Michigan Department of Transportation
RESEARCH Administration

## STATE PLANNING & RESEARCH PART II PROGRAM

FISCAL YEAR 2025

# ANNUAL REPORT

OCTOBER 1, 2024 — SEPTEMBER 30, 2025

www.michigan.gov/mdotresearch

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# State Planning and Research, Part II Program
# 2025 Annual Report

## Introduction

The Michigan Department of Transportation (MDOT) State 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 (RAd) Section in the Bureau of Field Services and 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 fiscal year (FY), 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), and National Cooperative Highway Research Program (NCHRP). The program must be reviewed and approved by the Federal Highway Administration (FHWA) Michigan Division Office prior to implementation. MDOT received FHWA approval for FY 2025 on Aug. 12, 2024. This annual report covers the MDOT SPR Part II Program from Oct. 1, 2024, through Sept. 30, 2025.

## Summary

FY 2025 research was conducted in the following focus areas, representing several modes of transportation and MDOT's diverse business functions:

**Highways Development**
- Environment and Water Resources
- Project Development
- Surveys and Automated Design

**Highways Bridges and Structures**
- Bridge and Structure Design and Construction
- Bridge and Structure Preservation and Inspection
- Geotechnical and Foundation Design

**Planning and Organizational Development**
- Data Inventory and Integration
- Program Development
- Travel Demand Forecasting

**Multimodal Transportation and Finance**
- Aviation
- Local Transit
- Finance

**Highways Delivery and Operations**
- Construction
- Intelligent Transportation Systems and Signals
- Fleet/Facility Management and Operations
- Roadway and Roadside Maintenance
- Mobility and Traffic Incidents
- Pavements and Materials
- Transportation Safety

The FY 2025 SPR, Part II, Program consisted of 104 projects; 44 were 80 percent federally funded while 60 were 100 percent federally funded. The FY 2025 approved budget was $8,059,682.11 with expenditures totaled $7,819,391.35. Table 1 summarizes 80 percent federally funded projects that were funded in FY 2025 while the associated progress reports contain project summaries with projects listed sequentially by job number. Table 2 summarizes 100 percent federally funded projects. For additional information regarding a specific project, please contact RAd.

## 2025 Program and Administrative Milestones

The research program was delivered successfully and included the following FY 2025 milestones:

- MDOT received two AASHTO Research Advisory Committee (RAC) High Value Research (HVR) Honorable Mention awards given to the top research projects in the nation:
    - *Utilizing Video Analytics with Connected Vehicles for Improved Safety.*
    - *Electronic Water Level Sensors for Monitoring Scour Critical Structures.*

- RAd staff members attended the TRB Annual Meeting in January 2025 and coordinated the attendance of other MDOT employees. Research staff presented information at a poster session on the 2024 HVR award winning research project, *Repair of Bridge Deck Facias.*

- Completed 17 projects that were 80 percent federally funded.

- Initiated contracts for 10 new 80 percent federally funded projects in FY 2025, with total budgets of approximately $2.9 million.

- Joined eight new 100 percent projects with a total commitment of $1.4 million.

- Research staff participated in the NCHRP 20-44(49) Research Implementation Peer Exchange in Memphis, Tennessee. This event contributed to RAd's knowledge and sharing of best practices for implementation practices. Several state departments of transportation were represented.

- Published documents to transfer the results of research and innovation to practitioners, including the following Research Spotlights, highlighting the value of individual research projects:

    - Cost-Effective Solutions to Enhance Nighttime Pedestrian Safety
    - Developing Infrastructure at Airports to Charge Electric Aircraft and Vehicles
    - Eastern Massasauga Rattlesnake's Use of Roadside Space in Southern Michigan
    - Enhancing MDOT's Digital Vision to Support Construction Processes
    - Improving Cost Estimates for Bridge Repairs and Replacement
    - New Cost Index Enhances Construction Estimates and Budgeting
    - Speed Warning Technologies Slow Drivers in Critical Speed-Change Areas
    - Water-Level Sensors Help Prioritize Inspections of Scour-Critical Bridges
    - Using Crowdsourced Data to Estimate Nonmotorized Traffic Volumes

- RAd updated MDOT's High Value Research StoryMap, highlighting several MDOT projects that were selected through AASHTO over the last six years as high value or special category.

- Published a MDOT Video Spotlight summarizing the following research project:

    - *MDOT Research Video Spotlight - Optimizing Mechanical-Empirical Pavement Design Software for MDOT's Use*

- A summary of successful technology implementation was documented and distributed in an Implementation Spotlight, *Dynamic Speed Feedback Signs Effectively Improve Driver Behavior*.

- RAd contracted 10 research projects with the two University Transportation Centers (UTCs) recently awarded to Michigan universities. The University of Michigan and its partners were awarded a $3 million UTC grant for connected and automated transportation research. Prairie View A&M University was awarded a $4 million grant for a UTC led by Prairie View A&M University. Michigan State University is a subcontractor in this award for research on durability and extending the life of transportation infrastructure. MDOT has provided project selection and project management support. An additional four research projects have been identified for contracting in the future.

- RAd met with FHWA Michigan Division Officer Jenny Staroska to assess progress on addressing the risks of the research program and met with FHWA Michigan Division staff and MDOT staff on April 22, 2025, for the risk assessment workshop.

- Completed a research project implementation tracking and planning process for the third time in FY 2025:
    - Held a workshop in February 2025 to guide project managers (PMs) of recently completed projects through the process.
        - PMs reviewed research implementation recommendations and determined if findings should be executed.
        - Preliminary implementation plans were drafted that include objectives and tasks, scope, schedule, pilot locations (if applicable), estimated cost and possible funding sources.
        - PMs recommended an implementation manager (IM).
    - Hosted RAC meetings in April 2025 where the PMs presented their implementation plans. The RAC determined if implementation was recommended, assigned an IM and identified specific funding sources for implementation (if applicable).
    - Held a Research Executive Committee (REC) meeting in May 2025, where the PMs and IMs presented their implementation plan recommendation(s) in an informative presentation. The REC provided further guidance.
    - A total of 21 projects were recommended to the RAC to continue with the implementation process from FY 2023 and 2024.
    - RAd will be in communication with IMs, periodically requesting an implementation status report.

- Initiated the FY 2027, 2028 and 2029 research program planning process.
    - In fall 2024 and winter 2025, RAd held a series of internal process improvement meetings focusing on the research project development processes.
    - Enhancements were made to questions, forms, data sets and tracking methods.
    - In spring 2025, MDOT developed new research priorities with input from focus area managers (FAMs) and administrators throughout the department. The priorities are posted on RAd's website.
    - In September 2025, RAd requested research ideas addressing MDOT's priorities. All stakeholders were contacted.

    - A new application and website were developed to collect research ideas submitted by stakeholders. Submitted research ideas will be evaluated in FY 2026 with a new application developed for FAMs to submit comments and rankings.
    - In preparation for the program planning process, extensive training materials were developed to assist research PMs with beginning their role, building their research advisory panel and developing their problem statements. Training materials include videos, self-paced lesson modules, a resource guidebook and a hands-on workshop.

- RAd prepared the FY 2026 SPR II program and received FHWA approval on Aug. 19, 2024.

- MDOT's State Innovation Alignment Team (SIAT), along with several subject matter experts, continued populating the external Innovation website to have a central location to showcase MDOT innovations. The SIAT created the Innovation Excellence Award for 2025 for MDOT projects and initiatives that have previously implemented innovation within Michigan. The Awards Committee selected and scored the submitted ideas based on strategic alignment with workforce and leadership goals, cost and time savings, partner and customer-centered, innovative, efficient and easy to do, and overall safety.

    The top five 2025 Innovation Excellence Award winners were:

    1. US-23 Flex Route Phase 2 Innovations
    2. Drone Deployment for Aeronautics Safety Inspections and Drone Deployment to MDOT Regions
    3. Temporary Modular Bridge
    4. Roadside Herbicide Spray Drone
    5. Dynamic Speed Feedback Signs

- MDOT continues to partner with FHWA along with industry, local and state government agencies, working together toward innovating our transportation system through the State Transportation Innovation Council (STIC) and the Every Day Counts Initiative (EDC), and the following initiatives:
    - Two STIC incentives grants worth $125,000 to implement:
        - A transit technology training program for transit agencies within Michigan.
        - An MDOT right of way conversion to GIS training implementation.
    - Monthly meetings to discuss transportation innovations with MDOT, local agency and industry representatives.
    - Two virtual STIC highlights meetings featuring a total of 12 Michigan transportation industry innovations, with a combined attendance of more than 300 people.
    - An in-person meeting to allow for networking and a field visit highlighting the Kent County Road Commission and their innovations related to bridge construction.

- During winter and spring 2025, MDOT received the NCHRP ballot. The ballot was sent to FAMs throughout MDOT for review and comment. RAd met with executive staff to score each problem statement included in the ballot. The summary ballot was submitted online to TRB's Cooperative Research Programs and final vote submitted by the MDOT director.

- Several MDOT staff members attended AASHTO RAC meetings throughout the year to understand the national research agenda and processes. These meetings have included periodic AASHTO RAC discussions and Region 3 collaboration and business meetings, with two RAd staff members attending the national meeting.

**TABLE 1 - 80% FEDERALLY FUNDED**

| Job No. | FY 2025 Expenditures | Expenditures to Date | Total Budget | Project Manager | Agency | Principal Investigator | Title | Start Date | End Date | Page No. |
|---|---|---|---|---|---|---|---|---|---|---|
| 128602 | $178,995.71 | $1,011,540.51 | $1,166,711.17 | Kahl, Steve | LTU | Grace | Statewide Overall Carbon Fiber Composite Cable Bridge Monitoring | 12/17/2013 | 9/30/2026 | 13 |
| 132231 | $23,404.35 | $513,208.39 | $528,322.16 | Qu, Yige | MSU | Cregg | Slope Restoration on Urban Freeways | 4/1/2017 | 12/31/2025 | 16 |
| 209437 | $58,977.98 | $365,951.49 | $492,314.72 | Hoffmeyer, Mary | CTC & Associates | Casey | Research Administration Section Planning and Communications | 10/1/2020 | 9/30/2025 | 19 |
| 211061 | $133,831.81 | $701,488.84 | $701,757.71 | Eacker, Michael | MSU | Kutay | Evaluation of MDOT’s Methodologies for both Quantifying Pavement Distress & Modeling Pavement Performance for LCC and RSL Estimation Purposes | 2/2/2021 | 8/31/2025 | 22 |
| 213122 | $87,239.06 | $346,227.84 | $484,499.23 | Kahl, Steve | LTU | Grace | Influence of Revising CFCC Guaranteed Strength on Performance of CFCC Prestressed Highway Bridge Beams Subjected to Various Environmental Conditions | 10/1/2021 | 9/30/2026 | 24 |
| 213316 | $69,096.85 | $556,617.82 | $556,935.71 | Carlson, Erik | MTU | Watkins | Michigan Hydrologic Calculation Procedures | 11/1/2021 | 6/30/2025 | 27 |
| 213318 | $31,310.43 | $385,899.93 | $509,167.20 | Snook, Ryan | UM | Hryciw | Michigan Cone Penetrometer Test Calibration | 1/1/2022 | 9/30/2026 | 30 |
| 213321 | $28,012.76 | $245,747.46 | $280,409.23 | Pakala, Parush | WMU | Attanayake | Operational Baseline for the 2nd Avenue Network Arch Bridge | 1/1/2022 | 12/31/2025 | 32 |
| 217419 | $178,596.34 | $415,128.34 | $447,365.16 | Tempinson, Don | WMU | Attanayake | Capacity Prediction of Repaired and Unrepaired Bridge Beams with Deteriorated Ends | 10/1/2022 | 9/30/2025 | 34 |
| 217934 | $130,723.22 | $234,139.79 | $234,139.79 | Uzcategui, Alonso | MSU | Gates | Efficacy of Speed Warning Technologies | 1/23/2023 | 5/15/2025 | 36 |
| 217937 | $35,979.84 | $190,000.00 | $190,000.61 | Roath, James | MSU | Zockaie | Winter Severity Index with Winter Maintenance Expenses and Material Usage | 2/6/2023 | 7/5/2025 | 37 |
| 218359 | $122,596.87 | $212,451.62 | $212,451.62 | Ahlschwede, Carla | MTU | Dobson | Identify Mapping Techniques of Invasive Plant Species within the MDOT Right-of-Way (ROW) | 10/11/2023 | 9/30/2025 | 39 |
| 218361 | $20,987.17 | $225,612.41 | $226,889.86 | Sevigny, Diane | Hatch | Bodarya | MDOT Fleet Electrification Strategies | 6/21/2023 | 2/28/2025 | 40 |
| 218362 | $25,130.25 | $170,028.95 | $170,638.15 | Smerdon, Tim | WMU | Van Houten | Examination of Lighting Practices at Crosswalks | 4/24/2023 | 1/31/2025 | 42 |
| 218364 | $131,758.72 | $307,155.65 | $375,519.41 | Hoffman, Sarah<br>Krom, Ben | WMU | Oh | Evaluation of MDOT's Methodology for Estimating Work Zone User Delay Times | 5/3/2023 | 2/28/2026 | 43 |
| 218367 | $177,609.75 | $292,333.61 | $349,434.06 | Halloran, Mike | HDR | Longfield | Improving MDOT’s Movable Bridge Reliability and Operations | 3/17/2023 | 5/30/2025 | 45 |
| 218391 | $120,731.03 | $164,125.30 | $355,217.92 | Martin, John | MSU | Savolainen | Socio Economic Impacts of Technology Based Stakeholder Engagement Platforms | 8/21/2023 | 8/21/2026 | 47 |
| 218394 | $46,481.30 | $81,652.96 | $409,190.45 | Kahl, Steve | LTU | Grace | Design Guidance Development for Continuous Prestressed CFCC Strand Beams | 10/1/2023 | 9/30/2026 | 49 |
| 218396 | $115,191.39 | $300,000.00 | $300,000.01 | Firman, Jason | MSU | Savolainen | Identify Best Locations for New Flex-Route Projects Throughout the State of Michigan | 6/14/2023 | 6/14/2025 | 51 |
| 218397 | $336,690.00 | $336,690.00 | $459,886.00 | Gorman, Joseph | KPMG | Ganesh | Revenue Opportunities from MDOT Fiber Infrastructure and Other Utility Types | 5/27/2025 | 11/26/2025 | 53 |

| Job No. | FY 2025 Expenditures | Expenditures to Date | Total Budget | Project Manager | Agency | Principal Investigator | Title | Start Date | End Date | Page No. |
|---|---|---|---|---|---|---|---|---|---|---|
| 218398 | $128,918.83 | $385,360.18 | $501,903.80 | Schenkel, Justin | MSU | Haider | Pavement ME Rehabilitation Design Protocols for MDOT Implementation | 7/13/2023 | 7/13/2025 | 54 |
| 218401 | $0.00 | $116,283.71 | $116,284.36 | Kirkpatrick, Kristi | WMU | Liu | Improving Cost Estimation and Budget Planning with New Michigan Highway Construction Cost Index | 5/30/2023 | 12/31/2024 | 57 |
| 218402 | $98,795.82 | $151,890.22 | $160,069.82 | Adams, Kelsey | TAMU | Glover | Bonding vs. Pay-Go | 10/30/2023 | 7/31/2025 | 58 |
| 218403 | $215,440.67 | $272,604.07 | $298,118.22 | Kent, Ellen | CRAFT | Ketterl | Marketing and Education Budget for Implementation of New Transit Technology | 11/27/2023 | 11/30/2025 | 60 |
| 218404 | $86,492.88 | $196,341.09 | $196,477.94 | Brink, Steve<br>Miller, Dawn | MSU | Gates | Optimizing Work Zone Conditions to Maximize Safety and Mobility | 6/27/2023 | 6/26/2025 | 62 |
| 219527 | $425,733.47 | $705,065.23 | $717,907.42 | Smith, Linn | WSP | Wheeler | Unmanned Aircraft System Communications Mesh Test Deployment | 1/9/2024 | 6/30/2025 | 63 |
| 219734 | $102,897.35 | $158,117.05 | $261,770.97 | Case, Michael | Spy Pond Partners | Robert | Multi-Objective Decision Analysis and Optimization Model for Transportation Investment Decision-Making at MDOT | 1/30/2024 | 1/30/2026 | 65 |
| 219736 | $0.00 | $0.00 | $392,228.13 | Douglas, Scott | CRAFT | Ketterl | Digital Process Methods and Implementations for Field Applications | 3/26/2025 | 3/25/2027 | 67 |
| 219771 | $70,155.57 | $70,155.57 | $150,900.77 | Armour, Jacob | WMU | Attanayake | Enhance Bridge Image Attribution Through Automated Post Image Processing | 9/1/2024 | 2/28/2026 | 68 |
| 220847 | $90,878.19 | $96,382.01 | $276,213.18 | Bramble, Mary | MSU | Gates | Safety Effectiveness of Non-Freeway Sinusoidal Shoulder Corrugations | 4/24/2024 | 4/24/2026 | 69 |
| 220848 | $187,268.55 | $196,933.47 | $312,685.63 | McQuiston, Carissa | MSU | Savolainen | Covid and Traffic Crashes/Impact on Safety Targets | 5/15/2024 | 5/14/2026 | 70 |
| 221858 | $18,020.90 | $18,020.90 | $377,305.19 | Zarzewski, Brian | LTU | Grace | Replacement of Outside Beams on Adjacent Box-Beam Structures | 1/21/2025 | 1/21/2027 | 71 |
| 221863 | $95,184.51 | $95,184.51 | $264,327.69 | Phaneuf, Heidi | MSU | Zockaie | Evaluation Model for Equitable Prioritization of Bridge Investments | 2/5/2025 | 2/4/2027 | 73 |
| 221864 | $40,504.50 | $40,504.50 | $195,222.01 | O'Neill, Michelle | MTU | Darestani | Spun Concrete Poles: Guidelines for Fabrication, Condition Assessment, Repair, and Replacement | 4/10/2025 | 11/30/2026 | 75 |
| 221865 | $974.99 | $974.99 | $205,797.45 | Hoffman, Sarah | MSU | Gates | Evaluation of Digital Speed Limit Signs in Work Zones | 5/5/2025 | 4/30/2027 | 77 |
| 221866 | $34,156.17 | $34,156.17 | $145,809.57 | Reynolds, Micael | MTU | Colling | Roadsoft Modernization Research Project | 4/1/2025 | 9/30/2026 | 78 |
| *221867 | $0.00 | $0.00 | $341,527.04 | Snook, Ryan | UM | Garcia | Measurement and Performance of Riprap | 12/1/2025 | 2/28/2028 | 80 |
| 221868 | $14,758.61 | $14,758.61 | $436,963.10 | Snook, Ryan | WMU | Attanayake | Characterizing Corrosion Rates and Predicting Remaining Service Life for Steel Bridge Piles | 3/1/2025 | 5/31/2028 | 81 |
| 221869 | $1,797.12 | $1,797.12 | $199,501.40 | Greenway, Jane | MSU | Gates | Evaluation and Prioritization of MDOT's Highway Rest Areas for Potential Closure | 5/1/2025 | 12/31/2026 | 83 |
| *221871 | $0.00 | $0.00 | $355,860.24 | Gordon, Tom | To Be Determined | To Be Determined | Connected and Automated Vehicles (CAVs) Readiness Survey: Are MDOT Roads Machine Readable | To Be Determined | To Be Determined | 84 |
| 224029 | $10,650.67 | $10,650.67 | $164,053.44 | Maffeo, Robert | TAMU | Li | Evaluate Speed Estimation Techniques for EPA Moves Model Input Using Big Data and Travel Demand Models for Regional Conformity Analysis | 6/2/2025 | 6/1/2027 | 85 |
| 224034 | $103,693.41 | $103,693.41 | $532,616.59 | Shapter, Paul | ARA | Morovatdar | Evaluation of Traffic Speed Deflectometer Data (TSD) for Potential Use in Michigan | 5/1/2025 | 10/31/2027 | 87 |

| Job No. | FY 2025 Expenditures | Expenditures to Date | Total Budget | Project Manager | Agency | Principal Investigator | Title | Start Date | End Date | Page No. |
|---|---|---|---|---|---|---|---|---|---|---|
| *224827 | $0.00 | $0.00 | $479,459.17 | Hoffmeyer, Mary | CTC & Associates | Hirt | Research Program Technology Transfer | 10/1/2025 | 9/30/2030 | 90 |
| *224829 | $0.00 | $0.00 | $658,216.92 | Kahl, Steve | LTU | Grace | Efficacy, Advancement, and Monitoring of Carbon Fiber Composite Cable (CFCC) | 10/1/2025 | 9/30/2030 | 92 |
| | **$3,779,667.04** | **$9,724,874.39** | **$16,192,070.22** | **TOTAL 80% FEDERALLY FUNDED PROJECTS** | | | | | | |

*Project start was delayed from FY 2025 into FY 2026.

