Improve attachments functionality that uploads files at the time they are attached to the bid file rather than 'with' the bid upload, resulting in faster bid submission
- Improve logging of bidder activity throughout the bidding process
- Improve security with the use of X.509 certificates

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

None.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION

Project expected completion in FY 2016.

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2015**

PROJECT TITLE: University Transportation Center – Center for Highway Pavement Preservation

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Erin Chelotti

CONTRACT/AUTHORIZATION NO.	2013-0066 Z3	PROJECT START DATE	11/1/2014
PROJECT NO.	126401	COMPLETION DATE (Original)	1/31/2017
OR NO.	OR15-508	COMPLETION DATE (Revised)	
RESEARCH AGENCY	Michigan State University		
PRINCIPAL INVESTIGATOR	Emin Kutay, Ph.D., P.E.		

PROJECT BUDGET STATUS

MDOT FY 2015 Budget		Total Project Budget	
Vendor Budget FY 2015	\$120,001.00	Total Vendor Budget	\$120,001.00
MDOT Budget FY 2015	\$0.00	Total MDOT Budget	\$0.00
Vendor FY 2015 Expenditures	\$24,542.84	Total Budget	\$120,000.01
MDOT FY 2015 Expenditures	\$0.00	Total Expenditures	\$24,542.84
		Total Amount Available	\$95,458.16

MDOT and MSU Funding	
MDOT Funding	\$120,001.00
University Match	\$50,000.00
Total Budget	\$170,001.00

PURPOSE AND SCOPE

One of the most important parameters of a chip seal design is the binder aggregate embedment depth. Transportation agencies typically specify an embedment depth on a percentage basis. Specifications require the embedment depth to be assessed after both construction completion and initial curing of the chip seal emulsion. Cold weather states generally require a 60-70 percent chip embedment depth while warm weather states require a 50-60 percent embedment depth at the time of initial acceptance. While the original chip seal design is based on a given percent embedment, an objective method to quantify and confirm percent embedment after placement does not exist. An objective field test is needed to support a more uniform method of acceptance for a chip seal treatment.

FISCAL YEAR 2015 ACCOMPLISHMENTS

Task 1: The research team finished a detailed literature review. One goal of the literature review was to understand the significance of embedment depth on chip seal performance. It was found that a finite element analysis based chip seal performance study could be a possible candidate method to compare embedment depth and performance of chip seal.

Task 2: The research team developed two algorithms for chip seal project acceptance tests. The initial algorithm was developed for calculating aggregate embedment depth and was based on the following assumptions: (1) surface of the existing pavement is assumed to be perfectly straight, and (2) no binder absorbs into the existing pavement. The team has made significant improvements to the initial algorithm. The new algorithm is capable of finding existing pavement surface (i.e., the surface of the substrate) and determining aggregate embedment into the substrate. Additional core samples from the field were collected (with the help from MDOT regional offices) in order to further improve the robustness of the Algorithm. Also, the research team has designed and manufactured a lab sample fabrication setup for the laboratory samples.

Task 3: Sand patch tests were performed on all field samples. In addition, the Ames laser texture scanner at the MDOT regional office was used for all core samples in order to measure texture content as mean profile depth, texture profile index, and estimated texture depth. With the help of using actual aggregate shape properties being taken from images and estimated texture depth, the actual embedment depth for all samples was calculated. 40 laboratory chip seal samples have been fabricated in order to investigate usage of embedment depth and the image-based coverage area method, and to measure the performance of chip seal samples under the laboratory sweep test setup. First, eight chip seal samples (containing 2 replicates) were prepared using the lowest and highest binder and aggregate application rates specified in the MDOT standard specifications. For the first 8 samples, the research team observed that the binder application rate has a greater influence on percent embedment and binder coverage than the aggregate application rate. Therefore, in order to determine the effect of binder application rate, 32 more chip seal samples (with 2 replicates) were fabricated with an emulsion application range between 0.39 gal./yd² and 0.46 gal./yd² (MDOT specification) with an increment of 0.01 gal./yd² and a constant aggregate application rate of 20 lb./yd². 16 of the samples were analyzed through image processing techniques just after the sample fabrication. The remaining 16 samples were analyzed in terms of embedment depth and coverage area method after conducting sweep test in the laboratory.

Delays: A time delay of approximately 6 weeks occurred in waiting for the sweep test apparatus. This was due to a delay in manufacturing of the device from the supplier. It has since been received and abrasion testing is underway. Repair and maintenance of an environmental chamber used to condition lab samples also caused a slight time delay of approximately one week. The environmental chamber is now functional.