**TABLE 2 - 100% FEDERALLY FUNDED PROJECTS**

| Project No. | FY 2025 Expenditures | Expenditures to Date | Total Budget | Agency | Project Manager | Title | Start Date | End Date | Page No. |
|---|---|---|---|---|---|---|---|---|---|
| 219547 | $69,291.28 | $85,441.71 | $90,465.63 | MSU | Keopke, Kenneth | Michigan (One Point) Cone Test Evaluation - University Transportation Center (UTC) | 5/16/2024 | 5/15/2026 | 94 |
| 219737 | $78,285.70 | $96,741.67 | $96,799.99 | MSU | Arnold, Luke | Digital Collaboration using Industry Foundation Classes (IFC) and Building Information Model (BIM) Technology – UTC | 6/3/2024 | 8/31/2025 | 96 |
| 219864 | $101,261.00 | $128,660.95 | $176,667.80 | UM | Mueller, Michele | Effectiveness of Inductive Vehicle Charging to Alleviate EV Range Anxiety - UTC | 3/1/2024 | 5/20/2026 | 98 |
| 220837 | $60,305.60 | $60,305.60 | $137,600.00 | MSU | Byrum, Chris | Finite Element Method (FEM) Matrix Study for Rapid Travel Profiler Curl/Wrap Correlations - UTC | 8/1/2024 | 2/28/2026 | 100 |
| 221109 | $89,270.21 | $126,504.00 | $126,504.00 | UM | Bayus, Richard<br>Dell, James | Research and Development of a 3-Item Transportation Security Index Mobility Measurement Tool - UTC | 5/22/2024 | 6/5/2025 | 102 |
| 221177 | $132,575.20 | $179,772.55 | $199,999.99 | UM | Seeger, William | Automatic Signal Retiming Using Vehicular Trajectory Data - UTC | 5/22/2024 | 11/30/2025 | 104 |
| 221183 | $90,806.09 | $117,569.10 | $124,849.33 | UM | Maffeo, Robert | End-to-End Learning Framework for Transportation Network Equilibrium Modeling - UTC | 5/28/2024 | 10/25/2026 | 106 |
| 221872 | $4,822.23 | $4,822.23 | $177,510.87 | MSU | Zweng, Harold | Flood Fragility of Roads and Railroads - UTC | 10/1/2024 | 9/30/2026 | 108 |
| 223695 | $0.00 | $0.00 | $432,000.00 | UM | Gordon, Tom | Multimodal 3D Perception System for Active Safety at Accident-prone Locations - UTC | 6/2/2025 | 6/1/2027 | 110 |
| *223991 | $0.00 | $0.00 | $238,446.04 | UM | MacKay, Caitlin | Enhancing Road Safety through Video Analytics and Connected Vehicles - UTC | To Be Determined | To Be Determined | 112 |
| *224831 | $0.00 | $0.00 | $266,955.68 | UM | Gordon, Tom | Examination of Light-Based Directed Vehicle to Everything Communications Systems for Bridge Strike Detection - UTC | 10/1/2025 | 3/30/2027 | 113 |
| Sol. 1626 | $0.00 | $0.00 | $125,000.00 | FHWA | Martin, John | Designing Safer Streets | 10/2/2024 | 9/30/2030 | 115 |
| SPR1801(179) | $198,000.00 | $198,000.00 | $198,000.00 | AASHTO/ FHWA | Clover, Andre | AASHTO Engineering Technical Service Programs | 10/1/2024 | 9/30/2025 | 116 |
| TPF-5(255) | $0.00 | $100,000.00 | $100,000.00 | FHWA | Garcia, Daniel | Highway Safety Manual Implementation | 11/9/2015 | 12/31/2025 | 117 |
| TPF-5(317) | $0.00 | $90,000.00 | $90,000.00 | FHWA | Dawe, Garrett | Evaluation of Low Cost Safety Improvements | 2/4/2015 | Continuing Effort | 120 |
| TPF-5(343) | $0.00 | $270,000.00 | $270,000.00 | Washington DOT | Torres, Carlos | Roadside Safety and Research for MASH Implementation | 10/1/2016 | 9/25/2025 | 122 |
| TPF-5(347) | $0.00 | $230,000.00 | $230,000.00 | South Dakota DOT | Roath, James | Development of Maintenance Decision Support System | 6/8/2016 | 9/30/2025 | 127 |

| Project No. | FY 2025 Expenditures | Expenditures to Date | Total Budget | Agency | Project Manager | Title | Start Date | End Date | Page No. |
|---|---|---|---|---|---|---|---|---|---|
| TPF-5(374) | $0.00 | $300,000.00 | $300,000.00 | Alabama DOT | Kennedy, Kevin | Accelerated Performance Testing on the 2018 NCAT Pavement Test Track w/ MnRoad Research Partnership | 10/1/2020 | 9/30/2025 | 129 |
| TPF-5(425) | $1,522,605.00 | $1,522,605.00 | $1,500,000.00 | FHWA | Clover, Andre | National Cooperative Highway Research Program (NCHRP) for FY 2025 | 10/1/2024 | 9/30/2025 | 131 |
| TPF-5(433) | $0.00 | $30,000.00 | $30,000.00 | Utah DOT | Tichenor, Joel | Behavior of Reinforced and Unreinforced Lightweight Cellular Concrete for Retaining Walls | 6/14/2019 | 1/31/2026 | 132 |
| TPF-5(435) | $0.00 | $125,000.00 | $125,000.00 | Iowa DOT | Roath, James | Aurora Program (FY20-FY24) | 7/17/2019 | 12/31/2026 | 134 |
| TPF-5(436) | $0.00 | $120,000.00 | $120,000.00 | Indiana DOT | Nadjarian, Allie | Development of Criteria to Assess the Effects of Pack-out Corrosion in Built-up Steel Members | 8/5/2019 | 8/31/2025 | 138 |
| TPF-5(437) | $0.00 | $60,000.00 | $60,000.00 | Iowa DOT | Byrum, Chris | Technology Transfer Concrete Consortium (FY20-FY24) | 8/5/2019 | 12/31/2027 | 141 |
| TPF-5(438) | $0.00 | $125,000.00 | $125,000.00 | Iowa DOT | Brookes, Chris | Smart Work Zone Deployment Initiative | 8/5/2019 | 12/31/2027 | 143 |
| TPF-5(441) | $0.00 | $50,000.00 | $50,000.00 | Colorado DOT | Pratt, Matt | No Boundaries Transportation Maintenance Innovations | 9/17/2019 | 12/30/2025 | 146 |
| TPF-5(444) | $0.00 | $50,000.00 | $50,000.00 | Montana DOT | Powell, Linda | Traffic Safety Culture - Phase 2 | 11/8/2019 | 9/30/2024 | 148 |
| TPF-5(446) | $0.00 | $80,000.00 | $80,000.00 | FHWA | Carlson, Erik | High Performance Computational Fluid Dynamics (CFD) Modeling Services for Highway Hydraulics | 1/28/2020 | 9/30/2025 | 150 |
| TPF-5(447) | $20,000.00 | $100,000.00 | $100,000.00 | FHWA | Re, Jon | Traffic Control Device (TCD) Consortium (3) | 6/2/2022 | 2/12/2025 | 152 |
| TPF-5(453) | $50,000.00 | $250,000.00 | $250,000.00 | Ohio DOT | Bodell, Jason | Automated Vehicle Pooled Fund Study | 6/30/2020 | 7/31/2026 | 154 |
| TPF-5(460) | $55,600.00 | $222,400.00 | $222,400.00 | South Dakota DOT | Carlson, Erik | Flood-Frequency Analysis in the Midwest: Addressing Potential Nonstationary Annual Peak-Flow Records | 9/17/2020 | 9/30/2025 | 156 |
| TPF-5(465) | $10,000.00 | $30,000.00 | $30,000.00 | Alabama DOT | Miller, Michelle | Consortium for Asphalt Pavement Research and Implementation (CAPRI) | 10/15/2020 | 12/31/2027 | 158 |
| TPF-5(466) | $524,856.00 | $1,124,856.00 | $974,856.00 | Minnesota DOT | Kennedy, Kevin | National Road Research Alliance - NRRA (Phase-II) | 12/17/2020 | 1/31/2026 | 160 |
| TPF-5(468) | $0.00 | $50,000.00 | $50,000.00 | FHWA | Wagner, Brad | Structural Behavior of Ultra-High Performance Concrete | 2/1/2021 | 12/31/2025 | 163 |
| TPF-5(479) | $25,000.00 | $100,00.00 | $125,000.00 | Minnesota DOT | Fedders, Carl | Clear Roads Winter Highway Operations Pooled Fund (Phase III) | 6/10/2021 | 6/30/2026 | 165 |
| TPF-5(480) | $30,000.00 | $150,000.00 | $150,000.00 | Iowa DOT | Arnold, Luke | Building Information Modeling (BIM) for Infrastructure | 6/30/2021 | 12/31/2027 | 170 |

| Project No. | FY 2025 Expenditures | Expenditures to Date | Total Budget | Agency | Project Manager | Title | Start Date | End Date | Page No. |
|---|---|---|---|---|---|---|---|---|---|
| TPF-5(486) | $75,000.00 | $185,000.00 | $235,000.00 | Indiana DOT | Halloran, Mike | Center for the Aging Infrastructure: Steel Bridge Research, Inspection, Training and Education Engineering Center - SBRITE | 11/16/2021 | 9/30/2026 | 172 |
| TPF-5(487) | $25,000.00 | $75,000.00 | $125,000.00 | FHWA | Peplinski, Suzette | Transportation Management Centers Pooled Fund Study Phase II | 11/9/2021 | 4/16/2027 | 174 |
| TPF-5(489) | $25,000.00 | $100,00.00 | $100,000.00 | FHWA | Gill, Sarah | Safety Service Patrol Standardization and Management Practices | 12/7/2021 | 9/30/2026 | 177 |
| TPF-5(490) | $35,000.00 | $140,000.00 | $175,000.00 | MDOT | Spinks, Marlon | Evaluating New Technologies for Roads Program Initiatives in Safety and Efficiency (ENTERPRISE) - Phase III | 10/25/2022 | 10/21/2028 | 179 |
| TPF-5(501) | $65,000.00 | $195,000.00 | $325,000.00 | Washington DOT | Torres, Carlos | Roadside Safety Pooled Fund – Phase 3 | 9/9/2022 | 12/31/2027 | 182 |
| TPF-5(508) | $50,000.00 | $150,000.00 | $200,000.00 | Texas DOT | Wagner, Brad | Concrete Bridge Engineering Institute (CBEI) | 3/20/2023 | 5/31/2027 | 185 |
| TPF-5(514) | $30,000.00 | $60,000.00 | $90,000.00 | Indiana DOT | Brookes, Chris | Work Zone Analytics | 5/4/2023 | 6/30/2026 | 187 |
| TPF-5(515) | $15,000.00 | $30,000.00 | $75,000.00 | FHWA | Dawe, Garrett | Evaluation of Low-Cost Safety Improvements (ELCSI-PFS) | 5/8/2023 | 9/30/2028 | 189 |
| TPF-5(516) | $16,000.00 | $48,000.00 | $80,000.00 | FHWA | Garcia, Daniel | Highway Safety Manual Implementation (HSM2) 2nd Edition | 5/2/2023 | 9/30/2027 | 190 |
| TPF-5(517) | $20,000.00 | $60,000.00 | $100,000.00 | Iowa DOT | Byrum, Chris | Performance Centered Concrete Construction | 5/30/2023 | 12/31/2029 | 191 |
| TPF-5(518) | $55,000.00 | $110,000.00 | $220,000.00 | Virginia DOT | Shapter, Paul | Implementation of Structural Data from Traffic Speed Deflection Devices | 5/17/2023 | 9/30/2028 | 193 |
| TPF-5(522) | $50,000.00 | $100,000.00 | $200,000.00 | Minnesota DOT | Hunt, Tyler | National Partnership to Improve the Quality of Pavement Preservation Treatment Construction & Data Collection Practices (Phase III) | 8/7/2023 | 12/31/2028 | 195 |
| TPF-5(523) | $15,000.00 | $40,000.00 | $100,000.00 | Iowa DOT | Wagner, Brad | Building Information Modeling (BIM) for Bridges and Structures – Phase II | 12/1/2023 | 1/31/2029 | 198 |
| TPF-5(532) | $60,000.00 | $60,000.00 | $150,000.00 | MDOT | Bodell, Jason | Mid-America Association of State Transportation Officials (MAASTO)Connected Automated Vehicle - Steering Committee | 6/11/2024 | 9/30/2028 | 200 |
| TPF-5(538) | $25,000.00 | $25,000.00 | $1000,00.00 | Minnesota DOT | Kaseer, Fawaz | Phase II: Continuous Asphalt Mixture Compaction Assessment using Density Profiling System (DPS) | 8/12/2024 | 9/30/2028 | 202 |
| TPF-5(543) | $25,000.00 | $25,000.00 | $125,00.00 | Iowa DOT | Roath, James | Aurora Program (FY25-FY29) | 1/2/2025 | 12/31/2029 | 204 |
| TPF-5(544) | $12,000.00 | $12,000.00 | $60,000.00 | Iowa DOT | Byrum, Chris | Technology Transfer Concrete Consortium (FY25-FY29) | 1/2/2025 | 12/31/2029 | 206 |

| Project No. | FY 2025 Expenditures | Expenditures to Date | Total Budget | Agency | Project Manager | Title | Start Date | End Date | Page No. |
|---|---|---|---|---|---|---|---|---|---|
| TPF-5(545) | $25,000.00 | $25,000.00 | $125,000.00 | Iowa DOT | Brookes, Chris | Smart Work Zone Deployment Initiative (FY25-FY29) | 1/2/2025 | 12/31/2029 | 207 |
| TPF-5(546) | $40,000.00 | $40,000.00 | $200,000.00 | Iowa DOT | Kennedy, Kevin | Transportation Materials Resource Center | 2/14/2025 | 9/30/2029 | 209 |
| TPF-5(547) | $15,000.00 | $15,000.00 | $75,000.00 | Montana DOT | Powell, Linda | Traffic Safety Culture Phase 3 | 10/1/2024 | 9/30/2029 | 211 |
| TPF-5(548) | $13,000.00 | $13,000.00 | $39,000.00 | Colorado DOT | Pratt, Matt | No Boundaries Transportation Maintenance Innovations: Phase IV | 10/29/2024 | 9/30/2027 | 212 |
| TPF-5(552) | $0.00 | $0.00 | $180,000.00 | FHWA | Carlson, Erik | High Performance Computational Fluid Dynamics (CFD) Modeling Services for Highway Hydraulics | 2/10/2025 | 9/30/2026 | 214 |
| TPF-5(555) | $50,000.00 | $50,000.00 | $250,000.00 | Georgia DOT | Mueller, Michele | Vehicle to Everything (V2X) | 3/11/2025 | 9/30/2029 | 215 |
| TPF-5(556) | $0.00 | $0.00 | $125,000.00 | Alaska DOT & Public Facilities | Smith, Linn | Uncrewed Aircraft Systems (UAS) Standardization | 10/1/2024 | 9/30/2029 | 217 |
| TPF-5(557) | $236,046.00 | $236,046.00 | $236,046.00 | AASHTO/ FHWA | Clover, Andre | TRB Core Program Activities FFY 2025 (TRB FY 2026) | 10/1/2024 | 9/30/2025 | 218 |
| | **$4,039,724.31** | **$7,771,724.81** | **$10,888,101.33** | **TOTAL 100% FEDERALLY FUNDED PROJECTS** | | | | | |

*Project start was delayed from FY 2025 to FY 2026.

# 80% FEDERALLY FUNDED PROJECTS

Sequentially Listed by Job Number

Michigan Department
Of Transportation
5312 (2014)

# RESEARCH ADMINISTRATION
# MDOT RESEARCH PROJECT
# ANNUAL REPORT - FISCAL YEAR 2025

PROJECT TITLE: Statewide Overall Carbon Fiber Composite Cable Bridge Monitoring

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

PROJECT MANAGER: Kahl, Steve

| | | | |
|---|---|---|---|
| CONTRACT/AUTHORIZATION NO. | 2014-0043 | PROJECT START DATE | 12/17/2013 |
| PROJECT NO. | 128602 | COMPLETION DATE (Original) | 9/30/2020 |
| OR NO. | OR14-039 | COMPLETION DATE (Revised) | 9/30/2026 |
| RESEARCH AGENCY | Lawrence Technological University (LTU) | | |
| PRINCIPAL INVESTIGATOR | Grace, Nabil | | |

**BUDGET STATUS**

| FY 2025 Budget | | Total Budget | |
|---|---|---|---|
| Vendor Budget FY 2025 | $334,166.37 | Total Vendor Budget | $1,166,711.17 |
| MDOT Budget FY 2025 | $1,000.00 | Total MDOT Budget | $0.00 |
| Vendor FY 2025 Expenditures | $178,995.71 | Total Budget | $1,166,711.17 |
| MDOT FY 2025 Expenditures | $0.00 | Total Expenditures | $1,011,540.51 |
| | | **Total Amount Available** | $155,170.66 |

**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 previously constructed bridges will provide information on long-term behavior and allow for recommendations to be made for future designs, considering 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 later corrected. The system then worked properly for both bridges and the readings conformed to the theoretical calculations. At the close of the Fiscal Year (FY), work continued connecting the M-102 bridge to the website and made 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 ACCOMPLISHMENTS**

Monitoring bridges containing CFRP elements continued throughout FY 2016. Several locations had equipment upgrades, along with assessments of the adequacy of the data collection equipment. Reports were provided of the trends in strains, loads, and deflections at different locations, and the data has been continued to be used in conjunction of research project 2013-0065 - Evaluating Long Term Capacity and Ductility of Carbon Fiber Reinforced Polymer prestressing and post tensioning strands. The data analysis and trends from this monitoring continue to validate numerical simulation of bridge behavior being done as part of that research.

**FISCAL YEAR 2017 ACCOMPLISHMENTS**

Monitoring the current inventory of bridges continues. The I-75 SB over Sexton Kilfoil Drain construction was completed, and load tests were performed. This bridge was added to the overall monitoring contract, and monitoring activities will continue until project completion, expected in 2020.

**FISCAL YEAR 2018 ACCOMPLISHMENTS**

Continued monitoring, and regular data reporting, on all six (6) wired bridges and continued correlating actual experimental data with theoretical calculated values.

Data was reported to the Research Advisory Panel (RAP) with meetings for the other research project (OR14-024), and this data was used to calibrate several equations and constants used in the proposed guide specifications.

The subcontractor visited the M-50 and Bridge Street bridges for annual maintenance. Defective equipment was noted, which resulted in abnormal readings. The subcontractor was able to replace the defective hardware and bring the system back to functioning properly. The Bridge Street bridge is also suffering from possible defective hardware but the troubleshooting and repair of the system is beyond the scope of annual maintenance.

In addition, the wireless carrier has issued a firmware upgrade to their phones as a fix from universal hacking and introducing malware into these systems. This fix can be done remotely on newer phones. Older phones such as those supplied in the bridge monitoring systems need to be upgraded manually. While the subcontractor was able to upgrade the firmware manually on the phones, the wireless carrier will stop supporting 3G networks in the next year and all phones will require the ability to utilize a 4G network. Therefore, an estimate for the repair of the hardware at Bridge Street and an upgrade for the phones in all bridge locations has been submitted to MDOT for review and approval of this amendment.

**FISCAL YEAR 2019 ACCOMPLISHMENTS**

Monitoring continues for the M-39, M-50, M-102, Bridge Street and I-75 bridges. The research team at LTU was successful at downloading data from all bridges with some concerns in the Bridge Street Bridge. The subcontractor visited all bridge sites, checked hardware as well as the accuracy of the collected data, and provided a report on the conditions of all bridge monitoring systems. The systems on M-50, M-102, and I-75 bridges were all in good working condition and provided accurate readings. There were some sensors on M-39 bridge that were not giving accurate readings (even when collected manually) and they were assumed defective. In Bridge Street Bridge, it appears that a recent power surge caused some hardware issues and caused some sensors to stop reading properly. Defective sensors were removed from the site and a plan to address the conditions of the monitoring system of Bridge Street Bridge is currently underway and being discussed with MDOT Engineers.

**FISCAL YEAR 2020 ACCOMPLISHMENTS**

Continued monitoring of the bridges in the contract, and analysis of long-term material behavior is expected. This analysis is being used to adjust material resistance factors and long-term durability considerations in the current design guidelines that MDOT has implemented as part of a separate research project. There were several data collection and communication components that were replaced and/or upgraded.

**FISCAL YEAR 2021 ACCOMPLISHMENTS**

Continued monitoring of the instrumented bridges on M-39, M-50, M-102, Bridge Street and I-75, along with generation of data points for long-term material performance and refinement of the creep-rupture factors for the 0.6” diameter CFRP strands. The MDOT Project Manager (PM) held quarterly meetings throughout the year.

**FISCAL YEAR 2022 ACCOMPLISHMENTS**

Monitoring continued for the M-39, M-50, M-102, Bridge Street and I-75 bridges. Overall, there seem to be no new issues with the monitoring system or the readings from the sensors. Monitoring on M-39 was interrupted due to software issues, which were resolved by the subcontractor. The research team analyzed the recorded data, shared the results with MDOT Engineers, and continued to download and analyze data while watching for any faulty readings. The team is working closely with the subcontractor to assess the readings from the sensors and address any maintenance issues. The team also performed in-depth calculations and finite element simulation to assess the effect of temperature change on the readings from different sensors.

**FISCAL YEAR 2023 ACCOMPLISHMENTS**

The monitoring continued for M-39, M50, M-102, Bridge Street and I-75 Bridges. Overall, there seems to be no new issues with the monitoring system or the readings from the sensors.

The research team is currently analyzing the recorded data and has shared the results with MDOT engineers. The team continues to download data and perform the necessary analysis and watch for any faulty readings. They’re working closely with the subcontractor to assess the readings from the sensors and address any maintenance issues.

**FISCAL YEAR 2024 ACCOMPLISHMENTS**

During the last fiscal year (2024), the monitoring continued for M-39, M50, M-102, Bridge Street and I-75 Bridges. Overall, there seems to be no new issues with the monitoring system or the readings from the sensors.
The research team is currently analyzing the recorded data and has shared the results with MDOT engineers. The research team continues to download the data and perform the necessary analysis and watch for any faulty readings. The team is working closely with the subcontractor to assess the readings from the sensors and address any maintenance issues. The research team is also working on the final report that summarizes the monitoring data.
The decision to repair the hardware components of Bridge-St-Bridge is still pending MDOT review and availability of funds.

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

Monitoring of CFFC performance continued for M-39, M50, M-102, Bridge Street and I-75 Bridges. With a temporary exception of Bridge St. Bridge, there were no new issues with the monitoring system or the readings from the sensors. A few load cells on M-50 Bridge continued to capture data points, while the rest showed out-of-range data. The research team worked closely with the subcontractor to repair different components and replace the data acquisition system on Bridge St. Bridge in September. The subcontractor performed a manual check to assess the quality of the collected data using the new equipment and is currently evaluating the data collected through the monitoring website to ensure proper a connection and reliable data collection. Since it is a new data acquisition system that is connected to fairly old set of sensors, monitoring and debugging the system is an essential step of the repair. A one-year no-cost extension for the research project was required to account for the Bridge Street bridge equipment updates. During the additional year, the research team will continue to collect the data from different bridges and address any issues that might arise in Bridge St. Bridge new system.

The research team compiled the monitoring data to date and is currently preparing an interim report that will be submitted to MDOT PM for review and recommendation. Data analysis was performed to evaluate the impact of different factors on the sensor readings including seasonal change in temperature, temperature gradient, and creep and shrinkage of concrete after years of service.

| FISCAL YEAR 2026 PROPOSED ACTIVITIES |
| --- |
| The research team will continue monitoring instrumented bridges on M-39, M-50, M-102, Bridge Street (pending approval of maintenance and repairs) and I-75, along with generation of data points for long-term material performance and refinement of the creep-rupture factors for the 0.6” diameter CFRP strands. The MDOT Project Manager will plan and schedule progress meetings throughout FY 2025 and anticipate data generation for the duration of the research project through FY 2025. |
| **JUSTIFICATION(S) FOR REVISION(S)** |
| Project cost was increased in FY 2017 to include the addition of the I-75 SB over Sexton-Kilfoil Drain, which is the longest CFCC prestressed bridge built to date. The contract was also modified in early 2019 to add five years of data collection and increase the budget to cover unexpected repairs that caused failures in bridge monitoring. There was also a change in MDOT project manager in FY 2022. |
| **SUMMARY OF THE IMPLEMENTATION RECOMMENDATION** |
| Project expected completion FY 2026. |

Michigan Department
Of Transportation
5312 (2014)

# RESEARCH ADMINISTRATION
# MDOT RESEARCH PROJECT
# ANNUAL REPORT - FISCAL YEAR 2025

PROJECT TITLE: Slope Restoration on Urban Freeways

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

PROJECT MANAGER: Qu, Yige

| | | | |
|---|---|---|---|
| CONTRACT/AUTHORIZATION NO. | 2013-0066 Z10 | PROJECT START DATE | 4/1/2017 |
| PROJECT NO. | 132231 | COMPLETION DATE (Original) | 7/31/2019 |
| OR NO. | OR16-008 | COMPLETION DATE (Revised) | 12/31/2025 |
| RESEARCH AGENCY | Michigan State University (MSU) | | |
| PRINCIPAL INVESTIGATOR | Cregg, Bert | | |

**BUDGET STATUS**

| FY 2025 Budget | | Total Budget | |
|---|---|---|---|
| Vendor Budget FY 2025 | $29,928.20 | Total Vendor Budget | $476,941.06 |
| MDOT Budget FY 2025 | $8,589.92 | Total MDOT Budget | $51,381.10 |
| Vendor FY 2025 Expenditures | $23,404.35 | Total Budget | $528,322.16 |
| MDOT FY 2025 Expenditures | $0.00 | Total Expenditures | $513,208.39 |
| | | **Total Amount Available** | $15,113.77 |

**PURPOSE AND SCOPE**

The purpose of this project is to research and subsequently develop best practices and viable alternatives to turf as a solution for slope stabilization, especially steep slopes. Current methods and practices necessary to specify correct soils, plant species, cultural practices, planting standards, maintenance plans, benefits, and costs will be analyzed. The result will be best practice recommendations for slope restoration and continued maintenance. The scope of work includes the following tasks:

1. Analyze existing research regarding erosion control, restoration, and maintenance on steep slopes adjacent to freeways.
2. Identify field research plot location(s) in the I-696 corridor.
3. Provide MDOT with research work plan.
4. Partner with MDOT and vendor installation contractor to provide oversight on installation.
5. Perform subsequent maintenance of research plots.
6. Collect data.
7. Review and analyze data collected to determine best practices and cost-benefit ratios.
8. Identify best practices for site preparation.
9. Identify native and non-native trees, shrubs, herbaceous perennials, and grasses suitable for Michigan roadside plantings. Compile research from the current project as well as a review of literature of similar studies and relevant guides from other DOTs to develop a new MDOT Plant Selection Guide
10. Present research results with final recommendations.

**FISCAL YEAR 2017 ACCOMPLISHMENTS**

Hired Research Technician for the project (Deborah Trelstad), finalized plot site selection, and marked research plot boundaries. Collected mulch, compost, and soil samples from study area. Also identified comparative areas along I-696 (outside of study blocks) and initiated sampling and assessment, of areas where establishment was successful. Hired a designer to complete plot design drawings for bid specs and a graduate student (Liza Christopher) initiated literature review of related roadside planting protocols from DOTs in other states. MDOT did not complete the planting in fiscal year 2017 as originally planned.

**FISCAL YEAR 2018 ACCOMPLISHMENTS**

Plot designs and plant lists were completed by MSU. MSU reviewed literature of related roadside planting protocols from DOTs in other states as well as roadside salts. The contractor for plot installation was selected (WH Canon) and installation started on June 15, 2018. Plot installation and planting completed for blocks 4-6 and 4a-6a. Over 50 percent of plant installations were completed in 2018 in coordination with major construction of I-696 and despite operators strike. MDOT facilitated watering operations between local municipalities, MDOT, researchers and contractors. MDOT region provided additional funding for plant replacement due to mortality from I-696 construction damage and 2018 summer drought. MSU measured leaf chlorophyll index on Cornus, Physocarpus, Forsythia and Dierivilla plants in blocks 4-6. Collected leaf tissue for nitrogen (N) analysis. They also installed rain gauges data loggers/ temperature sensors on the plots and collected data. Periodic growth measurements taken for blocks 4-6 and 4a-6a.

**FISCAL YEAR 2019 ACCOMPLISHMENTS**

Contractor completed installation of study treatments and plants in Blocks 1-3 in October 2018 on North side of I-696 West and East of the Nieman St. overpass. Sites for Blocks 1-3 were moved from their original planned locations to avoid additional lane closures during I-696 construction in Summer-Fall 2018. MSU researchers installed soil moisture sensors, soil temperature sensors and automatic data loggers in each plot. Data collection continued at the site throughout the 2019 growing season and included plant growth, plant moisture stress, plant nutrient status, and photosynthetic rate. MSU Personnel conducted periodic

maintenance on the plots including hand- weeding and application of pre- and post-emergent herbicides. Project was amended to allow for longer-term (5 years) evaluation of the test plantings. In conjunction with project amendment, MSU Researchers developed a proposal for additional funding through MSU project GREEEN, which was funded at $35,000 per year for two years ($70,000 total). The grant funding will provide continuing support for an M.S. graduate student at MSU. Preliminary results of the project indicate the addition of compost greatly improved plant establishment and growth. The response of plants to compost appears to be primarily related to improved plant nutrient availability. To date, tillage appears to provide relatively little benefit for plant establishment and growth.

**FISCAL YEAR 2020 ACCOMPLISHMENTS**

MSU graduate student, Maddy Dubelko, Drs, Cregg and Schutzki provided research results to date on the project at the Michigan Nursery and Landscape Association Great Lakes Trade Expo in January 2020. Covid-19 shutdown protocols affected early season site visits. When the MSU Research Team was cleared for travel, data collection and maintenance operations resumed, and the researchers were able to track plant growth, plant physiology, and soil testing throughout the remainder of the growing season. MSU researchers continued progress on the plant selection guide, which includes species from plant research and species based on an exhaustive literature search. Researchers installed two automated weather stations, one on the south side of I-696 and one on the north side of I-696. These stations will provide detailed micro-climate information that highlights conditions which affect plants by their respective locations. MSU used equipment currently on hand for one weather station and secured funding from the Michigan Department of Agriculture and Rural Development Horticulture fund to purchase equipment for the second weather station. It is expected that field operations will conclude late fall season 2020 and resume when weather and Covid-19 restrictions permit.

**FISCAL YEAR 2021 ACCOMPLISHMENTS**

MSU personnel completed intensive plant-based measurements on I-696 field plots in fall 2020. Data analysis and summary of data were completed in spring 2021. MSU Graduate student (Maddy Dubelko) completed an MS thesis documenting field study finding, which were also summarized in a project report submitted to MDOT. Key findings of the initial phase of the field research include Initial plant establishment was improved by addition of compost but was not affected by tillage. This indicates that top-dressing with compost is adequate, saving the cost of tilling sites before planting. The improvement of plant establishment with compost was related to improved soil and plant nutrition. Plant establishment varied with plant type, like shrubs, particularly Diervilla, Physocarpus, and Cephalanthus selections, had greater survival, growth, and plant cover than most of the herbaceous and grass selections. MSU personnel (Dubelko and Schutzki) completed and submitted a plant selection guide for roadside plantings for Michigan including plant selection for various regions of the state and planting specifications. MSU personnel presented key findings and recommendations from the project to MDOT Metro region personnel via virtual meeting on May 25, 2021. MSU personnel developed a request and plan of work for an extension of the project through 2025. The project extension will allow continued monitoring of the site to determine longer-term impacts of site preparation on soil properties and plant performance as well as evaluation of freeway microclimates. MSU personnel continued site visits in 2021 to maintain the field plots, including pre- and post-emergent herbicide applications, maintain the weather stations, and collect data on plant coverage.

**FISCAL YEAR 2022 ACCOMPLISHMENTS**

MSU personnel re-assessed plant coverage on all plots in September 2022. They maintained automated on-site weather stations and conducted periodic data downloads, conducted on-site plot maintenance, and applied pre- and post-emergent herbicides to control competing vegetation. MSU published a peer-reviewed article (Dubelko, M., Schutzki, R., Andresen, J., & Cregg, B. (2022). Compost addition, but not tillage, affects the establishment of urban highway plantings. Urban Forestry & Urban Greening, 75, 127688) based on plant growth and soil data collected through the first three years of the project.

**FISCAL YEAR 2023 ACCOMPLISHMENTS**

MSU personnel applied pre-emergent and post-emergent herbicides for weed control, gathered and summarized data from survival and plant cover assessments, including data from automated weather stations. They presented research findings to the Meridian Garden Club. Soil sampling on study blocks for soil pH and bulk density determination, along with the plant sampling for rooting depth determination, has been finalized. The MDOT Plant Manual for Slope Planting has been added to the Michigan Open Data Portal.

**FISCAL YEAR 2024 ACCOMPLISHMENTS**

Performed regular data downloads and maintenance on weather stations. Analyzed plant cover data across all plots. Removed weed barriers and applied pre-emergence herbicide. Provided project updates to the MDOT team.

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

The research team complied, considered, and analyzed the data from the past several seasons. Finalized summaries of long-term plant survival, canopy growth, and ground cover for both the site-preparation and plant-evaluation plots were documented. Work began on the final report and manuscript, pulling together results that highlight species as reliable, low-maintenance options for restoring vegetation on urban freeway slopes. Updates to the website detailing plant attributes for selection were made (MDOT Plant Manual for Slope Planting). The weather stations were removed.

**FISCAL YEAR 2026 PROPOSED ACTIVITIES**

It is expected that the update to the final report on the performance and maintenance of the selected species will be completed in FY26.

**JUSTIFICATION(S) FOR REVISION(S)**

A Project Manager (PM) change was approved on 3/13/2018 due to staff changes at MDOT. Another contract revision was approved 7/15/2019 that added scope and budget as well as extending the end date to 4/30/2021. The addition to the scope is a deliverable for documenting plant recommendations to replace outdated MDOT guidance. One additional year was needed because of delays associated with the planting phase. Another extension was granted to 12/31/2025 to support long-term evaluation of roadside plantings and refine plant selection and long-term maintenance recommendations. There was another PM change done during FY 2023 due to staff changes at MDOT.

| SUMMARY OF THE IMPLEMENTATION RECOMMENDATION |
| --- |
| Project expected completion in FY 2026. |

Michigan Department
Of Transportation
5312 (2014)

# RESEARCH ADMINISTRATION
# MDOT RESEARCH PROJECT
# ANNUAL REPORT - FISCAL YEAR 2025

PROJECT TITLE: Research Administration Section Planning and Communications

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

PROJECT MANAGER: Hoffmeyer, Mary

| | | | |
|---|---|---|---|
| CONTRACT/AUTHORIZATION NO. | 2020-0776 | PROJECT START DATE | 10/1/2020 |
| PROJECT NO. | 209437NI | COMPLETION DATE (Original) | 9/30/2025 |
| OR NO. | OR21-001 | COMPLETION DATE (Revised) | |
| RESEARCH AGENCY | CTC & Associates, LLC. | | |
| PRINCIPAL INVESTIGATOR | Casey, Patrick | | |

## BUDGET STATUS

| FY 2025 Budget | | Total Budget | |
|---|---|---|---|
| Vendor Budget FY 2025 | $66,925.89 | Total Vendor Budget | $492,314.72 |
| MDOT Budget FY 2025 | $0.00 | Total MDOT Budget | $0.00 |
| Vendor FY 2025 Expenditures | $58,977.98 | Total Budget | $492,314.72 |
| MDOT FY 2025 Expenditures | $0.00 | Total Expenditures | $365,951.49 |
| | | **Total Amount Available** | $126,363.23 |

Contract includes additional state funding from MDOT:

| | Budget | Expenditures by Fiscal Year | | | | |
|---|---|---|---|---|---|---|
| | | FY 2021 | FY 2022 | FY 2023 | FY 2024 | FY 2025 |
| **SPR-II** | $492,314.72 | $129,481.84 | $ 71,705.16 | $ 46,679.25 | $ 59,107.26 | $ 58,977.98 |
| **Additional State Funds** | $ 33,074.14 | $ 0.00 | $ 2,200.76 | $ 779.93 | $ 7,492.97 | $ 15,657.22 |
| **Total** | **$525,388.86** | **$129,481.84** | **$ 73,905.92** | **$ 47,459.18** | **$ 66,600.23** | **$ 74,653.20** |

## PURPOSE AND SCOPE

MDOT works diligently to deliver innovative research projects that improve operations and services. Research Administration (RAd) works to effectively communicate these research findings clearly and in platforms for wider public reach. This project works with RAd to continue to improve operations and provides the means to communicate department research efforts in a multitude of platforms (i.e., publications, social media, and visual media) that will share the outcomes of innovative research. These high impact tools are essential to enhance the visibility and presence of the department's work to a diverse set of end-users to further educate and implement the outcomes for the improvement of applicable operations and services. Effective communication and subsequent implementation of research will aid MDOT to work more efficiently, more safely, and increase economic benefit to the traveling public. The improvement of services and operations because of implementation will assist the department to aligning further with its core vision and values

## FISCAL YEAR 2021 ACCOMPLISHMENTS

Completed the At-A-Glance report summary of funding statistics and project progress for FY 2020. Completed spotlight newsletters including, but not limited to, Bridge Structural Analysis for Staged Construction, Construction Price Index, Evaluation of Camber and Deflections for Bridge Girders, and Developing Michigan Pedestrian and Bike Safety Models. Completed production of video spotlights on Carbon Fiber Reinforced Concrete and Effectiveness of Green Strobes on Winter Maintenance. Developed needed communication distribution strategies for spotlights. Began providing technical editing for final research project reports on Innovative Contracting. Developed RAd's first ArcGIS StoryMap to highlight MDOT's collaboration with other states on research projects through the Transportation Pooled Fund program. This interactive StoryMap highlights MDOT's success stories with research topics ranging from bridge design to intelligent transportation systems to highway maintenance.

## FISCAL YEAR 2022 ACCOMPLISHMENTS

Completed the At-A-Glance report summary of funding statistics and project progress for FY 2021. Completed spotlight newsletters including, but not limited to, Integration of Unmanned Aerial Systems Data Collection into Day-to-Day Usage for Transportation Infrastructure - A Phase III Project, Connected/Automated Vehicle and Infrastructure Research [Michigan Mobility Transformation Facility (MTF)], Infrastructure Protection and Rehabilitation Response to High Lake Levels, Quantifying Effectiveness and Impacts of Digital Message Signs on Traffic Flow, Evaluation of an Active Traffic Management System with Part-Time Use of the Inside Shoulder, and Synthesis of National Best Practices on Pedestrian and Bicycle Design, Guidance, and Technology Innovations. Completed spotlight videos on Slope Restoration on Urban Freeways and High-Tech Workforce Preparation for Emerging Transportation Technologies. Developed communication distribution strategies for spotlight newsletters and videos. Continued providing technical editing for final research project reports on Innovative Contracting.

**FISCAL YEAR 2023 ACCOMPLISHMENTS**

Completed the At-A-Glance report summary of funding statistics and project progress for FY 2022. Completed spotlight newsletters including, but not limited to, SPR-1719 Developing a Consistent Data Driven Methodology to Multimodal, Performance Based and Context Sensitive Design, SPR-1721 Safety Enhancements at Short-Storage-Space Railroad Crossings, SPR-1716 Assessing System Performance of the Michigan Trunkline: Measures and Analytical Procedures for Planning and Operations, SPR-1720 Quantifying the Impact of Wide Base Tires on Pavement Performance in Michigan, SPR-1698 Effects of Concrete Cure Time on Epoxy Overlay and Sealant Performance, SPR-1725 Evaluating the Performance and Safety Effectiveness of Roundabouts - An Update, SPR-1722 Evaluation of MDOT's Long-Life Pilot Projects, SPR-1727 Determining State and Federal Transportation Responsibilities to Residents on Islands, and SPR-1703 Concrete Deterioration of Prestressed Bridge Beams. Completed a promotional video to highlight the roles of RAd's project managers that lead innovative research efforts and to promote participation in the Research Program Development Cycle to build RAd's fiscal year program. Updated the ArcGIS StoryMap for the Transportation Pooled Fund program which highlights MDOT's collaboration with other states on research projects. Developed communication distribution strategies for spotlight newsletters and videos. Continued providing technical editing and graphic needs for final research project reports on Innovative Contracting.

**FISCAL YEAR 2024 ACCOMPLISHMENTS**

Completed the At-A-Glance report summary of funding statistics and project progress for FY 2023. Developed a new series of publications that focus on successful implementation of research findings; the first completed Implementation Publication covered *SPR-1692: Effectiveness of Green Strobes on Winter Maintenance*. Provided technical editing assistance to MDOT's Transportation Systems Management and Operations (TSMO) on a report for the State of Michigan Senate and House of Representatives entitled *Assessment of Agricultural Byproducts (ABPs) in Direct Liquid Application (DLA) for Road Maintenance*. This report addresses Michigan Public Act 310 of 2020, mandating the MDOT to conduct a pilot study to evaluate the effectiveness of ABPs used in DLA for winter plow routes in the state with the intention of identifying best practices for winter road maintenance with less environmental impact than traditional rock salt application, as well as less corrosive damage to road surfaces. Completed spotlight newsletters including, but not limited to, ***SPR-1705****: Evaluating New Technologies for Roads Program Initiatives in Safety and Efficiency (ENTERPRISE) PHASE II*, ***SPR-1723****: Testing Protocol, Data Storage, and Recalibration for Pavement-ME Design*, ***SPR-1726****: Eastern Massasauga Rattlesnake (Sistrurus catenatus) Detection and Space Use Near Roads in the Southern Lower Peninsula of Michigan*, ***SPR-1728****: Evaluation of Bridge Deck Winter Weather Warning Systems*, ***SPR-1730****: Repair of Bridge Deck Fascias*, ***SPR-1733****: Establish Policies and Procedures for Use of Subgrade Stabilization in Michigan*, ***SPR-1734****: Effective Pedestrian/Nonmotorized Crossing Enhancements Along Higher-Speed Corridors,* ***SPR-1736****: Corridor and Systemwide Application of Performance-Based Practical Design*, and ***SPR-1738****: Utilizing Video Analytics with Connected Vehicles for Improved Safety*. Updated the promotional video with commentary from a new Project Manager (PM) on the benefits of research. The video is intended to highlight the roles of RAd's PMs that lead innovative research efforts and promote participation in the Research Program Development Cycle to build RAd's fiscal year program. Developed communication distribution strategies for spotlight newsletters and videos.

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

Completed the At-A-Glance report summary of funding statistics and project progress for FY 2024. Completed spotlight newsletters including, but not limited to, Cost-Effective Solutions to Enhance Nighttime Pedestrian Safety, Developing infrastructure at airports to charge electric aircraft and vehicles, Eastern massasauga rattlesnake's use of roadside space in southern Michigan, Enhancing MDOT's digital vision to support construction processes, Improving Cost Estimates for Bridge Repairs and Replacement, New cost index enhances construction estimates and budgeting, Speed warning technologies slow drivers in critical speed-change areas, Water-Level Sensors Help Prioritize Inspections of Scour-Critical Bridges, and Using crowdsourced data to estimate nonmotorized traffic volumes. Completed and published an MDOT Video Spotlight summarizing the research project *MDOT Research Video Spotlight - Optimizing Mechanical-Empirical Pavement Design Software for MDOT's Use*. Completed a summary of successful technology implementation of two projects which were documented and distributed the Implementation Spotlights Dynamic Speed Feedback Signs Effectively Improve Driver Behavior and Green Strobes Added to MDOT Winter Maintenance Vehicles Increase Visibility respectively. Developed communication distribution strategies for spotlight newsletters and videos. Provided technical editing on research reports such as Assessment of Direct Liquid Application (DLA) with Use of Agricultural Byproducts (ABPs) for Winter Road Maintenance and continued to provide graphic needs for final research project reports on Innovative Contracting. RAd and CTC met quarterly for status updates to discuss progress on communication projects and the MDOT PM and CTC maintained contact via email/phone between meetings for day-to-day activities.

**JUSTIFICATION(S) FOR REVISION(S)**

None.

**SUMMARY OF THE IMPLEMENTATION RECOMMENDATION**

The work performed under this contract has enabled Research Administration to effectively and efficiently communicate research findings and related activities identified through the research projects conducted within the office during FY2021 through 2025, including the outcomes and benefits to Michigan, to all stakeholders, and aids practitioners to act on the results. The products and services developed and delivered over the course of this contract are as follows:

- Technology Transfer—51 Research Spotlight research briefs, 8 complementary video Research Spotlights, 2 implementation Spotlights, and an interactive ArcGIS-based StoryMap on Transportation Pooled Fund Success Stories.
- Program Assistance—Five annual At-A-Glance reports, a final report for the 2020 AASHTO/RAC Region 3 Peer Exchange, promotional videos to highlight the important role of MDOT research project managers and to highlight the MDOT Library and its services and the RAd Report Repository.

- Technical Writing—Technical report writing for the MI Legislature for the research study of the effectiveness of direct application of liquid salt brines enhanced with agricultural byproducts and report editing and graphic design for two technical publications for Innovative Contracting.

These products developed by CTC have helped, and will help with continued use, address Research Administration's ongoing and evolving communications needs. Moreover, the work performed under this contract assists Research Administration and provides needed visibility of the MDOT's research program and products which continues to grow within and beyond Michigan.

Michigan Department
Of Transportation
5312 (2014)

# RESEARCH ADMINISTRATION
# MDOT RESEARCH PROJECT
# ANNUAL REPORT - FISCAL YEAR 2025

PROJECT TITLE: Evaluation of MDOT's Methodologies for both Quantifying Pavement Distress & Modeling Pavement Performance for LCC and RSL Estimation Purposes

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

PROJECT MANAGER: Eacker, Michael

| | | | |
|---|---|---|---|
| CONTRACT/AUTHORIZATION NO. | 2021-0288 | PROJECT START DATE | 2/2/2021 |
| PROJECT NO. | 211061 | COMPLETION DATE (Original) | 5/31/2023 |
| OR NO. | OR21-007 | COMPLETION DATE (Extension) | 8/31/2025 |
| RESEARCH AGENCY | Michigan State University (MSU) | | |
| PRINCIPAL INVESTIGATOR | Kutay, M. Emin | | |

**BUDGET STATUS**

| FY 2025 Budget | | Total Budget | |
|---|---|---|---|
| Vendor Budget FY 2025 | $122,503.29 | Total Vendor Budget | $671,221.53 |
| MDOT Budget FY 2025 | $22,859.55 | Total MDOT Budget | $30,536.18 |
| Vendor FY 2025 Expenditures | $122,234.42 | Total Budget | $701,757.71 |
| MDOT FY 2025 Expenditures | $11,597.39 | Total Expenditures | $701,488.84 |
| | | **Total Amount Available** | $268.87 |

**PURPOSE AND SCOPE**

Since the inception of its pavement management system in the early 1990's, the Michigan Department of Transportation (MDOT) has been using the Distress Index (DI) as a measure of surface condition for pavements. The DI is based on an assignment of increasing-value numeric "points" to specific distress type-and-severity observations obtained through detailed surveys; the more detrimental a distress type/severity observation is to pavement structural condition, the higher the assigned point value. The distress information is collected via digital images by vendors on roughly half the MDOT network every year. There appears to be a gap between what the state of the practice in the pavement data collection industry typically provides nationwide, and the complexity of the distress information MDOT asks for. MDOT has decided to suspend collection of the full extent of the distresses typically requested and to suspend the use of DI as the pavement condition measure. This research is expected to investigate and recommend a new condition measure, or revisions to the existing DI system, that MDOT can utilize moving forward. This new/revised measure is expected to be compatible with what the pavement data collection industry can deliver in an accurate and timely manner. It is also expected to have a low impact on MDOT's business practices and processes, including the Remaining Service Life (RSL) estimation process and the Life-Cycle Cost Analysis (LCCA) process.

**FISCAL YEAR 2021 ACCOMPLISHMENTS**

The research team did an exhaustive literature search to find out what other states are using as measures of pavement performance. Typically, most states hire one of a small set of vendors to survey their pavements for condition assessment. The capabilities and standard practices of these vendors were investigated and assessed. The pavement condition assessment methodologies of 18 different states were studied to evaluate the details of the types of pavement distresses they assess. Based on this investigation, the research team narrowed it down to the five most promising methodologies.

The team began using detailed data from MDOT's Pavement Management System database for specific sections of pavements to create the pavement condition index using the selected five methodologies. These index values were compared to MDOT's DI values to create an initial assessment of applicability to Michigan's pavements.

Finally, the research team created a survey that will be sent to MDOT staff most closely involved with the pavement evaluation and scoping for fix type selection.

**FISCAL YEAR 2022 ACCOMPLISHMENTS**

Out of five choices from other states for distress index methodologies, the Minnesota method was chosen to implement in Michigan. The distress definitions and severity levels were finalized, and calibration of the point system began. MDOT decided that the new index will be called the Pavement Distress Score (PDS).

The research team also began reviewing different methods for modeling the predicted performance for families of pavements (reconstructs, rehab fixes, etc.). MDOT's method for splitting project lists into families was utilized with the PDS numbers to see the fix life predictions from each of the models. These fix life values were compared with MDOT's existing fix lives to judge the reasonableness of each of the models. These families, however, were based on the old Distress Index (DI) scores. So, the research team began working on a method to break project groups into families using the PDS.

The research team delivered the first draft of one of the three anticipated computer modules for the PDS. This first module is intended to take MDOT's previous distress data and convert it to the new PDS distress types and severities. MDOT began reviewing that JAVA code.

Lastly, the research team began reviewing literature for ways to model International Roughness Index (IRI) data to predict future IRI values.