FISCAL YEAR 2016 PROPOSED ACTIVITIES

The research team will continue to fabricate more laboratory samples to help in understanding more about the usage and capability of the binder coverage area algorithm. In addition to applicability of the binder coverage area method, correlation between percent embedment depth from both sand patch and Ames laser texture, and image-based embedment depth, will be investigated further. After gaining enough data, the possibility of implementing statistical methods will be determined. In addition, fabricating more samples will help in simulating different environmental conditions in the chamber and will allow further analysis of these samples. In terms of the way we fabricate chip seal samples, the research team will investigate the best way of simulating for compaction of laboratory samples with the MTS machine.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

None.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

Project completion expected in fiscal year 2018.

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2015**

PROJECT TITLE: University Transportation Center – National University Rail Center, Tier I

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Nikkie Johnson

CONTRACT/AUTHORIZATION NO.	2013-0067 Z11	PROJECT START DATE	1/1/2015
PROJECT NO.	126721	COMPLETION DATE (Original)	12/31/2016
OR NO.	OR14-056	COMPLETION DATE (Revised)	
RESEARCH AGENCY	Michigan Technological University		
PRINCIPAL INVESTIGATOR	Pasi Lautala, Research Assistant Professor		

BUDGET STATUS

FY 2015 Budget		Total Budget	
Vendor Budget FY 2015	\$62,694.77	Total Vendor Budget	\$99,997.35
MDOT Budget FY 2015	\$0.00	Total MDOT Budget	\$0.00
Vendor FY 2015 Expenditures	\$33,239.94	Total Budget	\$99,997.35
MDOT FY 2015 Expenditures	\$0.00	Total Expenditures	\$33,239.94
		Total Amount Available	\$58,447.42

RITA, MTU and MDOT Funding	
MDOT Project Budget	\$99,997.35
University Match	\$24,999.00
University Non-SPR II	\$21,060.00
USDOT – RITA	\$18,167.65
Total Budget	\$164,224.00

PURPOSE AND SCOPE

The purpose of this series of studies is to investigate capacity analysis methods and outcomes on shared use rail corridors, conduct life cycle analysis on modal decisions, recommend light density/rural rail line improvements, and conduct rail technology transfer sessions for MDOT's Office of Rail and other stakeholders.

Michigan is looking to increase rail passenger traffic, both for commuter and intercity purposes. One of the main challenges is adequate capacity of rail corridors, some of which are owned by private freight railroads. It would be essential to operate these corridors with maximum efficiency so capital investments could be minimized. Looking at modal decisions and related investments from a broader perspective may ultimately influence those decisions and decisions related to supporting infrastructure investments. Insufficient use of light density/rural freight rail lines in the state may remove transportation economies from businesses depending on rail shipments, or at the minimum, transfer more freight to the already congested road network. MDOT is building the staff levels in the Office of Rail and staff expertise is not yet fully known. Additionally, experienced staff can benefit from technology transfer sessions on emerging topics.

FISCAL YEAR 2015 ACCOMPLISHMENTS

LCA/LCCA Analysis: Continued data collection from literature, Highland Copper, and other associates. The first round of LCA analysis was performed in SimaPro, and the initial LCCA was performed through Excel. A Transportation Research Board (TRB) paper was submitted and accepted for presentation.

Undergraduate Student Project: Created a list of potential projects initiated by Michigan Technological University and discussed alternative projects with MDOT, tentatively settling on the Lake State Railway project. The student project team was selected, they were briefed on the project, and taken on a student field trip to Saginaw for data collection.

Michigan Rail Conference: Successfully conducted the rail conference with over 160 participants, and kept costs within budget.

MDOT Coordination Meetings: Held the official kickoff web conference in April, and progress meeting/discussions were held periodically after the rail conference.

FISCAL YEAR 2016 PROPOSED ACTIVITIES

LCA/LCCA Analysis: Finalize LCA/LCCA analysis, continuing to improve parameter values; perform sensitivity analysis; complete the draft report and submit for review; and potentially submit a paper for the 2016 Joint Rail Conference.

Undergraduate Student Project: Complete the site survey for drainage and structural work, an interim design review with Lake State Railway, the final conceptual design report, and final briefing. Also, identify the scope of work for a spring project team.

Michigan Rail Conference: Complete analysis of the MIRC 2015 survey and begin planning for MIRC 2016 in Marquette, including holding the initial planning committee meeting, preparing the preliminary budget, and opening discussions with the conference venue and hotels.

MDOT Coordination Meetings: The next progress meeting is planned for April, 2016, but a web conference will be conducted in November to review LCA/LCCA study outcomes and provide update on the student project. Regular conference calls on the MI Rail Conference will begin again late in the year.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

None.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

Project completion expected fiscal year 2016.