**FISCAL YEAR 2023 PROPOSED ACCOMPLISHMENTS**

The proposed PDS and performance model methodologies were presented to internal and external stakeholders on December 12, 2022. Distress definitions to be used for future data collections were finalized, and the final calibration of the deduct point system for calculating the PDS values was completed.

The computer code (JAVA) for converting historical MDOT distress raw data to the PDS definitions was delivered. Service life modeling of IRI, rutting and faulting occurred with estimated fix and service life values for each. Network-level modeling of IRI began.

Began drafting the final project report.

**FISCAL YEAR 2024 ACCOMPLISHMENTS**

Service life modeling of the various pavement rehabilitation and reconstruction fix types using IRI, faulting, and rutting was completed. Transition matrices were developed to facilitate network modeling of IRI, % cracking, rutting, and faulting. This will allow for the prediction of future condition of the MDOT network, based on these metrics, which are required by federal rules every four years. Drafts of the final report for all tasks except the network modeling were delivered and reviewed by MDOT.

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

The research team completed analysis that allowed for the summation of historical pavement project data to be used as inputs in the Pavement Management software being developed for MDOT. These inputs are:

- Pavement metric (IRI, % cracking, etc.) deterioration models for various pavement types.
- Quantification of the improvements in condition due to different fix types.
- Quantification of the ranges of pavement metric values at the time of construction for various fix types.

Additionally, a literature search was completed to discover what other states are using utility scoring and their methodology for setting the utility values.

A tool was developed that allows MDOT to calculate the above information at statewide or regional levels, with the ability to combine fix types into fix categories. This will allow MDOT to tailor the inputs for the Pavement Management software for the level of
analysis desired by the users of the software.

The methodology of using deterioration and improvement matrices to forecast the individual metrics of the Pavement Condition Measure (PCM) was finalized. These metrics are IRI, rutting, faulting, and % cracking. A method for rolling up the individual forecasts such that the Good/Fair/Poor percentages of the network could also be forecast, was also finalized. A tool to do all of this was created and presented to MDOT.

The drafts for two final reports - one for the original scope of work (Part I) and one for the contract extension work (Part II), were delivered.

**FISCAL YEAR 2026 PROPOSED ACTIVITIES**

Finalize both Parts I and Part II final reports.

**JUSTIFICATION(S) FOR REVISION(S)**

A time extension was granted in December 2022 to fine tune work on task 5 (service life curves for our different pavement fixes), develop and deliver task 6 (application to create service life curves), and work on task 7 (network modeling of IRI, cracking, faulting, and rutting). The project end date was extended again in December 2023 to complete Task 7 and provide more time for MDOT engineers/regions and industry to evaluate/ comment on PDS magnitudes, fix lives, and LCCA methodology so they can be refined and perfected. A 12-month extension that added additional tasks and $45,832.57 in cost was granted in June 2024. The tasks for the extension will provide key input values MDOT can use within the Project Identification Tool (PIT) when it goes live. PIT is a new IT application being developed for MDOT to help with identification of the most cost beneficial pavement projects.

**SUMMARY OF THE IMPLEMENTATION RECOMMENDATION**

Implementation is already underway via IT work needed to calculate the PDS from the annually collected pavement condition data. Implementation of the methodology for creating fix lives and service lives will also begin in the future once the PDS calculation work is complete. The methodology and tools for forecasting network condition of Pavement Condition Measure (PCM) will be utilized by Planning when it is time to set condition targets required by FHWA. Part II results will be incorporated into the Pavement Management software once development of that software resumes.

Michigan Department
Of Transportation
5312 (2014)

# RESEARCH ADMINISTRATION
# MDOT RESEARCH PROJECT
# ANNUAL REPORT - FISCAL YEAR 2025

PROJECT TITLE: Influence of Revising CFCC Guaranteed Strength on Performance of CFCC Prestressed Highway Bridge Beams Subjected to Various Environmental Conditions

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

PROJECT MANAGER: Kahl, Steve

| | | | |
|---|---|---|---|
| CONTRACT/AUTHORIZATION NO. | 2019-0309 Z3 | PROJECT START DATE | 10/1/2021 |
| PROJECT NO. | 213122 | COMPLETION DATE (Original) | 9/30/2024 |
| OR NO. | OR21-018 | COMPLETION DATE (Revised) | 9/30/2026 |
| RESEARCH AGENCY | Lawrence Technological University (LTU) | | |
| PRINCIPAL INVESTIGATOR | Grace, Nabil | | |

**BUDGET STATUS**

| *FY 2025 Budget | | Total Budget | |
|---|---|---|---|
| Vendor Budget FY 2025 | $222,177.12 | Total Vendor Budget | $481,165.90 |
| MDOT Budget FY 2025 | $3,333.33 | Total MDOT Budget | $3,333.33 |
| Vendor FY 2025 Expenditures | $87,239.06 | Total Budget | $484,499.23 |
| MDOT FY 2025 Expenditures | $0.00 | Total Expenditures | $346,227.84 |
| | | **Total Amount Available** | $138,271.39 |

*This project includes $94,496.40 in University Matching Funds over and above the reported project budget.

| University Match | | | | |
|---|---|---|---|---|
| **By Fiscal Year** | **Annual Budget** | **Annual Expenditures** | **Total Expenditures** | **Total Amount Available** |
| 2022 | $31,180.80 | $13,121.52 | $13,121.52 | $81,374.88 |
| 2023 | $31,274.88 | $14,218.00 | $27,339.52 | $67,156.88 |
| 2024 | $32,040.72 | $24,649.04 | $51,988.56 | $42,507.84 |
| 2025 | $42,507.84 | $17,458.17 | $69,446.73 | $25,049.67 |

**PURPOSE AND SCOPE**

The current manufacturer of carbon fiber composite cable (CFCC) has introduced a 0.7” diameter strand, which is more of a one-to-one replacement for steel strands, and MDOT is pursuing using these strands. Based on extensive tensile test results, the manufacturer of CFCC strands updated the guaranteed breaking load of different strand diameters to reflect the current material strength with the proper safety margin. The increase in the guaranteed strength ensures efficient and economical use of the material. Implementing the new value in the design and construction of highway bridge beams necessitates the support of comprehensive experimental and analytical investigations to adequately predict the performance of the constructed beams under different loads and environmental conditions. LTU is conducting an extensive experimental program, including breaking load tests, elongation tests, creep rupture tests, fire load tests, environmental chamber tests, and full-scale bridge model tests. These results will then be compared to numerical modeling results using complex finite element analysis software to calibrate the material resistance factors for use in bridge design applications. Mathcad calculation templates, and specifications will be developed to aid designers.

**FISCAL YEAR 2021 ACCOMPLISHMENTS**

Project start was delayed until FY 2022 due to COVID, and the impacts on LTU’s abilities to onboard research assistants. Project kickoff meeting was held on 10/26/2022. Experimental program has already begun with the procurement of 0.7” diameter strand from the manufacturer and loading into hydraulically controlled load frames from creep rupture testing and strain recordings.

**FISCAL YEAR 2022 ACCOMPLISHMENTS**

The research team worked on Tasks 2, 3, 4, 6, and 7.

**Task 2:** Creep/relaxation/prestress loss: The test specimens for creep and relaxation have been under continuous monitoring since 2017. The research team continued to evaluate the prestress loss in relaxation specimens and performed the necessary maintenance on the test setup to ensure that the creep specimens are still subjected to a constant load level.

**Task 3:** Transfer and Development Length: The research team is analyzing the test results of the three decked bulb T beams in the light of the test results obtained from pull-out testing and the ongoing shear testing of the end zone of similar decked bulb T beams. The objective of the research is to evaluate the end zone and establish the minimum amount of confinement reinforcement to avoid concrete cracking/splitting at beams ends.

**Task 4:** Decked bulb T beam shear testing: The research team completed the shear testing of one end of a decked bulb T beam with steel stirrups at a spacing of 3.0 in. Test results showed that the shear capacity exceeded the flexural capacity and that the

modified compression field theory for shear capacity calculations underestimated the capacity of the section. The team is currently evaluating the other end of the beam with CFCC stirrups at a spacing of 3.0 in.

**Task 6:** Freeze-thaw test: Like the Beams under Task # 3, three half-scale decked bulb T beams were constructed with lengths of 8,12, and 16 ft. The beams will be placed in the environmental chamber and exposed to 300 cycles of freezing and thawing. After completing the cycles, the beams will be tested under three-point loading to failure. Test results will be compared to those from Task 3 to evaluate the impact of freeze-thaw cycles on development length and bond strength between concrete and CFRP strands. Due to hardware malfunction, the environmental chamber has gone under extensive maintenance, and the freeze-thaw test is delayed until the repair of the chamber is completed.

**Task 7:** Full-scale precast beams: The research team constructed two full-scale AASHTO I-beams prestressed with CFCC strands using the new guaranteed strength and the new prestressing force. The first beam was tested to failure, while the second beam is currently under testing.

**FISCAL YEAR 2023 ACCOMPLISHMENTS**

The research team worked on Tasks 2, 4, 5, 6, 7, and 8.

**Task 2:** Creep/relaxation/prestress loss: The test specimens for creep and relaxation have been under continuous monitoring since 2017. The research team continued to evaluate the prestress loss in relaxation specimens and performed the necessary maintenance on the test setup to ensure that the creep specimens are still subjected to a constant load level. Two of the five 0.6” CFCC specimens have been experiencing a slight drop in the load due to leakage of the pump system. The team continues to adjust the force monthly and bring it back to the initial prestress level.

**Task 4:** Decked bulb T beam shear testing: The research team continued to test decked bulb T beam with different stirrup material and spacing under shear loading. Four beams were prepared for testing with stirrup spacings of 3, 4, 6, and 8 in. In addition, half of each beam is provided with steel stirrups, while the other half is provided with CFCC stirrups of the same diameter. Both sides with CFCC and steel stirrups achieved and exceeded the theoretical shear capacity calculated using available codes and guidelines. The research team is currently analyzing the test results to provide guidelines for the design of the beam end zones and recommendations for the transfer and development lengths.

**Task 5:** Fire Testing: The research team completed the testing of another AASHTO beam specimen. The beam was exposed to one hour of fire followed by loading the beam to failure at ambient conditions and evaluating the prestress loss and strength loss due to fire exposure.

**Task 6:** Freeze-thaw test: The research team has completed the flexural testing of the three beams after exposure to 300 cycles of freezing/thawing. The team continue to analyze the failure modes and the residual strength in comparison to identical control beams not exposed to freeze-thaw cycles (Beams under Task # 3). In addition, the research team is testing identical beams with steel prestressing strands to serve as a benchmark in the comparison.

**Task 7:** Full-scale precast beams: The research team is gathering the results of testing two AASHTO I-beams prestressed with CFCC strands and is performing an in-depth comparison between the beams and similar beams that were constructed and tested under an earlier research project. The comparison addresses aspects such as energy absorption capacity, failure modes, and effect of increasing prestressing force per strand on the overall beam design and performance.

**Task 8:** Design concepts: The research team is gathering the results from different test programs to evaluate the impact of increasing the guaranteed strength and the prestressing force per strand on the overall design of CFCC prestressed beams. The team focuses on the design of the beam end zone including establishing the appropriate transfer and development lengths.

**FISCAL YEAR 2024 ACTIVITIES**

During fiscal year 2024, the research team worked on Tasks 2, 5, 6, 8, 9 and 10 of the research project.

**Task 2:** Creep/relaxation/prestress loss: The test specimens for creep and relaxation have been under continuous monitoring since 2017. The research team continued to evaluate the prestress loss in relaxation specimens and performed the necessary maintenance on the test setup to ensure that the creep specimens are still subjected to a constant load level. Two of the five 0.6” CFCC specimens have been experiencing a slight drop in the load due to leakage of the pump system. The team continues to adjust the force monthly and bring it back to the initial prestress level. Creep specimens from 2013 were released due to bending of the steel anchors of one of the strands, which resulted in shifting of the steel spring and the end plate.

**Task 5:** Fire Testing: The research team has resumed the fire testing and continued to evaluate the performance of AASHTO beam segments prestressed with 0.7 in. CFCC strands under fire event according to ASTM E119. The research team completed the fire testing segments and is currently comparing the test results to the control specimens. The research team also evaluated the residual flexural resistance of one segment after it was exposed to fire/loading scenario for one hour

**Task 6:** Freeze-thaw test: Testing resumed, and the freeze-thaw specimens underwent 300 cycles, after which they were removed from the environmental chamber and were tested under a three-point-loading setup to evaluate the residual bond strength and flexural capacity. In addition, the research team is preparing three additional freeze-thaw specimens prestressed with steel strands to go for 300 freeze-thaw cycles. The new group of specimens will serve as a benchmark for the CFCC prestressed specimens.

**Task 7:** Full-scale precast beams: The research team completed the testing of AASHTO I beams including one beam prestressed with stainless steel strands. The team shared the test results with MDOT engineers

**Task 8:** Design concepts: The research team continues to gather the results from different test programs to evaluate the impact of increasing the guaranteed strength and the prestressing force per strand on the overall design of CFCC prestressed beams. The team focuses on the design of the beam end zone including establishing the appropriate transfer and development lengths

**Task 9:** Products and implementation: The research team is in contact with MDOT engineers to discuss the test results and their impact on the design of CFCC prestressed beams in upcoming bridge projects.

**Task 10:** Reporting: The research team continued to report on the development of the test program and worked on a draft report for findings of the research project

**FISCAL YEAR 2025 ACTIVITIES**

The research team worked on Tasks 2, 6, 8, 9, and 10 of the research project:

**Task #2:** Creep/relaxation/prestress loss: The test specimens for creep and relaxation have been under continuous monitoring since 2017. The research team continued to evaluate the prestress loss in relaxation specimens and performed the necessary maintenance on the test setup to ensure that the creep specimens are still subjected to a constant load level. Two of the five 0.6”

CFCC specimens have been experiencing a slight drop in the load due to leakage of the pump system. The team continues to adjust the force monthly and bring it back to the initial prestress level.

**Task # 6:** Freeze-thaw test: The three beam specimens with steel strands are still awaiting the repair of the environmental chamber. The research team prepared the specimens and placed them inside the freezing tank, and a subcontractor is currently working on the repair of the main compressors of the environmental chamber. Once the repair is completed, the research team will expose the specimens to 300 cycles of freezing and thawing and assess the residual capacity after exposure

**Task # 8:** Design concepts: the research team is analyzing the test results from various test specimens to evaluate the impact of increasing the guaranteed strength on the design of beams prestressed with CFCC strands. In addition, special attention is directed towards the end zone to assess the confinement capacity and the adequacy of using AASHTO LRFD confinement provisions in beams prestressed with CFCC strands. The team is discussing with MDOT PM possible additional testing to evaluate different confinement configurations.

**Task # 9:** Products and implementation: The research team is in contact with MDOT engineers to discuss the test results and their impact on the design of CFCC prestressed beams in upcoming bridge projects. The research team is also working on updating design Mathcad files to reflect the increase in the prestressing force and the reduction in the reinforcement ratio associated with it.

**Task # 10:** Reporting: The research team continues to report on the development of the test program to MDOT engineers and continued work on a draft report for the completed tasks of the research project. Due to the equipment breakdown, a one-year no-cost extension will be used to ensure all required testing occurs.

**FISCAL YEAR 2026 PROPOSED ACTIVITIES**

The research team will continue to work on different research items according to the proposed work schedule. During the next year, it is expected that the research team will work on Tasks 2, 6, 8, 9, and 10 and will continue to share and discuss the test results with MDOT Engineers. Project completion is expected by the end of FY26.

**JUSTIFICATION(S) FOR REVISION(S)**

A time extension was necessary in FY 2024 due to the breakdown and repair of freeze-thaw chamber. Lead time for parts necessitated a time extension such that complete cycles could be ran to the full 300 cycles. Another extension was necessary in FY 2025 due to equipment failure causing delays in testing.

**SUMMARY OF THE IMPLEMENTATION RECOMMENDATION**

Project expected completion FY 2026.

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# RESEARCH ADMINISTRATION
# MDOT RESEARCH PROJECT
# ANNUAL REPORT - FISCAL YEAR 2025

PROJECT TITLE: Michigan Hydrologic Calculation Procedures

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

PROJECT MANAGER: Carlson, Erik

| | | | |
|---|---|---|---|
| CONTRACT/AUTHORIZATION NO. | 2019-0311 Z3 | PROJECT START DATE | 11/1/2021 |
| PROJECT NO. | 213316 | COMPLETION DATE (Original) | 12/31/2024 |
| OR NO. | OR21-019 | COMPLETION DATE (Revised) | 6/30/2025 |
| RESEARCH AGENCY | Michigan Technological University (MTU) | | |
| PRINCIPAL INVESTIGATOR | Watkins, David W. | | |

## BUDGET STATUS

| FY 2025 Budget | | Total Budget | |
|---|---|---|---|
| Vendor Budget FY 2025 | $69,414.74 | Total Vendor Budget | $556,935.71 |
| MDOT Budget FY 2025 | $5,000.00 | Total MDOT Budget | $0.00 |
| Vendor FY 2025 Expenditures | $69,096.85 | Total Budget | $556,935.71 |
| MDOT FY 2025 Expenditures | $0.00 | Total Expenditures | $556,617.82 |
| | | **Total Amount Available** | $317.89 |

## PURPOSE AND SCOPE

The Federal Highway Administration (FHWA), the Michigan Department of Environment, Great Lakes, and Energy (EGLE) and the Michigan Department of Transportation (MDOT) reviewed the approved procedures for calculating discharges from simulated Michigan rainfall events. The current hydrologic methods rely on older data sets where newer data is available. The purpose of this project is to update these methods to incorporate modern data sets and improve calculated discharge results.

1. Interview MDOT and EGLE staff to understand the current hydrologic methods and their application.
2. Update and validate the method outlined in “Computing Flood Discharges for Small Ungauged Watersheds” (Sorrell, 2010)
3. Identify GIS data for developing SCS Curve Numbers
4. Update the regression equation from the 1984 Michigan linear regression for large watersheds greater than 10 square miles aka “Statistical Models for Estimating Flow Characteristics of Michigan Streams.”
5. Investigate alternative hydrologic techniques to calculate recurrence interval peak discharges at ungagged sites.
6. Report on findings

## FISCAL YEAR 2021 ACCOMPLISHMENTS

The start of this project was delayed until FY 2022.

## FISCAL YEAR 2022 ACCOMPLISHMENTS

The following activities were completed.

1. Task 1: Interview MDOT and EGLE staff to understand the current hydrologic methods and their application is complete.
2. Task2: Update and validated the method outlined in “Computing Flood Discharges for Small Ungauged Watersheds” (Sorrell, 2010) using current National Oceanic and Atmospheric Administration (NOAA) “Atlas 14” rainfall and recommended distributions had the following progress:
    a. Developed an understanding of the existing methodology that uses “Rainfall Atlas of the Midwest (Bulletin 71)” rainfall and Type II Soil Conservation Service (SCS) rainfall distribution including records that EGLE has from when the method was developed.
3. Task 3: GIS data for developing SCS Curve Numbers had the following progress:
    a. Collected information on the following:
        i. Existing 1978 land use dataset
        ii. United States Geological Service (USGS) Multi-Resolution Land Characteristics Consortium’s Land Cover raster set.
        iii. EGLE’s process for preprocessing curve numbers by county, based on merged soils and land use datasets.
    b. Identified where the 1978 land use data could be substituted with the more recent land cover datasets to improve hydrologic calculations.
    c. Considered other GIS data sets that could be used for SCS curve number development.
    d. Became familiar with current RCN procedures and evaluate data sets to provide automated workflows for developing SCS Curve Numbers in GIS.

4. Task 4: Update the regression equation from the 1984 Michigan linear regression for large watersheds greater than 10 square miles aka “Statistical Models for Estimating Flow Characteristics of Michigan Streams” had the following progress:
    a. Developed an understanding of the existing linear regression calculations that used data from 180 gages and identified parameters for calculating discharge. The current method uses Quaternary Geology parameters. There should be a focus on reconsidering the use of this dataset, and consideration of other parameters to replace these parameters. Other key parameters include drainage area, slope of watershed, percent of length that is swamp, slenderness ratio, and rainfall.
    b. Identified parameters and collect data now available in GIS that should be considered in a regression update.

**FISCAL YEAR 2023 ACCOMPLISHMENTS**

The following activities were completed.

1. Task 1 is complete, and no additional work is anticipated.
2. Task 2: Update and validate the method outlined in “Computing Flood Discharges for Small Ungauged Watersheds” (Sorrell, 2010) using current National Oceanic and Atmospheric Administration (NOAA) “Atlas 14” rainfall and recommended distributions will have the following activity:
    a. Collected and evaluated data from existing and discontinued USGS gages with small drainage areas and a sufficient period of record. Compiled rainfall data from gaged watersheds.
    b. Developed updated methods following guidelines outlined in The United States Department of Agriculture’s National Engineering Handbook Part 630 (Hydrology) using current NOAA Atlas 14 rainfall and recommended distributions.
        i. Evaluated unit hydrograph peak rate factors for various sites across the State.
        ii. Evaluated rainfall distribution options with input from USDA.
        iii. Performed preliminary investigation of potential precipitation climate zones.
3. Task 3: GIS data for developing SCS Curve Numbers:
    a. Developed GIS tool for automatic watershed delineation. The tool requires accurate hydrography to hydro enforced Light Detection and Ranging (LiDAR) derived Digital Elevation Models (DEMs).
    b. Developed GIS tool for derivation of curve numbers for the SCS method. The tool was developed for ArcPro 2.9.5 and 3.1.
    c. Provided in-person training to EGLE and MDOT staff on both tools.
4. Task 4: Updated the regression equation from the 1984 Michigan linear regression for large watersheds greater than 10 square miles aka “Statistical Models for Estimating Flow Characteristics of Michigan Streams” will have the following activity:
    a. Collected discharge data from the original set of gages and any newer gages with 15 years of record and at least one significant event or 20 years of record regardless of the existence of a significant event.
    b. Started to update additional data sets necessary such as rainfall.
    c. Conducted a parametric data analysis using gage data on new identified parameters to find the parameters of statistical significance.
5. Task 5: Investigated alternative hydrologic techniques to calculate recurrence interval peak discharges at ungagged sites will explore the following techniques:
    a. Rain on grid
        i. Performed literature search.
        ii. Investigated potential watersheds.
    b. Non-stationarity
        i. Performed literature search.
        ii. Will evaluate FHWA’s CMIP tool in FY2024.

**FISCAL YEAR 2024 ACCOMPLISHMENTS**

The following activities were completed.

1. Task 1 is complete, and no additional work is anticipated.
2. Task 2: Update and validate the method outlined in “Computing Flood Discharges for Small Ungauged Watersheds” (Sorrell, 2010) using current National Oceanic and Atmospheric Administration (NOAA) “Atlas 14” rainfall and recommended distributions will have the following activity:
    a. Collected and evaluated data from existing and discontinued USGS gages with small drainage areas and a sufficient period of record. Compiled rainfall data from gaged watersheds.
    b. Developed updated methods following guidelines outlined in The United States Department of Agriculture’s National Engineering Handbook Part 630 (Hydrology) using current NOAA Atlas 14 rainfall and recommended distributions.
        i. Evaluated unit hydrograph peak rate factors for various sites across the State.
        ii. Evaluated rainfall distribution options with input from USDA.
        iii. Determined potential precipitation climate zones.
    c. Performed a comparison analysis for multiple sites against statistical gauge data.
3. Task 3: GIS data for developing SCS Curve Numbers:
    a. Developed GIS tool for automatic watershed delineation. The tool requires accurate hydrography to hydro enforced Light Detection and Ranging (LiDAR) derived Digital Elevation Models (DEMs).
    b. Developed GIS tool for derivation of curve numbers for the SCS method. The tool was developed for ArcPro 2.9.5 and 3.1.
    c. Provided in-person training to EGLE and MDOT staff on both tools.

4. Task 4: Updated the regression equation from the 1984 Michigan linear regression for large watersheds greater than 10 square miles aka “Statistical Models for Estimating Flow Characteristics of Michigan Streams” will have the following activity:
    a. Collected discharge data from the original set of gages and any newer gages with 15 years of record and at least one significant event or 20 years of record regardless of the existence of a significant event.
    b. Conducted a parametric data analysis using gage data on new identified parameters to find the parameters of statistical significance.
    c. Tested the regression equation to evaluate meaningful variables within the equations.
5. Task 5: Investigated alternative hydrologic techniques to calculate recurrence interval peak discharges at ungagged sites will explore the following techniques:
    a. Rain on grid
        i. Performed literature search.
        ii. Investigated potential watersheds.
        iii. Noted that this topic was an NCHRP synthesis topic which has spawned into a full NCHRP research project.
    b. Non-stationarity
        i. Evaluated FHWA’s CMIP tool for two locations within the state (Ann Arbor and Houghton).

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

1. Task 2 is complete. MTU has recommended moving to using Atlas 14 rainfall (broken down by townships) using MSE3 or MSE4 rainfall distributions. It was also recommended to use unit hydrographs with PRF = 300 for the lower peninsula and PRF = 350 for the upper peninsula.
2. Task 3 is complete. MDOT and EGLE staff have been utilizing the GIS tools developed by the project.
3. Task 4 is nearing completion. Adjustments to regression modeling to better fit Michigan is ongoing.
    c. Recommendations on the maximum drainage area thresholds for the SCS method and minimum drainage area thresholds for the regression analysis and how to use this method for watersheds as small as 10 sq. miles are being completed.
    d. Developed guidance documents for EGLE and MDOT. The information has been provided to allow for the integration into EGLE and MDOT guidance documents.
    e. Provided training to EGLE and MDOT staff - this is scheduled for October 28, 2025.
4. Task 5 is complete. CMIP models suggest future rainfall could increase by 25% for the western UP and 10% in metro Detroit. MTU did not perform rain on grid modeling but provided some literature and documentation that may be of benefit in the future.

**FISCAL YEAR 2026 PROPOSED ACTIVITIES**

A late-stage collaborative discovery requires additional time to amend content of the final deliverables to ensure positive implementation of project output. The revised final report is expected in the first or second quarter for final review by MDOT and EGLE. This will include a summary of implementation opportunities within both Michigan agencies, while considering future research potentials to further enhance this information.

**JUSTIFICATION(S) FOR REVISION(S)**

Some rain gage data needed to complete Tasks 2 and 4 required working with local governments that utilize third parties to host data. This caused delays resulting in the contract being extended early in FY 2025. Additional time is needed due to coordinating reviews with EGLE and resulting requests for adjustments to the final report, which is expected to be completed outside of contract timeframe with receipt expected in FY 2026.

**SUMMARY OF THE IMPLEMENTATION RECOMMENDATION**

Project deliverables are expected to be completed in Q1 of FY26. After adjustments to regression modeling in Task 4 and the training, it is expected that EGLE and MDOT will be working through implementing the information in existing manuals. The GIS tools that have been developed are currently being utilized. An anticipated update to the Drainage Manual is expected for EOC review during the Winter of 2026.

Michigan Department
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5312 (2014)

# RESEARCH ADMINISTRATION
# MDOT RESEARCH PROJECT
# ANNUAL REPORT - FISCAL YEAR 2025

PROJECT TITLE: Michigan Cone Penetrometer Test Calibration

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

PROJECT MANAGER: Snook, Ryan

| | | | |
|---|---|---|---|
| CONTRACT/AUTHORIZATION NO. | 2019-0312 Z8 | PROJECT START DATE | 1/1/2022 |
| PROJECT NO. | 213318 | COMPLETION DATE (Original) | 11/30/2024 |
| OR NO. | OR21-020 | COMPLETION DATE (Revised) | 9/30/2026 |
| RESEARCH AGENCY | University of Michigan (UM) | | |
| PRINCIPAL INVESTIGATOR | Hryciw, Roman / Garcia, Estefan | | |

## BUDGET STATUS

| FY 2025 Budget | | Total Budget | |
|---|---|---|---|
| Vendor Budget FY 2025 | $149,777.70 | Total Vendor Budget | $503,426.52 |
| MDOT Budget FY 2025 | $4,800.00 | Total MDOT Budget | $5,740.68 |
| Vendor FY 2025 Expenditures | $31,310.43 | Total Budget | $509,167.20 |
| MDOT FY 2025 Expenditures | $0.00 | Total Expenditures | $385,899.93 |
| | | **Total Amount Available** | $123,267.27 |

## PURPOSE AND SCOPE

MDOT purchased Cone Penetration Test (CPT) equipment in 2019 to better define the geotechnical conditions at project sites. Statistical comparison is needed to calibrate the Michigan CPT test and identify procedures that should be followed to produce and interpret Michigan soil data reliably. In addition, MDOT could benefit from a standardized procedure that stores data in the Data Interchange for Geotechnical and Geo-Environmental Specialists (DIGGS) data storage format and provides automated output that assists with risk-based design. Further identifying site variability may help with appropriate site characterization and design savings. The scope of work includes the following items:

- Conduct literature search and survey of state DOT state of the practice.
- Collect existing datasets from MDOT, published literature, and other sources.
- Evaluate correlation of MDOT CPT data to published soil type behavior charts and other published CPT charts.
- Make recommendations on how to apply published correlations to Michigan soils, and/or what corrections might be needed.
- Develop MDOT CPT procedures for bridge foundation design using direct design as well as CPT correlations.
- Develop a DIGGS based data storage system.
- Identify frameworks to characterize sites and group site variability.
- Identify how to apply CPT to reduce uncertainty in foundation design decisions.
- Identify an acceptable software package(s) that assists with data visualization.
- Identify software package(s) that provide an automated output with statistical risk-based foundation design.
- Provide training, manuals, and implementation guidance.

## FISCAL YEAR 2021 ACCOMPLISHMENTS

This project was delayed starting FY 2022.

## FISCAL YEAR 2022 ACCOMPLISHMENTS

- Conducted literature search and survey of state DOT state of the practice.
- Collected existing datasets from MDOT, published literature, and other sources.
- Began to statistically compare MDOT's soil boring data and lab test data to MDOT's CPT data. Analysis methodology should allow for continuous import of new CPT data to refine/update correlations.
- Began to evaluate correlation of MDOT CPT data to published soil type behavior charts and other published CPT charts.
- Made preliminary recommendations on how to apply published correlations to Michigan soils, and/or what corrections might be needed.

## FISCAL YEAR 2023 ACCOMPLISHMENTS

- Finished statistically comparing MDOT's soil boring data and lab test data to MDOT's CPT data. Analysis methodology should allow for continuous import of new CPT data to refine/update correlations.
- Finished evaluating correlation of MDOT CPT data to published soil type behavior charts and other published CPT charts.
- Made final recommendations on how to apply published correlations to Michigan soils, and/or what corrections might be needed.
- Developed a MDOT CPT procedures for bridge foundation design using direct design methods.
- Developed a DIGGS base data storage system using Data forensics services/software.
- Began identifying frameworks to characterize sites and group site variability.

- Began identifying how to apply CPT to reduce uncertainty in foundation design decisions.
- Began identifying an acceptable software package(s) that assists with data visualization.

**FISCAL YEAR 2024 ACCOMPLISHMENTS**

- Finished developing a software tool to characterize soil type. This tool provides information on soil behavior type, yield stress, and other CPT parameters. It will provide an important visual of CPT test results that will aid in foundation design.
- Completed a procedure for identifying organic soils in Michigan by comparing how soils identified as organics within the MDOT dataset compared with existing correlations for organic soil types.
- Developed guidance for identifying organic soil layers and estimating unit weights based on CPT data.
- Developed a screening tool for identifying organics using statistical sensitivity and specificity to quantify the rate of false positives, false negative, true positives, and true negatives.

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

- Research Report Summarizing the outcomes from Phase I including: literature search survey summary, dataset.
- Summary, data correlations, and recommendations on how to apply published correlations to Michigan soils.
- Developed a MDOT CPT procedures manual for bridge foundation design application.
- Developed a Data forensics / DIGGS data system.

**FISCAL YEAR 2026 PROPOSED ACTIVITIES**

University of Michigan is continuing to work through the details of the remaining tasks, while preparing deliverables and final products for this project. Review of final draft projects by the Research Advisory Panel is expected in FY26.

**JUSTIFICATION(S) FOR REVISION(S)**

Additional data was provided to U of M in January 2024, which took more time to incorporate into the analysis.

**SUMMARY OF THE IMPLEMENTATION RECOMMENDATION**

Project expected completion FY 2026.

Michigan Department
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5312 (2014)

# RESEARCH ADMINISTRATION
# MDOT RESEARCH PROJECT
# ANNUAL REPORT - FISCAL YEAR 2025

PROJECT TITLE: Operational Baseline for the 2nd Avenue Network Arch Bridge

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

PROJECT MANAGER: Pakala, Purush

| | | | |
|---|---|---|---|
| CONTRACT/AUTHORIZATION NO. | 2019-0313 Z8 | PROJECT START DATE | 1/1/2022 |
| PROJECT NO. | 213321 | COMPLETION DATE (Original) | 5/31/2024 |
| OR NO. | OR22-008 | COMPLETION DATE (Revised) | 12/31/2025 |
| RESEARCH AGENCY | Western Michigan University (WMU) | | |
| PRINCIPAL INVESTIGATOR | Attanayake, Upul B. | | |

**BUDGET STATUS**

| FY 2025 Budget | | Total Budget | |
|---|---|---|---|
| Vendor Budget FY 2025 | $49,629.26 | Total Vendor Budget | $258,887.71 |
| MDOT Budget FY 2025 | $9,223.75 | Total MDOT Budget | $21,521.52 |
| Vendor FY 2025 Expenditures | $14,967.49 | Total Budget | $280,409.23 |
| MDOT FY 2025 Expenditures | $13,045.27 | Total Expenditures | $245,747.46 |
| | | **Total Amount Available** | $34,661.77 |

**PURPOSE AND SCOPE**

A skewed, unbraced network arch bridge is being constructed to carry the 2nd Avenue over I-94. This 245 ft long, 96 ft wide structure will carry vehicular traffic, bicycles, and pedestrians in separate dedicated lanes. The unique structural configuration and the use of innovative accelerated bridge construction (ABC) techniques make this one of the most significant projects in the United States. The bridge skeleton, consisting of trapezoidal steel arch ribs, tie girders, end diaphragms, and steel floor beams will be assembled in a staging area near the bridge site. This bridge skeleton will be moved into place using self-propelled modular transporters (SPMTs) during a weekend closure of I-94. Following SPMT move and placement of the skeleton on permanent bearings, the rest of the construction activities will be completed. The stresses in several major structural elements are monitored using a structural health monitoring (SHM) system to capture the stresses during construction and in service. The research includes the following tasks:

1. Develop an understanding of the structure by studying as-built drawings and taking necessary measurements
2. Evaluate the performance of instrumentation.
3. Evaluate the data collected during construction.
4. Collect data from instruments on a regular basis for two years providing MDOT quarterly updates.
5. Store and evaluate seasonal trends in data.
6. Conduct load testing to establish an operational baseline for the structure.
7. Develop finite element models for intrinsic and live loads to predict the envelope of performance and calibrate models to this structure. A) Compare assumptions in research model to Engineer of Record model. B) Perform parametric studies to evaluate the effect of different parameters (ex: temperature, loading cycles or fatigue, creep, overload traffic etc.) on the structural response of the bridge C) Perform analysis to evaluate the residual capacity of the tied-arch system subjected to failure of critical member(s) of the tied arch network. The number of failed members could be more than one based on the critical locations identified.
8. Identify instrumentation output envelopes within which the structure can be maintained.
9. Develop a long-term sampling plan and transfer responsibility and training to MDOT for long term instrument monitoring of the structure

**FISCAL YEAR 2022 ACCOMPLISHMENTS**

- Instrumentation of the bridge is completed along with the installation of a data acquisition system. Data has been collected continuously, reviewed frequently and compared with the data from laboratory and field specimens.
- Tie girder concrete specimens were collected and used for evaluating the properties such as shrinkage, creep, strength, and modulus of elasticity. Data from the tests was used to develop material property models.
- Analysis model developed by Janssen & Spaans was reviewed and a summary report was developed.
- User-defined material models in refined analysis models were reviewed. Simple models were used to evaluate the application of user-defined models to simulate shrinkage, creep, and combined effects before implementing such models in bridge components.
- Field visit and two progress meetings were conducted.

**FISCAL YEAR 2023 ACCOMPLISHMENTS**

- Evaluation of the performance of instrumentation occurred. Though this task is complete, WMU is still evaluating the performance since the system is operating on solar power and intermittent interruptions are observed.
- Collected data from instruments. This is an ongoing process to collect data from instruments for two years.

- Storage and evaluation of seasonal trends in instrumentation data. Data from the instruments is evaluated on a regular basis to make sure that the concrete compression and tension limits measured from the instrumentation are within the design limits. Results of the findings have been regularly communicated during project progress meetings.
- The PI and his team continued developing a refined 3D finite element model of concrete frame including tie girders and end diaphragms to simulate the construction process and evaluate the assumptions used in the engineer of record (EOR) models.
- A detailed model in LARSA was developed by the PI's team to compare results from this model to that obtained from EOR model.

**FISCAL YEAR 2024 ACCOMPLISHMENTS**

- Evaluate the performance of instrumentation: This is an ongoing process to collect data from instruments and WMU is regularly collecting data from the instruments.
- Collect data from instruments as well as evaluate seasonal trends in the data: WMU has been collecting data for 2 years. Bridge construction was completed in late summer of 2023 and declared open on 10/27/23. Due to this, 2 years of data from the completed bridge is not available. With the data collected, strain plots are updated every 3 days to review and identify any trends in data. Data collected from completed bridge to date is inadequate to evaluate seasonal trends.
- Conduct load testing to establish an operational baseline for the structure: Load testing was conducted on 7$^{th}$ August 2024.
- Continue developing and refining finite element model of the bridge for intrinsic and live loads to predict the performance envelope and calibrate model from field/lab test data: Detailed LARSA model was developed to represent the as-built geometry. Stresses from the output of this model were used to compare it against the results from the Engineer of Record (EOR) and other models. Further, load configurations for load testing were developed using this model.
- Develop a long-term data acquisition plan and transfer responsibility and training to MDOT for long-term monitoring of the structure: This is an ongoing task. A draft training manual was developed but requires including output enveloped to develop guidelines for long-term monitoring and managing the structure. PI is working with MDOT PM to get a project extension till 12/31/2025.

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

- The contract was extended to the end of December 2025 to ensure an understanding of data and analysis for the project. This extension allowed for an additional understanding of seasonal performance of the structure and its various components. These data points have allowed for the development of a more precise finite element model, allowing for better operational envelope understanding. Considering the unique nature of the structure, monitoring is critical and this past year helped determine a path and plan for gaining data from the bridge.

**JUSTIFICATION(S) FOR REVISION(S)**

A no cost time extension was approved in FY 2024 because additional time was necessary for data analysis of bridge monitoring data to complete tasks 5, 7, 8, and 9 related to refining the element model and developing the data acquisition plan. Another six-month extension was granted early in FY 2025 to extend monitoring time and explore the possibility of adding a task for creating a web dashboard. One more time extension was granted during the summer of 2025 to ensure a full two years of open-to-traffic monitoring data after bridge construction was completed.

**SUMMARY OF THE IMPLEMENTATION RECOMMENDATION**

Project expected completion FY 2026.

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# RESEARCH ADMINISTRATION
# MDOT RESEARCH PROJECT
# ANNUAL REPORT - FISCAL YEAR 2025

PROJECT TITLE: Capacity Prediction of Repaired and Unrepaired Bridge Beams with Deteriorated Ends

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

PROJECT MANAGER: Tempinson, Don

| | | | |
|---|---|---|---|
| CONTRACT/AUTHORIZATION NO. | 2022-0434 Z1 | PROJECT START DATE | 10/1/2022 |
| PROJECT NO. | 217419 | COMPLETION DATE (Original) | 9/30/2024 |
| OR NO. | OR23-001 | COMPLETION DATE (Revised) | 9/30/2025 |
| RESEARCH AGENCY | Western Michigan University (WMU) | | |
| PRINCIPAL INVESTIGATOR | Attanayake, Upul B. | | |

## BUDGET STATUS

| FY 2025 Budget | | Total Budget | |
|---|---|---|---|
| Vendor Budget FY 2025 | $210,833.16 | Total Vendor Budget | $447,365.16 |
| MDOT Budget FY 2025 | $25,400.00 | Total MDOT Budget | $0.00 |
| Vendor FY 2025 Expenditures | $178,596.34 | Total Budget | $447,365.16 |
| MDOT FY 2025 Expenditures | $0.00 | Total Expenditures | $415,128.34 |
| | | **Total Amount Available** | $32,236.82 |

## PURPOSE AND SCOPE

From the problem statement – Revise as needed.
Deterioration of the ends of bridge beams can compromise the structural integrity of the beam itself and that of the superstructure system. It is important to know when actions, such as an updated load rating analysis, additional monitoring, installation of temporary supports, beam retrofit, or bridge closure, are needed. Load rating engineers must be able to determine the capacity of the beam in the deteriorated and repaired states to ensure the bridge can safely carry Michigan legal and permitted loads. Programming and resource challenges highlight the importance of employing the strategy that best addresses capacity concerns, makes efficient use of limited resources and is in alignment with the remaining life span of the bridge. This will ensure that public safety is maintained, while also avoiding potentially unnecessary restrictions on the motoring public.
This research will focus primarily on concrete beams and specific areas of concern for steel beams.

## FISCAL YEAR 2023 ACCOMPLISHMENTS

- Literature review was completed.
- Review of MDOT processes and guidance was completed.
- Data from MDOT was shared with WMU.
- Several on-site data collection efforts were completed, through scans and images.
- Both concrete and steel beam end deterioration repair types have been identified.
- A preliminary calculation sheet was developed for prestressed beam ends.

## FISCAL YEAR 2024 ACCOMPLISHMENTS

- Additional data was collected for further analysis.
- End deterioration and repair types were identified from photos and documents received.
- Developed and distributed surveys to determine MDOT experiences and policies regarding beam ends.
- Multiple visits were made to bridges with deterioration and repairs to collect field data.
- Conducted further review and refinement of end capacity calculation methods.

## FISCAL YEAR 2025 ACCOMPLISHMENTS

- Created calculation sheet for determining capacity of deteriorated PS I-beams.
- Conducted laboratory testing of steel beam repair samples with pack rust. Results will be provided later as an addendum to the project once enough rust is developed to get results.
- Results of laboratory testing of concrete repairs as well as field inspections have led to best practice recommendations for repairs.
- Provided documentation to assist with Request for Actions (RFAs) as well as inspections.
- WMU created final documents and submittals.

## JUSTIFICATION(S) FOR REVISION(S)

During FY 2024, a time extension was required to give WMU more time to obtain field data during construction season and analyze it. During the project, it was found there weren't any field samples available for testing where pack rust is a concern. WMU will have to create samples and trigger pack rust to adequately determine the deterioration's effect on capacity. This was not included in the original scope of work and included a small increase in cost.

| SUMMARY OF THE IMPLEMENTATION RECOMMENDATION |
| --- |
| Project expected completion FY 2025. The RFA guidance will be provided to the RFA committee. Inspection guidelines will be forwarded to the bridge inspection group. Calculation sheets for deteriorated beam ends will be used within the Load Rating Unit as well as becoming available to local agencies. The design unit that primarily works on repairs and RFAs will be informed of the details and notes from the report. |

Michigan Department
Of Transportation
5312 (2014)

# RESEARCH ADMINISTRATION
# MDOT RESEARCH PROJECT
# ANNUAL REPORT - FISCAL YEAR 2025

PROJECT TITLE: Efficacy of Speed Warning Technologies

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

PROJECT MANAGER: Uzcategui, Alonso

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|---|---|---|---|
| CONTRACT/AUTHORIZATION NO. | 2023-0135 | PROJECT START DATE | 1/23/2023 |
| PROJECT NO. | 217934 | COMPLETION DATE (Original) | 5/15/2025 |
| OR NO. | OR23-010 | COMPLETION DATE (Revised) | |
| RESEARCH AGENCY | Michigan State University (MSU) | | |
| PRINCIPAL INVESTIGATOR | Gates, Timothy J. | | |

**BUDGET STATUS**

| FY 2025 Budget | | Total Budget | |
|---|---|---|---|
| Vendor Budget FY 2025 | $130,723.22 | Total Vendor Budget | $234,139.79 |
| MDOT Budget FY 2025 | $21,493.16 | Total MDOT Budget | $0.00 |
| Vendor FY 2025 Expenditures | $130,723.22 | Total Budget | $234,139.79 |
| MDOT FY 2025 Expenditures | $0.00 | Total Expenditures | $234,139.79 |
| | | **Total Amount Available** | $0.00 |

**PURPOSE AND SCOPE**

Crashes related to speed-change areas occur at locations where a change in speed is required to safely navigate, including horizontal curves, work zones, and when entering communities. A variety of factors contribute to the occurrence of crashes at these locations, including poor pavement surface conditions, limited visibility, driver distraction, drowsiness, and intoxication. While traditional warning treatments, including signs, delineation, and beacons have been used for decades, MDOT has recently expanded implementation of new technologies to warn motorists on the approach to such areas, including speed feedback signs, flashing chevrons, and other warning technologies that are activated by sensors when approaching vehicles exceed a preset speed threshold.

Previous MDOT research on the use of radar speed feedback signs has shown promising results but is limited to the use of such devices on freeway interchange ramps and only during favorable weather conditions. Current MDOT research is strictly focused on the driver behavioral aspects and does not include evaluation of crashes and injuries.

The purpose of this research is to broadly assess the effectiveness of speed warning technologies across a variety of roadway configurations and weather conditions. The project work includes a literature review of nationwide practices for the use of speed warning technologies; determination of viable speed warning technologies and applicable location types for implementation; evaluation of the effectiveness of speed warning technologies on driver behavior across a variety of roadway configurations and weather conditions in Michigan; review of the impacts of existing speed warning technologies on crashes and injuries in Michigan; evaluation of maintenance and operational performance of selected speed warning technologies; and development of guidelines and support tools for the use of such technologies in the state.

**FISCAL YEAR 2023 ACCOMPLISHMENTS**

Collecting data as required on the scope of work. Complete tasks 1 through 3 and started work on task 4.

**FISCAL YEAR 2024 ACCOMPLISHMENTS**

Continued data collection and began writing project reports and recommendations. Also continued task 4 and began tasks 5 through 8, along with starting to draft the final project report.

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

The vendor completed data collections and submitted a final report with research outcomes and recommendations. PM approved final deliverables.

**JUSTIFICATION(S) FOR REVISION(S)**

A time extension is in progress to allow suitable weather for the university to complete collection and analysis of data for remaining location sites.

**SUMMARY OF THE IMPLEMENTATION RECOMMENDATION**

Based on the study findings, the continued use of the tested speed warning technologies is recommended for the highway contexts evaluated in this study. A series of specific recommendations related to sign characteristics, operational performance, and installation details for each road context are provided in the final project report. These recommendations were developed on the basis of providing optimal performance toward reducing high speeds and associated crashes in contexts where speed adjustments are necessary. All recommendations comply with the requirements of the Manual on Uniform Traffic Control Devices (MUTCD), 11th Edition.

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# RESEARCH ADMINISTRATION
# MDOT RESEARCH PROJECT
# ANNUAL REPORT - FISCAL YEAR 2025

PROJECT TITLE: Winter Severity Index with Winter Maintenance Expenses and Material Usage

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

PROJECT MANAGER: Roath, James

| | | | |
|---|---|---|---|
| CONTRACT/AUTHORIZATION NO. | 2023-0155 | PROJECT START DATE | 2/6/2023 |
| PROJECT NO. | 217937 | COMPLETION DATE (Original) | 2/6/2025 |
| OR NO. | OR23-003 | COMPLETION DATE (Revised) | 7/5/2025 |
| RESEARCH AGENCY | Michigan State University (MSU) | | |
| PRINCIPAL INVESTIGATOR | Zockaie, Ali | | |

**BUDGET STATUS**

| FY 2025 Budget | | Total Budget | |
|---|---|---|---|
| Vendor Budget FY 2025 | $35,980.45 | Total Vendor Budget | $190,000.61 |
| MDOT Budget FY 2025 | $6,250.00 | Total MDOT Budget | $0.00 |
| Vendor FY 2025 Expenditures | $35,979.84 | Total Budget | $190,000.61 |
| MDOT FY 2025 Expenditures | $0.00 | Total Expenditures | $190,000.00 |
| | | **Total Amount Available** | $0.61 |

**PURPOSE AND SCOPE**

Inclement weather conditions require proper planning for winter maintenance services, including materials and available budget for maintenance personnel and equipment. Overspending on materials in the beginning and during the winter season might lead to materials shortages or budget dollars from strong storms at the end season going into spring and summer. A winter weather index can improve estimates and allocation predictions for resources based on observed trends and predicted weather conditions. This research will define a weather index to assist in forecasting funds and materials needed for the winter season, improve alignment and consistency between service providers, and identify current uses of Winter Severity Indices (WSIs) and weather condition applications by other states. Tasks will include surveying other state agencies on their current uses of a WSI (Iowa, Minnesota, Wisconsin, etc.), review the current index, study winter severity from the last ten seasons for MDOT and compare with budget and materials used, develop a new WSI for MDOT, and pilot the index during the first winter season to evaluate and improve the index.

**FISCAL YEAR 2023 ACCOMPLISHMENTS**

- Kick-Off Meeting with MDOT Research Advisory Panel (RAP) on February 27, 2023
- Meeting with Project Manager (PM) to get access and information on Maintenance Decision Support System (MDSS) on April 11, 2023
- Meeting with PM and RAP members to provide an update on project progress, discuss feedback on state DOT survey, and explore data needs from MDOT on September 19, 2023
- Reviewing Michigan current practices. Data was collected and analyzed along with additional information requested.
- The Nationwide State DOTs Survey was drafted and reviewed by MDOT and then distributed to state contacts.
- Based on available data, some initial progress was made on developing a preliminary modified WSI and rating scheme. Michigan's available data and other state's data was used to explore the relationships between WSI and winter maintenance costs and material usage.

**FISCAL YEAR 2024 ACCOMPLISHMENTS**

- Continue Review of Michigan Current Practices: The remaining data needs from MDOT will be collected and analyzed to provide input for Task 5.
- Perform a Nationwide State DOTs Survey: The results will be analyzed to provide input for Task 5 and assist in developing the survey/interview with local service providers in Michigan.
- Started Survey/Interview with Local Service Providers in Michigan: Once the state DOT survey is conducted, the research team will focus on developing a separate survey with local agencies in Michigan. Then an on-line meeting will be set up to get further feedback from these local agencies based on the information provided in the survey.

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

- Completing Survey/Interview with Local Service Providers in Michigan: Once the state DOT survey is conducted, the research team will focus on developing a separate survey with local agencies in Michigan. Then an on-line meeting will be set up to get further feedback from these local agencies based on the information provided in the survey.
- Developed Preliminary Modified WSI and Rating Scheme. The research team will continue to explore more WSIs for state level analyses, in addition to county-level analyses in Michigan.
- Piloted Phase for modified WSI Validation and Verification.
- Final Recommendation for WSI Improvements were made.
- Developed and Delivered Draft and Final Reports.

| JUSTIFICATION(S) FOR REVISION(S) |
| --- |
| None. |
| **SUMMARY OF THE IMPLEMENTATION RECOMMENDATION** |
| We have met with MSU to go over final recommendations and the final report. At this time, MDOT is going to continue using our current WSI and experiment in the upcoming season with the equation MSU has created. MDOT wants to compare the equations and see if there is any potential future work that can be done with the new equation from MSU. |

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# RESEARCH ADMINISTRATION
# MDOT RESEARCH PROJECT
# ANNUAL REPORT - FISCAL YEAR 2025

PROJECT TITLE: Identifying Mapping Techniques of Invasive Plant Species Within the MDOT Right-of-Way

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

PROJECT MANAGER: Ahlschwede, Carla

| | | | |
|---|---|---|---|
| CONTRACT/AUTHORIZATION NO. | 2022-0432 Z2 | PROJECT START DATE | 10/11/2023 |
| PROJECT NO. | 218359 | COMPLETION DATE (Original) | 9/30/2025 |
| OR NO. | OR23-004 | COMPLETION DATE (Revised) | |
| RESEARCH AGENCY | Michigan Technological University (MTU) | | |
| PRINCIPAL INVESTIGATOR | Dobson, Richard | | |

**BUDGET STATUS**

| FY 2025 Budget | | Total Budget | |
|---|---|---|---|
| Vendor Budget FY 2025 | $122,596.87 | Total Vendor Budget | $212,451.62 |
| MDOT Budget FY 2025 | $10,000.00 | Total MDOT Budget | $0.00 |
| Vendor FY 2025 Expenditures | $122,596.87 | Total Budget | $212,451.62 |
| MDOT FY 2025 Expenditures | $0.00 | Total Expenditures | $212,451.62 |
| *Project start was delayed | | **Total Amount Available** | $0.00 |

**PURPOSE AND SCOPE**

Invasive species in habitats and migration corridors near MDOT roadways can create obstacles for routine road maintenance, jeopardize MDOT's compliance with state and federal environmental regulations, and occasionally pose a health risk to maintenance and construction workers. Routine activities such as mowing, plowing, and grading may create additional opportunities for invasive species to spread within MDOT right-of-way and to neighboring properties. This research seeks to assist with proper location identification (mapping) of invasive species to help MDOT effectively monitor invasive species, contain their spread, and manage roadway vegetation to discourage invasive species and promote preferable species. Scoped tasks for this project include reviewing current academic literature on mapping locations of invasive species such as Japanese Knotweed (*Fallopia japonica*), Leafy Spurge (*Euphorbia esula*), and Common Reed (*Phragmites australis*); provide a summary of remote mapping alternatives for one or more species (i.e.: remote sensing, drone photography, etc.); demonstrate one or more mapping alternatives and their accuracy; and provide recommendations of mapping methods based on their accuracy, availability and ease of access of technology, and other factors deemed appropriate by the research team.

**FISCAL YEAR 2023 ACCOMPLISHMENTS**

Project start was delayed beyond FY 2023. The kickoff meeting was held on 10/31/2023.

**FISCAL YEAR 2024 ACCOMPLISHMENTS**

Conducted and completed most field work. The literature review was completed and submitted. Presented preliminary field results at the September quarterly meeting.

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

The vendor completed required field work data collection and performed data analysis (tasks 5 and 6) for the final report. The research findings and recommendations were delivered to MDOT and reviewed/accepted by the MDOT PM.

**JUSTIFICATION(S) FOR REVISION(S)**

None.

**SUMMARY OF THE IMPLEMENTATION RECOMMENDATION**

The research team offered technical training beyond the project requirements.

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# RESEARCH ADMINISTRATION
# MDOT RESEARCH PROJECT
# ANNUAL REPORT - FISCAL YEAR 2025

PROJECT TITLE: MDOT Fleet Electrification Strategies

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

PROJECT MANAGER: Sevigny, Diane

| | | | |
|---|---|---|---|
| CONTRACT/AUTHORIZATION NO. | 2023-0418 | PROJECT START DATE | 6/21/2023 |
| PROJECT NO. | 218361 | COMPLETION DATE (Original) | 2/28/2025 |
| OR NO. | OR23-011 | COMPLETION DATE (Revised) | |
| RESEARCH AGENCY | Hatch Associates Consultants (Michigan), Inc. | | |
| PRINCIPAL INVESTIGATOR | Bodarya, Mihir | | |

**BUDGET STATUS**

| FY 2025 Budget | | Total Budget | |
|---|---|---|---|
| Vendor Budget FY 2025 | $22,264.62 | Total Vendor Budget | $226,889.86 |
| MDOT Budget FY 2025 | $3,409.09 | Total MDOT Budget | $0.00 |
| Vendor FY 2025 Expenditures | $20,987.17 | Total Budget | $226,889.86 |
| MDOT FY 2025 Expenditures | $0.00 | Total Expenditures | $225,612.41 |
| | | **Total Amount Available** | $1,277.45 |

**PURPOSE AND SCOPE**

Reliance on petroleum-based fueled fleet creates financial risk of dependency on a sole product, reliance on a limited natural resource, and contributes to a major source of air pollution. MDOT's goal is to enter the electrification or alternate fueled vehicle (AFV) market by establishing a set of criteria that can be used to make future decisions on equipment procurement. This research will create a baseline for MDOT's minimum operational needs of each equipment type. As alternate fueled fleet and electrified equipment options continue to enter the commercial fleet industry, MDOT will need dedicated resources to keep up to date with the evolving market to investigate the viability of AFVs, or the expertise to perform cost/benefit/impact studies to make informed decisions.

This research study will document current and emerging technologies in the electric and alternative fuels markets. Primary objectives will be to determine the operational capabilities of these technologies, assess their suitability for MDOT's purposes, identify risks/rewards and cost/benefit for each vehicle type. Deliver a best practice report to guide MDOT future efforts with equipment procurements, utilizing a blended mix strategy.

**FISCAL YEAR 2023 ACCOMPLISHMENTS**

The project kick of meeting was held, and major progress was made in collecting data. A request for information was developed and submitted to gather information pertaining to MDOT fleet with a preliminary analysis conducted on the received information. The data was analyzed and organized to facilitate workshops with user groups. A series of eleven information gathering meetings were held with MDOT end-users (Transportation Maintenance Workers, Garage Supervisors, Mechanics, Equipment Foremen, Statewide Crews, Statewide Maintenance, Electricians, Construction Engineers, and Bridge Crews) to provide the researchers with a real case use understanding and baseline for MDOT's minimum operational requirements for various equipment types in MDOT's fleet. Formal structured questionnaires were developed as a part of the preparation for workshops. Peer group workshops were then conducted to understand and document the use case of vehicles by each user group. Additional workshops were conducted with supervisors and foremen to understand fleet maintenance and storage. Notes were consolidated and organized to be utilized for assessing levels of public engagement, which was initiated. Some initial analysis was conducted on the available AFV vehicles that are similar in size and capacity to the most common trucks in MDOT's fleet. The project is moving forward on time and within budget and through collaborative efforts, MDOT and the research team consolidated the schedule to make up for later than planned contract execution.

**FISCAL YEAR 2024 ACCOMPLISHMENTS**

The research team completed all necessary data gathering, developed minimum MDOT operating requirements for categorical fleet units, completed an analysis of available zero-emission equipment currently available in the industry that meets MDOT's minimum operating requirements, and performed additional research on transition planning initiatives by other state DOTs and municipalities. The feasibility analysis got underway. The researcher also began work to document and finalize findings. This project is ahead of schedule.

| FISCAL YEAR 2025 ACCOMPLISHMENTS |
| --- |
| The vendor, Hatch, Inc. finalized the feasibility analysis and cost/benefit determination for categorical zero emission fleet conversion candidates. |
| **JUSTIFICATION(S) FOR REVISION(S)** |
| None. |
| **SUMMARY OF THE IMPLEMENTATION RECOMMENDATION** |
| This research provided insights for MDOT to consider initiating a zero-emission fleet transition, including pilot projects and key performance indicators (KPIs) such as CO2 reduction, cost savings, and infrastructure needs. The final project report details the conversion of specific vehicle types and emphasizes the environmental, financial, and operational benefits of transitioning to an alternative-fueled fleet. These results will guide MDOT in future equipment procurement and set a precedent for similar research efforts nationwide. |

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# RESEARCH ADMINISTRATION
# MDOT RESEARCH PROJECT
# ANNUAL REPORT - FISCAL YEAR 2025

PROJECT TITLE: Examination of Lighting Practices at Crosswalks

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

PROJECT MANAGER: Smerdon, Tim

| | | | |
|---|---|---|---|
| CONTRACT/AUTHORIZATION NO. | 2022-0434 Z3 | PROJECT START DATE | 4/24/2023 |
| PROJECT NO. | 218362 | COMPLETION DATE (Original) | 1/31/2025 |
| OR NO. | OR23-015 | COMPLETION DATE (Revised) | |
| RESEARCH AGENCY | Western Michigan University (WMU) | | |
| PRINCIPAL INVESTIGATOR | Van Houten, Ron | | |

**BUDGET STATUS**

| FY 2025 Budget | | Total Budget | |
|---|---|---|---|
| Vendor Budget FY 2025 | $25,739.45 | Total Vendor Budget | $170,638.15 |
| MDOT Budget FY 2025 | $3,200.00 | Total MDOT Budget | $0.00 |
| Vendor FY 2025 Expenditures | $25,130.25 | Total Budget | $170,638.15 |
| MDOT FY 2025 Expenditures | $0.00 | Total Expenditures | $170,028.95 |
| | | **Total Amount Available** | $609.20 |

**PURPOSE AND SCOPE**

Fatality Analysis Reporting System (FARS) data show that most increases in pedestrian fatalities occurred at night on urban arterials (Tefft, Arnold, & Horrey (2021); Hu, & Cicchino, (2018). Improved street lighting as one way to decrease pedestrian crashes at night is available at or near crosswalk or intersection locations but does not always illuminate pedestrians in the crosswalks. Since pedestrian safety is a priority for MDOT and the traffic safety community across the state, this research aims to address the high proportion of pedestrian crashes that occur in conditions with inadequate lighting and how MDOT can better illuminate crosswalks to identify crosswalk users. The scope of the project will include determining what type of lighting is needed at crosswalks to identify pedestrians that can easily be seen by drivers; identify a methodology or approach to best accomplish this goal; locate vendors who can offer smart lighting solutions for crosswalks and potentially provide data on the efficacy of this approach to promote development of additional products; and evaluation and analyze new prototypes and their measured effectiveness on crosswalk lighting.

**FISCAL YEAR 2023 ACCOMPLISHMENTS**

Held the project kick-off meeting. Completed task 1 (literature review and product list) and made significant progress on Task 2 (gather new information/data on the efficacy of crosswalk lighting solutions).

**FISCAL YEAR 2024 ACCOMPLISHMENTS**

Two progress meetings were held (fall/winter of 2023 and spring 2024). The research team completed tasks 2 and 3 (determine whether crashes during lighted conditions occur during said conditions) and began work on tasks 4 and 5 (prepare technical report and strategic plan). Field observations, testing, and data collection also occurred in the Spring/Summer. Data collection for unlighted conditions is nearly complete. Progress has been made in determining whether bright LED lighting at crash sites was installed before or after the crash. Data has been added from Ann Arbor, Detroit, Warren, Royal Oak, and Southfield. We have before and after lighting data for I8 crosswalks at two locations. Tapco, one of the vendors of smart lighting, has agreed to send us a system of four smart lights and movable posts, which can be moved between crosswalks. We have received the units and will be able to obtain data at two of the Rectangular Rapid-Flashing Beacon (RRFB) sites we have been working with. Sufficient data will be available early next fiscal year.

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

The vendor completed all project objectives and delivered required final deliverables, including a final report that was reviewed and accepted by the MDOT PM.

**JUSTIFICATION(S) FOR REVISION(S)**

The contract has not been revised; however, MDOT did approve a shift in budgeted funds from equipment to student hours for data collection. (The city of Kalamazoo purchased the Smart Lighting Systems equipment that was included in the project budget.) This change will not alter the overall project budget and will result in better deliverables for MDOT.

**SUMMARY OF THE IMPLEMENTATION RECOMMENDATION**

PM is currently reviewing and discussing recommendations internally. Reviewing recommendations in relation to current State Law (Public Act 51) and asking for an AG's opinion on findings of the research project.

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# RESEARCH ADMINISTRATION
# MDOT RESEARCH PROJECT
# ANNUAL REPORT - FISCAL YEAR 2025

PROJECT TITLE: Evaluation of MDOT's Methodology for Estimating Work Zone User Delay Times & Costs

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

PROJECT MANAGER: Krom, Ben / Hoffman, Sarah

| | | | |
|---|---|---|---|
| CONTRACT/AUTHORIZATION NO. | 2022-0434 Z4 | PROJECT START DATE | 5/3/2023 |
| PROJECT NO. | 218364 | COMPLETION DATE (Original) | 2/28/2026 |
| OR NO. | OR23-013 | COMPLETION DATE (Revised) | |
| RESEARCH AGENCY | Western Michigan University (WMU) | | |
| PRINCIPAL INVESTIGATOR | Oh, Jun-Seok | | |

**BUDGET STATUS**

| FY 2025 Budget | | Total Budget | |
|---|---|---|---|
| Vendor Budget FY 2025 | $141,481.81 | Total Vendor Budget | $347,947.58 |
| MDOT Budget FY 2025 | $52,941.18 | Total MDOT Budget | $27,571.83 |
| Vendor FY 2025 Expenditures | $119,839.44 | Total Budget | $375,519.41 |
| MDOT FY 2025 Expenditures | $11,919.28 | Total Expenditures | $307,155.65 |
| | | **Total Amount Available** | $68,363.76 |

**PURPOSE AND SCOPE**

MDOT uses a macro-enabled spreadsheet called Construction Congestion Cost (CO3) created in the late 1990's to estimate user delay times and costs that the traveling public can expect to experience while traveling through or around construction work zones. This research will allow MDOT to make an informed decision on how best to move forward after evaluating whether CO3 can be updated to ensure future viability or other sustainable software solutions should be implemented to best meet MDOT's business needs.

The scope of the project includes performing an evaluation and analysis of the current CO3 method of estimating user delay times and costs for future viability and accuracy; reviewing and evaluating alternate methods/software to estimate user delay times and costs; and recommending other viable methodology/software options that meet MDOT's business needs.

**FISCAL YEAR 2023 ACCOMPLISHMENTS**

Finished development of the final work plan and held the project kick-off meeting in May of 2023.

Other accomplishments include:

- Completion of the literature review.
- Development & subsequent distribution of a work zone survey questionnaire to MDOT and consultant stakeholders.
- Started collecting, organizing, and analyzing work zone data.

**FISCAL YEAR 2024 ACCOMPLISHMENTS**

The WMU research team concluded the work zone survey, conducted one focus group meeting with a select group of survey participants and gathered their feedback on the needs for a software tool. One Research Advisory Panel (RAP) meeting occurred in November 2023, where the results of the survey and focus group were presented and discussed. Working with MDOT, work zone data collection activities were completed. Their analysis of various work zone scenarios using several existing software tools was also substantially completed, with an upcoming RAP meeting scheduled to discuss the results.

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

The WMU research team completed the analysis of the various work zone scenarios using several software tools and presented the results to MDOT in early FY 2025. All research results to date were then summarized in an interim report, with the recommendation that MDOT proceed with Phase 2 of the project (developing a tool to meet MDOT's business needs). Based on MDOT's review and discussion, the Research Advisory Panel decided to proceed with Phase 2. WMU created an updated work plan and began development of a new work zone evaluation tool. In order to validate the various traffic models under development, actual traffic counts and delay measurements were conducted by the research team in a variety of active work zones this past summer, by reviewing collected digital images and using wireless traffic sensors. The model validations, various software modules, some test scenarios and the user manual are all under development and are at various stages of completion.

**FISCAL YEAR 2026 PROPOSED ACTIVITES**

The WMU research team will complete the various model validations, and the new work zone evaluation tool. The new software tool will be validated using the test scenarios developed from the actual work zone data that was collected. Other final deliverables will include: a final research report, user manual, implementation guidelines and presentation.

| JUSTIFICATION(S) FOR REVISION(S) |
| --- |
| A six-month time extension and slight budget increase is in process in order to develop and validate the ramp traffic analysis module, and the actual work zone traffic data collection. |
| **SUMMARY OF THE IMPLEMENTATION RECOMMENDATION** |
| Expected project completion FY 2026. |

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# RESEARCH ADMINISTRATION
# MDOT RESEARCH PROJECT
# ANNUAL REPORT - FISCAL YEAR 2025

PROJECT TITLE: Improving MDOT's Movable Bridge Reliability and Operations

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

PROJECT MANAGER: Halloran, Mike

| | | | |
|---|---|---|---|
| CONTRACT/AUTHORIZATION NO. | 2023-0281 | PROJECT START DATE | 3/17/2023 |
| PROJECT NO. | 218367 | COMPLETION DATE (Original) | 5/31/2024 |
| OR NO. | OR23-016 | COMPLETION DATE (Revised) | 5/30/2025 |
| RESEARCH AGENCY | HDR Michigan, Inc. | | |
| PRINCIPAL INVESTIGATOR | Longfield, Matt | | |

**BUDGET STATUS**

| FY 2025 Budget | | Total Budget | |
|---|---|---|---|
| Vendor Budget FY 2025 | $234,710.20 | Total Vendor Budget | $349,434.06 |
| MDOT Budget FY 2025 | $10,000.00 | Total MDOT Budget | $0.00 |
| Vendor FY 2025 Expenditures | $177,609.75 | Total Budget | $349,434.06 |
| MDOT FY 2025 Expenditures | $0.00 | Total Expenditures | $292,333.61 |
| | | **Total Amount Available** | $57,100.45 |

**PURPOSE AND SCOPE**

MDOT's movable bridges occasionally experience unscheduled downtime due to electrical and mechanical component malfunction. Responding, troubleshooting, and performing repairs can be costly, and more importantly, be disruptive to users of the bridge. Unscheduled downtime of movable bridges has negative mobility impacts, affecting emergency response services, the motoring public as well as marine traffic. Component malfunction also often results in MDOT personnel responding outside of normal working hours to troubleshoot the problem and perform repairs, including nights, weekends, and holidays.
This research will:

- Identify best practices throughout the nation on movable bridge reliability and maintenance.
- Determine what performance data to collect and parameters to track to allow workers to predict component malfunction proactively, and how best to collect and display that information.
- Identify enhancements or modifications to movable bridge components/hardware to improve reliability.
- Validate MDOT's current maintenance strategy and determine opportunities for improvement based on benefit-cost analysis.
- Determine effective ways to optimize traffic operations during movable bridge downtime. A strategy using Intelligent Transportation Systems (ITS) to improve customer messaging is appealing to allow users to make more informed decisions on when to seek an alternate route or wait for services to be restored.

**FISCAL YEAR 2023 ACCOMPLISHMENTS**

The research team developed surveys/questionnaires related to movable bridge reliability, distributed them to several bridge owners throughout the nation, and began reviewing survey results. A literature review was also completed along with developing a list of questions for MDOT staff and vendors to use in troubleshooting bridges.

**FISCAL YEAR 2023 PROPOSED ACTIVITES**

Interviews with MDOT staff and vendors were scheduled and held to help the research team understand common issues and develop strategies to mitigate them. The team will continue reviewing survey results from other agencies and compile the data for review. They will also identify vulnerabilities in the network, make recommendations to MDOT, and update existing maintenance procedures and recommendations. The initial draft of the final report will also be developed.

**FISCAL YEAR 2024 ACCOMPLISHMENTS**

The research team continued reviewing survey responses and results were synthesized for their applicability in Michigan. Several MDOT staff as well as others involved in operating, troubleshooting, and repairing the movable bridges were interviewed and the results synthesized. The team researched previously identified topics such as remote monitoring, I/O link protocol, and operator training, as well as information on limit switches. They have also been reviewing previous malfunctions at bridges and looking at protocols for dealing with them, including detour route activation.

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

All tasks were completed during FY25. All draft materials were developed and reviewed. The final report and products were completed. The materials that were developed as part of the effort are and have been utilized to enhance processes for MDOT's movable bridges.

| JUSTIFICATION(S) FOR REVISION(S) |
| --- |
| A no cost time extension of one year was granted in FY 2024 because the contract start was delayed and MDOT found challenges in providing MiBridge data to the vendor. Survey responses also took more time than expected and additional time was incorporated to allow for an adequate review of data to be incorporated into final deliverables. |
| **SUMMARY OF THE IMPLEMENTATION RECOMMENDATION** |
| The products from the projects have been considered and some have been provided to enhance current practices. |

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# RESEARCH ADMINISTRATION
# MDOT RESEARCH PROJECT
# ANNUAL REPORT - FISCAL YEAR 2025

PROJECT TITLE: Socio Economic Impacts of Technology Based Stakeholder Engagement Platforms and Their Effects

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

PROJECT MANAGER: Martin, John

| | | | |
|---|---|---|---|
| CONTRACT/AUTHORIZATION NO. | 2023-0566 | PROJECT START DATE | 8/21/2023 |
| PROJECT NO. | 218391 | COMPLETION DATE (Original) | 8/21/2026 |
| OR NO. | OR23-017 | COMPLETION DATE (Revised) | |
| RESEARCH AGENCY | Michigan State University (MSU) | | |
| PRINCIPAL INVESTIGATOR | Savolainen, Peter T. | | |

**BUDGET STATUS**

| FY 2025 Budget | | Total Budget | |
|---|---|---|---|
| Vendor Budget FY 2025 | $140,400.88 | Total Vendor Budget | $353,967.92 |
| MDOT Budget FY 2025 | $1,666.67 | Total MDOT Budget | $1,250.00 |
| Vendor FY 2025 Expenditures | $120,731.03 | Total Budget | $355,217.92 |
| MDOT FY 2025 Expenditures | $0.00 | Total Expenditures | $164,125.30 |
| | | **Total Amount Available** | $191,092.62 |

**PURPOSE AND SCOPE**

Michigan and the nation have been forever changed because of social interaction ripples created by the Covid pandemic. Isolation and distance have been a few of the tools utilized to slow the virus spread. This research seeks to answer several questions. Has the pandemic environment of technology-based communication platforms promoted a dichotomy in stakeholder involvement? Are socio-economic challenged neighborhoods/census tracts able to utilize new tech platforms? Or, has their voice been further diminished via socio economic inequality? Are there thresholds at which point socio-economic groups simply 'shut down'? Hearing stakeholders is the foundation from which well-designed transportation solutions are built. However, if the abilities and limits of the stakeholders are not understood, can or are engagement techniques effective?

This project will inventory current MDOT guidance and engagement tools used in the field prior to the pandemic; identify performance measures currently tracked and offer reliable data sets to be tracked moving forward; inventory engagement shifts from face-to-face pre-pandemic norms to a virtual environment as a result of early pandemic social condition requirements; evaluate current engagement techniques used in a post-pandemic (new normal) environment; formulate guidance for engagement methods with Michigan's divorce population and context sensitive factors; evaluate potential markers for social stress impacting engagement success; and provide guidance, tools, and performance measures to be updated clarifying populations accessing MDOT public participation opportunities throughout MDOT's development process.

**FISCAL YEAR 2023 ACCOMPLISHMENTS**

- Kick-off meeting was held.
- Initiated literature search.
- MSU began the interaction process with MDOT to determine staff members to interview and create a list for future meetings.
- Began developing questions for the survey.

**FISCAL YEAR 2024 ACCOMPLISHMENTS**

- It is expected that MSU will complete the following:
  - Review of MDOT Practices.
  - Assessment of National State-of-the-Practice.
  - Attend several community engagement events.
  - Complete data assessment of statewide levels of public engagement.
  - Determine stressed user group characteristics.
- It is expected that MSU will begin working on testing strategies in community focus groups.

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

- Attended additional community engagement events (continued).
- Sent out target and random survey cards w/ incentives to selected bodies across the regions.
- Developed and deployed a survey on other virtual and digital platforms to increase the sample size.
- Utilized virtual and digital survey formats to bolster technique / response ratio.
- Began assessment of technique / response ratio.
- Preliminary report table contents completed.
- Preliminary assessments across study for additional points of contact in progress.

| FISCAL YEAR 2026 PROPOSED ACTIVITES |
| --- |
| Continue conversation with Research Advisory Panel and Principal Investigator to ensure that final products are completed. |
| **JUSTIFICATION(S) FOR REVISION(S)** |
| None. |
| **SUMMARY OF THE IMPLEMENTATION RECOMMENDATION** |
| Project expected completion FY 2026. |

Michigan Department
Of Transportation
5312 (2014)

# RESEARCH ADMINISTRATION
# MDOT RESEARCH PROJECT
# ANNUAL REPORT - FISCAL YEAR 2025

PROJECT TITLE: Design Guidance Development for Continuous Prestressed CFCC Strand Beams

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

PROJECT MANAGER: Kahl, Steve

| | | | |
|---|---|---|---|
| CONTRACT/AUTHORIZATION NO. | 2022-0431 Z2 | PROJECT START DATE | 10/1/2023 |
| PROJECT NO. | 218394 | COMPLETION DATE (Original) | 9/30/2026 |
| OR NO. | OR23-023 | COMPLETION DATE (Revised) | |
| RESEARCH AGENCY | Lawrence Technological University (LTU) | | |
| PRINCIPAL INVESTIGATOR | Grace, Nabil F. | | |

**BUDGET STATUS**

| *FY 2025 Budget | | Total Budget | |
|---|---|---|---|
| Vendor Budget FY 2025 | $127,225.41 | Total Vendor Budget | $399,990.45 |
| MDOT Budget FY 2025 | $6,800.00 | Total MDOT Budget | $9,200.00 |
| Vendor FY 2025 Expenditures | $46,481.30 | Total Budget | $409,190.45 |
| MDOT FY 2025 Expenditures | $0.00 | Total Expenditures | $81,652.96 |
| * Project start was delayed | | **Total Amount Available** | $327,537.49 |

This project includes $83,750.00 in University Matching Funds over and above the reported project budget.

| University Match | | | | |
|---|---|---|---|---|
| **By Fiscal Year** | **Annual Budget** | **Annual Expenditures** | **Total Expenditures** | **Total Amount Available** |
| 2024 | $27,800.00 | $9,279.05 | $9,279.05 | $74,470.95 |
| 2025 | $27,200.00 | $15,861.12 | $25,140.17 | $58,609.83 |

**PURPOSE AND SCOPE**

The analysis of continuous bridge beams is more complicated than that of simply-supported beams, yet continuous beam spans can be the best option in unique bridge projects. Carbon Fiber Composite Cable (CFCC) has not been utilized in Michigan in draped conditions required for continuous beams, so the configuration and design requirements need to be developed. This project will explore the possible application of new materials and new designs in a combined effort. This will be accomplished by assessing the feasibility of using CFCC post-tension strand beams to achieve continuity, considering the benefits of continuous CFCC prestressed beams with pretensioned draped and top CFCC strands, and developing design guidance for continuous beams prestressed with bonded draped CFCC strands.

**FISCAL YEAR 2023 ACCOMPLISHMENTS**

Contracting for this project was delayed pushing the date to begin work into FY 2024.

**FISCAL YEAR 2024 ACCOMPLISHMENTS**

For the 2024 fiscal year, the research team worked on Tasks # 2, 3, 4, 8 and 10.

**Task # 2:** Draped CFCC Testing: The research team completed the building of the steel frames to evaluate the strength and prestress loss of CFCC strands with different draping angles. The team is also designing multiple beams with straight and draped strands to evaluate the proposed continuity techniques. The first round of draped strand testing with 4” dimeter rollers was completed for different angles of draping. The team will continue the testing using different diameter rollers and different draping angles.

**Task # 3:** Post-tensioned CFCC Strands: The research team is evaluating different methods to apply post-tensioning in the field without the need for large conduits and large anchorage devices. The team is evaluating new anchor grout materials that are readily available and do not require special heat curing. In addition, the team is evaluating different types of conduit grouts to be applied after post-tensioning. The intension of grouting the conduit is to create a load transfer mechanism independent of the anchorage device, thereby minimizing the possibility of anchor failure. The team successfully post-tensioned a deck slab using sleeve anchorage that was attached to the strands in on-site simulation, and the conduits were grouted with ultra-high-performance concrete in select locations. After grout curing, the anchorage devices were released, and the force transfer took place through the grout only.

**Task # 4:** Pretensioned bulb T Beams for Flexure: The research team completed the construction of a two-span 50-ft-long bulb T beam that is pretensioned with straight strands and support a deck slab that is post-tensioned over the intermediate support. The team completed the construction of the slab and is currently conducting a load test over the two spans.

**Task # 8:** Analysis and Design Concepts: The research team performed preliminary analysis aiming at establishing the general design procedure for continuous beams prestressed with CFCC strands. The procedure of the analysis will involve both flexural and shear design.

**Task # 10:** The team continues to report and share the test results with MDOT engineers.

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

The research team worked on Tasks # 4, 5, 6, 7, 8, and 10 of the research project.

**Task # 4:** Pretensioned bulb T beams for flexure: The team has completed the testing of a control beam, where the two spans were built individually and later joined together using a cast-in-place concrete deck with additional deck reinforcement over the intermediate support. The performance of the beam was compared with that of an earlier continuous beam with post-tensioned strands over the middle support instead of the additional negative moment reinforcement.

**Task # 5:** Pre-tensioned Bulb T beam for shear: Shear testing of the control beam was evaluated under different levels of moving loads and crack maps were plotted to show the development of shear cracks as the load moves from one end of the beam to the other end. During ultimate load test, the two spans of the beam were loaded simultaneously, each with a point load. Shear force diagram was plotted for the loading case at the maximum load level and shear capacity was evaluated at strength limit state. The failure was not triggered with a shear failure but rather with a flexural failure at negative moment region followed by the failure of the positive moment region at midspan of each span.

**Task # 6:** Post-tensioned decked bulb T beam for flexure: The research team constructed two additional 50-ft long pretensioned beams to be loaded as two-span continuous beams. The research team is currently evaluating alternative options to achieve continuity using post-tensioning without adding delay to the work schedule for post-tensioning. In addition, the research team constructed a single span segmental beam with the segments connected using ultra high-performance concrete and grouted post-tensioned strands. Three strands were used: two straight strand and one draped strand. Failure of the beam took place at the location of maximum bending moment due to rupture of post-tensioned strands. No joint separation of failure was observed.

**Task # 07:** Post-tensioned decked bulb T beam in shear: Along with the flexural testing of the post-tensioned beam, the research team evaluated the shear capacity of the beam under different loading levels and check for shear cracks or cracks at the joints between the beam segments.

**Task # 8:** Analysis and Design Concepts: The research team met with MDOT engineers and discussed alternative options to achieve continuity and used shallower beam sections without causing excessive delay or unnecessary difficulty to the flow of work. The team has presented an analytical study showing different loading scenarios for a two-span continuous beam with options to change the cross section to accommodate the negative moment generated at mid-span.

**Task # 10:** The team continues to report and share the test results with MDOT engineers.

**FISCAL YEAR 2026 PROPOSED ACTIVITES**

The research team will continue to work on tasks according to the proposed work schedule. During the next fiscal year, it is expected work will be completed on Tasks 5, 6, 7, 8, and 10.

**JUSTIFICATION(S) FOR REVISION(S)**

None.

**SUMMARY OF THE IMPLEMENTATION RECOMMENDATION**

Project expected completion FY 2026.

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# RESEARCH ADMINISTRATION
# MDOT RESEARCH PROJECT
# ANNUAL REPORT - FISCAL YEAR 2025

PROJECT TITLE: Identify best locations for new Flex-Route projects throughout the state of Michigan

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

PROJECT MANAGER: Firman, Jason

| | | | |
|---|---|---|---|
| CONTRACT/AUTHORIZATION NO. | 2023-0458 | PROJECT START DATE | 6/14/2023 |
| PROJECT NO. | 218396 | COMPLETION DATE (Original) | 6/14/2025 |
| OR NO. | OR23-006 | COMPLETION DATE (Revised) | |
| RESEARCH AGENCY | Michigan State University (MSU) | | |
| PRINCIPAL INVESTIGATOR | Savolainen, Peter T. | | |

## BUDGET STATUS

| FY 2025 Budget | | Total Budget | |
|---|---|---|---|
| Vendor Budget FY 2025 | $115,191.40 | Total Vendor Budget | $300,000.01 |
| MDOT Budget FY 2025 | $8,350.00 | Total MDOT Budget | $0.00 |
| Vendor FY 2025 Expenditures | $115,191.39 | Total Budget | $300,000.01 |
| MDOT FY 2025 Expenditures | $0.00 | Total Expenditures | $300,000.00 |
| | | **Total Amount Available** | $0.01 |

## PURPOSE AND SCOPE

Travel demand variation is one of the main sources of traffic congestion. It is essential to study state-wide congestion distribution to identify the best locations for assigning the highest priority project candidates for future flex-routes or other managed lane strategies. This project also investigates developing a viable project rollout strategy that would support increasing the number of managed lanes, including temporary shoulder use, throughout the state. The research will provide a methodology for determining statewide congestion distributions to identify best locations for new managed lanes and temporary shoulder use projects throughout the state, study temporal and spatial congestion patterns to identify candidate locations for a new managed lane and temporary shoulder use application, review impact on secondary routes/roadway infrastructure and safety due to traffic spillover effects, and define needed resources (i.e. cost, staffing, equipment/software tools, etc.) as a result of proposed managed lane and temporary shoulder use.

## FISCAL YEAR 2023 ACCOMPLISHMENTS

- Literature Review - The MSU team has completed a review of the research literature regarding the use of hard shoulder running and associated operational and safety impacts, as well as criteria impacting the selection of candidate locations for part-time shoulder use.
- State DOT Survey - A state agency survey was disseminated with a total of 38 responses received to date. This survey sought to determine which DOTs have experience with static and/or dynamic part-time shoulder use. Information was also collected on screening and decision criteria, along with pertinent aspects of the design and operation of such facilities.
- Data Collection and Analysis - Data has been collected for the MDOT freeway network detailing geometric and operational characteristics. This includes details such as roadway cross-sectional characteristics (e.g., lane width, shoulder width, median width) and speed/travel time data from the Regional Transportation Information System (RITIS). This data is being used to prepare summary files for use in meetings with MDOT Regional Staff.

## FISCAL YEAR 2024 ACCOMPLISHMENTS

- State DOT Survey - The research team has prepared a summary of the state agency survey, which was presented at a series of regional workshops. Follow-up has been conducted with a small number of non-responding agencies and incomplete responses. The results have been incorporated into the project report.
- Safety Analysis – The team has finished assembling crash data on the corridors that have been identified as candidate locations in consultation with MDOT. These analyses focus on crashes that were congestion-related based upon information form the UD-10 crash report forms.
- Additional Analysis – Preparation for additional analyses began, which will consider potential impacts on the other factors, such as the environment as well as potential cost implications of corridor conversions. MSU has also requested details from MDOT on prior studies conducted based on potential flex routes or related strategies.
- Final Report – The team has begun to work on the draft project report.

## FISCAL YEAR 2025 ACCOMPLISHMENTS

Data analyses were completed. A draft final report was completed for MDOT's review. The vendor delivered a final report and presentation to MDOT. Final deliverables were submitted and approved by PM.

| JUSTIFICATION(S) FOR REVISION(S) |
| --- |
| None. |

| SUMMARY OF THE IMPLEMENTATION RECOMMENDATION |
| --- |
| This study provides a data-driven framework for prioritizing Part-Time Shoulder Use (PTSU) implementation on Michigan freeways. The findings demonstrate that PTSU has the potential to significantly reduce congestion and improve mobility, but safety considerations and corridor-specific constraints must be carefully evaluated before implementation. The ranking system developed in this study serves as a useful decision-support tool for MDOT to guide future PTSU planning and investment. Specific recommendations are outlined in the final project report. |

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# RESEARCH ADMINISTRATION
# MDOT RESEARCH PROJECT
# ANNUAL REPORT - FISCAL YEAR 2025

PROJECT TITLE: Revenue Opportunities from MDOT Fiber Infrastructure and Other Utility Types

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

PROJECT MANAGER: Gorman, Joe

| | | | |
|---|---|---|---|
| CONTRACT/AUTHORIZATION NO. | 2024-0242 | PROJECT START DATE | 5/27/2025 |
| PROJECT NO. | 218397 | COMPLETION DATE (Original) | 5/25/2026 |
| OR NO. | OR23-012 | COMPLETION DATE (Revised) | |
| RESEARCH AGENCY | KPMG LLP | | |
| PRINCIPAL INVESTIGATOR | Ganesh, Prakash | | |

**BUDGET STATUS**

| *FY 2025 Budget | | Total Budget | |
|---|---|---|---|
| Vendor Budget FY 2025 | $449,866.00 | Total Vendor Budget | $449,886.00 |
| MDOT Budget FY 2025 | $10,000.00 | Total MDOT Budget | $10,000.00 |
| Vendor FY 2025 Expenditures | $336,690.00 | Total Budget | $459,886.00 |
| MDOT FY 2025 Expenditures | $0.00 | Total Expenditures | $336,690.00 |
| * Project start was delayed | | **Total Amount Available** | $123,196.000 |

**PURPOSE AND SCOPE**

Various state highway agencies permit telecommunications to be located longitudinally along freeway rights-of-way (ROW). MDOT is interested in a study of alternative sources of transportation revenues that could be phased in over time to replace revenue lost as motor and diesel fuel decline become obsolete. MDOT focus would be on non-vehicle related revenue streams, such as leasing rights-of-way for Fiber Communications and/or other utility types, possibly private transportation facilities, and/or public-private partnerships. This research seeks to explore access to advanced telecommunications technologies and services for remote communities enabling them to remain vital and prosperous, viable cost sharing assistance with the installation of fiber optics networks along state highway ROW, and assistance in funding Intelligent Transportation Systems (ITS) applications as MDOT seeks more convergence of ITS implementation and roadway ROW access via smart partnerships with telecommunications and other utility types in the industry. This will be accomplished by:

- Performing a synthesis to identify merits of viable alternative approaches to supplement and/or replace current revenue streams to construct, operate, and maintain the state transportation infrastructure.
- Developing a strategic investment plan for MDOT to improve accessibility of advanced telecommunications technologies to rural communities, including both short term and long- term deployments.
- Determining a methodology to evaluate/calculate a B/C measure for implementing a cost sharing practice for installing telecommunication and/or other utility type services along state highway ROW.

**FISCAL YEAR 2023 ACCOMPLISHMENTS**

Contracting for this project was delayed pushing the date to begin work into FY 2024.

**FISCAL YEAR 2024 ACCOMPLISHMENTS**

Contracting for this project was delayed pushing the date to begin work into FY 2025.

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

The vendor accomplished execution and completion of major tasks and identified relevant metrics for state assessment of future revenue opportunities. A summary of the project's preliminary findings is planned for MDOT leadership. Feedback will be considered in the final reporting and outcomes relating to recommendations for MDOT consideration. The project duration is extended for a few months.

**FISCAL YEAR 2026 PROPOSED ACTIVITES**

Plan and deliver leadership presentation of initial analysis and assessment for MDOT consideration. Develop a tool to compare opportunities alternative approaches for implementation, based on projected benefit/cost analysis.

**JUSTIFICATION(S) FOR REVISION(S)**

A six-month extension was authorized early in FY 2025 to allow additional time for soliciting feedback from the Research Advisory Committee on the direction of final analysis, which was critical to ensuring final outputs are in alignment with MDOT's vision/mission and expectations for future implementation.

**SUMMARY OF THE IMPLEMENTATION RECOMMENDATION**

Project expected completion FY 2026.

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# RESEARCH ADMINISTRATION
# MDOT RESEARCH PROJECT
# ANNUAL REPORT - FISCAL YEAR 2025

PROJECT TITLE: Pavement ME Rehabilitation Design Protocols for MDOT Implementation

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

PROJECT MANAGER: Schenkel, Justin

| | | | |
|---|---|---|---|
| CONTRACT/AUTHORIZATION NO. | 2023-0342 | PROJECT START DATE | 7/13/2023 |
| PROJECT NO. | 218398 | COMPLETION DATE (Original) | 7/13/2025 |
| OR NO. | OR23-014 | COMPLETION DATE (Revised) | 12/31/2025 |
| RESEARCH AGENCY | Michigan State University (MSU) | | |
| PRINCIPAL INVESTIGATOR | Haider, Sayed Waqar | | |

**BUDGET STATUS**

| FY 2025 Budget | | Total Budget | |
|---|---|---|---|
| Vendor Budget FY 2025 | $225,688.36 | Total Vendor Budget | $402,903.80 |
| MDOT Budget FY 2025 | $19,774.09 | Total MDOT Budget | $99,000.00 |
| Vendor FY 2025 Expenditures | $128,918.83 | Total Budget | $501,903.80 |
| MDOT FY 2025 Expenditures | $0.00 | Total Expenditures | $385,360.18 |
| | | **Total Amount Available** | $116,543.62 |

**PURPOSE AND SCOPE**

MDOT is undergoing the process to fully implement Mechanistic-Empirical (ME) pavement design per the American Association of State Highway and Transportation Officials (AASHTO) Mechanistic-Empirical Pavement Design Guide (MEPDG) and its associated software, AASHTOWare Pavement ME Design (Pavement ME). For pavement rehabilitation design, MDOT is using the AASHTO 1993 (A93) method, and this empirical approach limits the effectiveness as a modern pavement design method as compared to Pavement ME that utilizes site-specific conditions such as traffic, climate, and existing pavement conditions, in creating the final design. ME rehabilitation pavement design is more complex and requires characterization of existing materials and their thicknesses. Past projects used various mix types that are no longer used or have adjusted their requirements (such as air voids or gradations). Therefore, it is difficult to standardize or provide guidelines related to Pavement ME pavement rehabilitation design without extensive investigation. This research will provide recommendations for how to most accurately model rehabilitation fixes within Pavement ME, characterize existing materials given the standard available project information, and streamline the process so that MDOT can use Pavement ME for rehabilitation design decisions. This project will expand on findings from MDOT report, *RC-1594 "Preparation for Implementation of the Mechanistic-Empirical Pavement Design Guide in Michigan Part 2: Evaluation of Rehabilitation Fixes"* by detailing the pavement design protocols necessary for Pavement ME design which will be the basis for implementing Pavement ME in designing rehabilitation projects.

Project scope will include evaluating current MDOT pavement design practices, protocols, data, and past research for reconstruction and rehabilitation; recommend appropriate Pavement ME modeling selection (i.e., Pavement ME design type and pavement type categories); compare different input levels for rehabilitation pavement design; evaluate and update Pavement ME calibration coefficients as warranted; provide a comparison of performance predictions and/or design thicknesses for selected pavements designed using the A93 pavement design method against the same pavements designed using Pavement ME to quantify/qualify differences; and provide updated guidance for MDOT pavement design of rehabilitation fixes.

Project tasks include the following:

- Task 1: Literature review & rehab design practices
- Task 2: Characterization of existing layers
- Task 3: Rehabilitation modeling selection for analysis and design
- Task 4: Compare material input levels
- Task 5: Input database
- Task 6: Verification and recalibration of rehab models
- Task 7: Compare Pavement Mechanistic Design (PMED) vs. AASHTO93
- Task 8: Identify limitations of the designs
- Task 9: Final report (including design recommendations) and tech transfer

**FISCAL YEAR 2023 ACCOMPLISHMENTS**

The team worked on Tasks 1 through 4 and accomplished the following work:

- A comprehensive review of the implementation of PMED rehabilitation analysis and design. The literature includes an overview of the methodologies practiced by other state highway agencies (SHAs).

- Researchers compared different ME analysis options for rubblizing pavement, investigating scenarios where it was designed either as a new flexible pavement or as a Hot Mix Asphalt (HMA) overlay over fractured Jointed Plain Concrete Pavement.
- The team is organizing and setting up an inventory of the 2023 rehabilitation project cores and material samples that were provided by MDOT. They also prepared lab samples and formulated testing protocols for subsequent laboratory assessments. The team has started to conduct laboratory testing for the concrete and HMA cores.

**FISCAL YEAR 2024 ACCOMPLISHMENTS**

The team worked on Tasks 2 through 5 and accomplished the following:

- Comprehensive review of project records in extracting inputs, including cross-section details, average daily traffic (ADT) counts, and a year of construction for the projects sampled/tested in 2023 and 2024.
- Back calculation of layer moduli based on Falling Weight Deflectometer (FWD) deflection data for sampled/tested projects.
    - Reviewed the back calculation methodologies (based on FWD deflections) to estimate the layers moduli of existing flexible and composite pavements.
    - Back calculated layer moduli for flexible and composite pavements using three and four-layered pavement structures for all sampled/tested rehab projects.
    - Back calculated layer moduli using the outer area method for composite pavements.
    - The results were compared and verified with pre-construction back calculated layer moduli for unbound layers to compare moduli (lab vs. field).
- Tested the asphalt pavement field cores to obtain damaged modulus master ($|E^*|_{damaged})_{lab}$ curves for existing layers. The undamaged modulus master curve for the projects was also obtained using PMED v3.0 and the Witczack equation.
    - Comparison of the laboratory-measured damaged modulus master ($|E^*|_{damaged})_{lab}$ curves with the calculated damaged modulus master ($|E^*|_{damaged})_{PMED}$ curve based on back-calculated FWD modulus.
    - Comparison of the undamaged modulus and PMED-predicted damaged modulus master curves at three rehabilitation levels.
    - The laboratory-measured damage modulus for wheel path (WP) and non-wheel path (NWP) cores were compared.
    - Manually calculated damaged modulus master curve using Excel.
    - Compared the laboratory-measured damaged modulus master ($|E^*|_{damaged})_{lab}$ curve with the PMED calculated damaged modulus master ($|E^*|_{damaged})_{PMED}$ curve based on back-calculated FWD moduli values (rehabilitation Level 1).
- Using the triaxial lab test, crushed asphalt base material was characterized to estimate its resilient modulus ($M_R$).
- Tested the compressive strength of PCC cores from the sampled composite pavements.
- Evaluation of existing unbound base/subbase material ME inputs for rehabilitation design of existing pavements.
- Evaluation of the impact of HMA mechanical properties input levels for HMA overlay over fractured JPCP in Pavement ME.
- Sampled materials (and associated findings) were organized and cataloged.
- Assessed the performance prediction of HMA overlay over HMA pavements using ME rehabilitations Levels 2 and 3.
- HMA overlay over crushed asphalt was analyzed in Pavement ME by modeling the crushed asphalt as a pulverized in place recycled asphalt layer and alternatively, as an unbound aggregate base layer.
- Pavement sections with TSD deflection data were selected and in process of review to assess its use/application for pavement design/analysis.
- Analyzed the responses from the MDOT online survey to better understand existing practices and MDOT expectations for rehab design.

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

The research team worked on Tasks 3 through 8 to complete the research project. This included the following items:

- Provide final recommendations for Pavement ME inputs of crushed asphalt base, ASCRL, and existing unbound base/subbase materials.
- Based on non-destructive testing, compare the performance prediction for laboratory-measured damaged dynamic modulus and PMED-predicted damaged dynamic modulus.
- Recalibration of the PMED performance models for rehabilitation options.
- A TSD data analysis of selected sections for pavement design application.
- Analyze the impact of input levels on the performance predictions. This analysis will identify the most appropriate/ practical input level for the specific design types based on Michigan's local conditions.
- Work on the design matrix to identify essential variables for potential catalog design using the PMED and compare with
- AASHTO 1993 designs.
- Identified limitations of PMED for various rehabilitation types.
- Compare the outputs of AASHTO 1993 and PMED rehab designs to identify recommendations for MDOT best practices.

**FISCAL YEAR 2026 PROPOSED ACTIVITIES**

The research team will conduct the remaining project tasks. A final report and deliverables will be submitted for MDOT's review/approval, including PMED design thresholds and a technical transfer presentation.

| JUSTIFICATION(S) FOR REVISION(S) |
| --- |
| A five-month extension was granted during FY 2025 to allow additional time to enhance local calibration models. Another extension to 3/31/2026 is in progress, which will allow all stakeholders to attend the closeout presentations and provide feedback that will result in improved deliverables. |
| **SUMMARY OF THE IMPLEMENTATION RECOMMENDATION** |
| Project expected completion FY 2026. |

Michigan Department
Of Transportation
5312 (2014)

# RESEARCH ADMINISTRATION
# MDOT RESEARCH PROJECT
# ANNUAL REPORT - FISCAL YEAR 2025

PROJECT TITLE: Improving Cost Estimation and Budget Planning with New Michigan Highway Construction Cost Index

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

PROJECT MANAGER: Kirkpatrick, Kristi

| | | | |
|---|---|---|---|
| CONTRACT/AUTHORIZATION NO. | 2022-0434 Z5 | PROJECT START DATE | 5/30/2023 |
| PROJECT NO. | 218401 | COMPLETION DATE (Original) | 12/31/2024 |
| OR NO. | OR23-018 | COMPLETION DATE (Revised) | |
| RESEARCH AGENCY | Western Michigan University (WMU) | | |
| PRINCIPAL INVESTIGATOR | Liu, Hexu | | |

## BUDGET STATUS

| FY 2025 Budget | | Total Budget | |
|---|---|---|---|
| Vendor Budget FY 2025 | $65,338.13 | Total Vendor Budget | $116,284.36 |
| MDOT Budget FY 2025 | $0.00 | Total MDOT Budget | $0.00 |
| Vendor FY 2025Expenditures | $0.00 | Total Budget | $116,284.36 |
| MDOT FY 2025 Expenditures | $0.00 | Total Expenditures | $116,283.71 |
| | | **Total Amount Available** | $0.65 |

## PURPOSE AND SCOPE

MDOT has developed a highway construction cost index (HCCI), including categorical, regional, and statewide indices; however, the future trend of the cost index was forecasted using a time series analysis that cannot consider significant economic factors such as the pandemic, and/or periods of high inflation, leading to low accuracy of the forecasted index value. This makes it difficult to use the current index for engineering estimates and budget planning. With the consumer price index rising in February 2022 to 7.9%, a program analysis template to better understand the impacts of inflation and adaptation to inflation is needed, along with an analysis of labor, logistics, and economic factors that may be affecting pricing. The purpose of this research is to develop a new HCCI, including calculation tool/program, at the project and pay item levels to more accurately adjust the historical price of pay items, improving the accuracy of the historical data-based estimation as well as provide MDOT with a better understanding of why pricing fluctuates for specific materials and/or regions over time. This project will evaluate the impact of the COVID-19 pandemic on the construction cost index trend; develop and advanced approach to predict the construction cost index considering economic factors such as the pandemic and periods of high inflation; develop a project-level and pay item-level construction cost index, including a calculation tool for better cost estimation; create a new HCCI-based construction cost estimation method for engineering estimates; and compare HCCI across different regions and states.

## FISCAL YEAR 2023 ACCOMPLISHMENTS

Fiscal year 2023 accomplishments included project kick-off meeting; data requirements review discussion; data sharing agreement review; literature review; and identifying factors in construction pricing.

## FISCAL YEAR 2024 ACCOMPLISHMENTS

Accomplishments include obtaining a fully executed data sharing agreement and successful data collection. From this data, a project and pay item cost index was developed that can take into consideration economic factors based on cost index predictions. Other accomplishments include the development of an index-based estimation method for budget planning purposes while completing a state and regional cost index comparison. An updated tool for cost index calculation and price analysis was created, with new features for MHCCI predictions and new index calculations. The final report was completed and submitted to the Research Advisory Panel (RAP) for review.

## FISCAL YEAR 2025 ACCOMPLISHMENTS

The project and its products were finalized in December 2024. The outcomes utilized the Michigan Highway Construction Cost Index (MHCCI) for budgetary discussion assistance with MDOT leadership and external stakeholders.

## JUSTIFICATION(S) FOR REVISION(S)

None.

## SUMMARY OF THE IMPLEMENTATION RECOMMENDATION

Based on the findings of this research several recommendations were proposed. 1) Implement contract and item cost indices to improve bid-based estimation accuracy. 2) Adopt economic factor-based predictive models. 3) Revise budget planning and project scoping procedures to integrate index-based methodologies. 4) Continued monitoring and comparison of regional cost indices to account for geographical variations in increased construction prices. 5) Use developed MHCCI tool that integrates contract and item level cost indices, predictive models, and historical price data.

Advanced models will be used to predict future HCCI using economic data, including inflation and labor trends, while piloting contract and item level cost indices to facilitate comparison and contrasting data from the contract level index with results from the project delivery risk (PDR) tool recently developed by the Bureau of Development. Continued discussion with other MDOT staff has allowed for an increased understanding of the tool's use and potentials.

Michigan Department
Of Transportation
5312 (2014)

# RESEARCH ADMINISTRATION
# MDOT RESEARCH PROJECT
# ANNUAL REPORT - FISCAL YEAR 2025

PROJECT TITLE: Bonding Vs. Pay as You Go

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

PROJECT MANAGER: Adams, Kelsey

| | | | |
|---|---|---|---|
| CONTRACT/AUTHORIZATION NO. | 2023-0460 | PROJECT START DATE | 10/30/2023 |
| PROJECT NO. | 218402 | COMPLETION DATE (Original) | 2/28/2025 |
| OR NO. | OR23-020 | COMPLETION DATE (Revised) | 7/31/2025 |
| RESEARCH AGENCY | Texas A&M University Transportation Institute (TTI) | | |
| PRINCIPAL INVESTIGATOR | Glover, Brianne | | |

**BUDGET STATUS**

| FY 2025 Budget | | Total Budget | |
|---|---|---|---|
| Vendor Budget FY 2025 | $106,975.42 | Total Vendor Budget | $160,069.82 |
| MDOT Budget FY 2025 | $0.00 | Total MDOT Budget | $0.00 |
| Vendor FY 2025 Expenditures | $98,795.82 | Total Budget | $160,069.82 |
| MDOT FY 2025 Expenditures | $0.00 | Total Expenditures | $151,890.22 |
| | | **Total Amount Available** | $8,179.60 |

**PURPOSE AND SCOPE**

The purpose of this research is to explore the value of financing infrastructure improvements through bonding versus a program of pay-go improvements and determine which approach should be used to facilitate our capital program, and what the long-term cost/benefit is to that approach. This will include comparing the debt service cost of bonding against the increased costs of inflation, increased costs related to the deterioration from delayed improvements, the on-going costs for targeted maintenance and repairs necessary while waiting for pay-go funding to become available, and user delays due to constraints of the pay-go approach.

**FISCAL YEAR 2023 ACCOMPLISHMENTS**

Contracting for this project was delayed pushing the date to begin work into FY 2024.

**FISCAL YEAR 2024 ACCOMPLISHMENTS**

- TTI conducted a literature review and provided MDOT with a report summarizing their findings in May 2024. The literature review examined: 1) the true cost of bonding; 2) the impacts of inflation on transportation projects; 3) costs related to construction delay; and 4) costs related to increasing user delay.
- As part of the literature review, the team conducted a review of best practices with ten states like Michigan that explored: 1) obligations issued or assumed; 2) change in indebtedness; and 3) receipts and disbursements for debt service. Findings were included in the May 2024 report.
- The research team also conducted a deeper dive with Michigan and three peer states (Ohio, Indiana, and Wisconsin) to compare: 1) the amount obligated; 2) interest rates; 3) timing; 4) debt coverage ratios; and 5) revenue versus general obligation bonds.
- TTI is currently working on comparing debt service costs associated with bonding against 1) increased costs related to delayed construction, including additional maintenance and deterioration (review of typical life cycle costs); 2) user delay costs due to increased congestion over time; and 3) increased cost of inflation (sourcing the Michigan Transportation Construction Price Index and the National Highway Construction Cost Index).

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

This research project sought to define and examine the value of financing infrastructure improvements through bonding versus a program of pay-go improvements for highway construction. This research project was completed in February of 2025 and produced a final research report which included the following results:

- This research project was able to provide an overview of the advantages and disadvantages associated with both bonding and pay-go methods of funding.
- The research delved into the costs and benefits attributed to both funding mechanisms by assessing the costs and benefits of both pay-go and bonding mechanisms, by selecting three Michigan reconstruction projects that were funded using bond proceeds ranging from $41.5 million to $143.1 million. Inflationary and congestion factors were applied to these three projects to illustrate the estimated change in costs, had the project been constructed under a pay-go scenario. Both a 5-year and 10-year delay were examined.
- Additionally, the vendor was able to conduct a review of Michigan and 10 peer states to gain a better understanding of their current debt practices. The review found that Michigan is similar in its debt usage and ranks in the middle of the group about outstanding debt, debt per capita, and debt per lane mile.

- This research project also developed a comparison tool to evaluate the impacts varying economic factors such as coverage ratios, inflation, and interest rates have on both methods of finance.

**JUSTIFICATION(S) FOR REVISION(S)**

There was a change in the MODT Project Manager in the middle of fiscal year 2024. A no-cost-time extension was granted due to delays in the contract award that provides the vendor with the original 21-month project schedule noted in the original project workplan, which provided the time necessary for quality data and analysis that will result in higher quality deliverables for MDOT.

**SUMMARY OF THE IMPLEMENTATION RECOMMENDATION**

The results of this research note the advantages and disadvantages associated with both pay-go and bonding methods of finance. Both methods include factors such as availability of funds and fiscal stability, inflation, population growth, as well as congestion growth rates, to name a few. While there is no one-size fits all answers, understanding how these factors influence the outcomes and when they may be applicable, allows policy makers to make more informed decisions for the future.

Michigan Department
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5312 (2014)

# RESEARCH ADMINISTRATION
# MDOT RESEARCH PROJECT
# ANNUAL REPORT - FISCAL YEAR 2025

PROJECT TITLE: Marketing and Education Budget for Implementation of New Transit Technology

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

PROJECT MANAGER: Vandevender, Sherry

| | | | |
|---|---|---|---|
| CONTRACT/AUTHORIZATION NO. | 2023-0726 | PROJECT START DATE | 11/27/2023 |
| PROJECT NO. | 218403 | COMPLETION DATE (Original) | 8/31/2025 |
| OR NO. | OR23-021 | COMPLETION DATE (Revised) | 11/30/2025 |
| RESEARCH AGENCY | CRAFT | | |
| PRINCIPAL INVESTIGATOR | Ketterl, Mona | | |

**BUDGET STATUS**

| ***FY 2025 Budget** | | **Total Budget** | |
|---|---|---|---|
| Vendor Budget FY 2025 | $213,820.00 | Total Vendor Budget | $295,618.22 |
| MDOT Budget FY 2025 | $6,285.71 | Total MDOT Budget | $2,500.00 |
| Vendor FY 2025 Expenditures | $215,440.67 | Total Budget | $298,118.22 |
| MDOT FY 2025 Expenditures | $0.00 | Total Expenditures | $272,604.07 |
| * Project start was delayed | | **Total Amount Available** | $25,514.15 |

**PURPOSE AND SCOPE**

Transit agencies are introducing new, customer-facing technology such as software and technology systems used in mobile trip planning, ticketing, and payment processing. Meager budgets for marketing and public education result in low adoption of the technology, leading to MDOT-funded investments often being abandoned or under-utilized. There is also a lack of realization of the potential benefits from use of the new technology such as improved customer experience, operating efficiencies, data collection opportunities, increased ridership, and better coordination. This research seeks to determine how to appropriately budget for marketing and education when launching new transit technology, identify best practices for methods to use for marketing and public education regarding new transit technology, and identify the benefit to transit agencies when implementing new marketing and public education technology tools related to transit. This will be accomplished by completing a literature review of best practices for budgeting and marketing related to public transit, investigating current budgeting practices for marketing/education campaigns and marketing standards in used in Michigan and other states, analyzing budgeting and marketing gaps that could be addressed through best practices, identifying best practices and obstacles, and reviewing lessons learned from agencies that recently launched new transit technology.

**FISCAL YEAR 2023 ACCOMPLISHMENTS**

Contracting for this project was delayed pushing the date to begin work into FY 2024.

**FISCAL YEAR 2024 ACCOMPLISHMENTS**

Completed CRAFT project activities for FY24 include:

- Presented on OR23-021 at the Rural Transit Workshop in April 2024. The presentation covered overview of project, preliminary market research, work plan overview, and vision/goals of the project.
- Conducted a literature review of the best practices for budgeting and marketing for public transit. They examined what research exists today, both locally and nationally, to identify top use cases which they could use to evaluate and benchmark. They examined the current state with transit authorities and key barriers to successful adoption, marketing and in consideration of budgeting.
- Conducted workshops between June and July with transit stakeholders to fully investigate current state challenges, opportunities, planning recommendations and validation process for the introduction of new transit technology. Additionally, through the workshops CRAFT was able to develop personas of the agencies (size, location, scope, staffing, budget, current use of tech, etc.), identify the current rider profile, and build persona and user profiles.
- Developed a survey that was distributed through the Office of Passenger Transportation “OPT Weekly” newsletter that is sent out to all transit agencies to identify needs/solutions, transit methods, etc. Received 50 survey responses.
- Presented on OR233-021 at the MPTA Annual Conference in August 2024. Provided sessions on technology, budgeting, and community and partnerships. Also, roundtable discussions were conducted to solicit more formal feedback from rural and urban transit agency stakeholders on challenges with tech adoption.

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

While tools like digital ticketing, scheduling, and trip planning can enhance operations and rider experience, transit agencies often face funding and staffing barriers in adopting these tools. The purpose of this research project is to help Michigan public transit agencies (both small rural and large urban) implement, market, and budget for new technologies with scalable strategies. Project activities completed in FY25 have included the following:

- Task 2: Research and development. Craft performed primary and secondary research literature reviews, interviews with transit agencies and MDOT stakeholders, conducted workshops and field visits, and utilized survey and user polls. Findings included the following:
  - How COVID-19 has reshaped public transit, reducing ridership and revenues.
  - Trends in Michigan's transit systems, identifying key technologies currently in use, and highlighting leading innovations like zero-emission buses and Mobility-as-a-Service (MaaS) models.
  - Identified funding instability, digital divides, and implementation challenges, framing the need for adaptable and well-communicated technology strategies.
- Task 3: Use case and feasibility development. Craft evaluated key uses cases across Michigan and presented five case studies showing how transit agencies integrate technology while balancing human-centered service. Examples include:
  - Allegan County's multilingual communication system
  - Clinton Transit's mobility wallet rollout
  - RCTA and WAVE's technology transition
  - MDOT's GTFS trip planning pilots
  - Flint MTA's clean energy transformation
- Task 4: Strategic guidebook. Based on the research findings Craft developed a practical guidebook structured around five phases:
  - Assessing needs
  - Planning, funding, procuring
  - Implementing and training
  - Marketing and educating
  - Managing and evaluating

**FISCAL YEAR 2026 PROPOSED ACTIVITES**

Anticipated FY26 activities will include the completion of Task 4 and Task 5, which will include the final report.

**JUSTIFICATION(S) FOR REVISION(S)**

None.

**SUMMARY OF THE IMPLEMENTATION RECOMMENDATION**

Project expected completion FY 2026.

Michigan Department
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# RESEARCH ADMINISTRATION
# MDOT RESEARCH PROJECT
# ANNUAL REPORT - FISCAL YEAR 2025

PROJECT TITLE: Optimizing Work Zone Conditions to Maximize Safety and Mobility

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

PROJECT MANAGER: Brink, Steve / Miller, Dawn

| | | | |
|---|---|---|---|
| CONTRACT/AUTHORIZATION NO. | 2023-0498 | PROJECT START DATE | 6/27/2023 |
| PROJECT NO. | 218404 | COMPLETION DATE (Original) | 6/26/2025 |
| OR NO. | OR23-022 | COMPLETION DATE (Revised) | |
| RESEARCH AGENCY | Michigan State University (MSU) | | |
| PRINCIPAL INVESTIGATOR | Gates, Timothy J. | | |

## BUDGET STATUS

| FY 2025 Budget | | Total Budget | |
|---|---|---|---|
| Vendor Budget FY 2025 | $86,629.73 | Total Vendor Budget | $196,477.94 |
| MDOT Budget FY 2025 | $7,750.00 | Total MDOT Budget | $0.00 |
| Vendor FY 2025 Expenditures | $86,492.88 | Total Budget | $196,477.94 |
| MDOT FY 2025 Expenditures | $0.00 | Total Expenditures | $196,341.09 |
| | | **Total Amount Available** | $136.85 |

## PURPOSE AND SCOPE

The purpose of this research is to identify which factors cause some work zones to have fewer crashes and perform better in safety and mobility than others, focusing mitigating crashes occurring within the work zone. The goal is to provide the safest working conditions while providing the best mobility for travelers, as well as identifying the most effective way of spending transportation funds to maximize safety and mobility in future work zones. This will be achieved by determining crash frequency and work zone crash rate by work zone area, providing crash performance of different work zone designs, identifying preferred setups to minimize crash risk, assessing cost effectiveness of different strategies, and determining work zone performance measures.

## FISCAL YEAR 2023 ACCOMPLISHMENTS

Task 1a: Began literature review.
Task 1b: Drafted survey of other states' best practices for work zone safety and mobility.
Task 2b: Drafted survey for polling MDOT regions for work zone screening information for further review.

## FISCAL YEAR 2024 ACCOMPLISHMENTS

Task 1a: Completed literature review. Research Advisory Panel members and PM's feedback ongoing.
Task 1b: Completed and distributed a survey to other states for best practices for work zone safety and mobility. Compiling responses to provide to MDOT for review.
Task 2: National fatal crash data collected and analyzed and provided for MDOT review, awaiting feedback. Analyzed Michigan work zone data and compared it to FARS database. Analysis written and provided to MDOT for review, awaiting feedback. Selected MDOT work zones for review. Reviewed configurations and work zone data. Completing analysis of safety performance within 25 selected MDOT work zones, performing extensive analysis of each.
Task 3: Collected and continue to analyze work zone driver behavioral and operational data for two 'zipper merge' sites. Collected data with and without law enforcement presence. Data is being analyzed.
Task 4: No work performed in FY 2024
Task 5: No work performed in FY 2024

## FISCAL YEAR 2025 ACCOMPLISHMENTS

Task 1a: Finalize synthesis based on feedback.
Task 1b: Finalize data and analysis from other states' agencies. Provide analysis for review then finalize documentation.
Task 2a: Finalize National WZ synthesis based on feedback.
Task 2b: Finalize Michigan WZ synthesis based on feedback.
Task 2c: Complete detailed crash analyses of 25 MDOT work zones and provide report for review; finalize based on comments.
Task 3: Finalize review of driver behavior. Provide driver behavior data for review.
Task 4: Begin and complete findings and cost-effectiveness evaluation.
Task 5: Complete final project report and provide for review. Finalize based on comments.

## JUSTIFICATION(S) FOR REVISION(S)

None.

## SUMMARY OF THE IMPLEMENTATION RECOMMENDATION

Findings from project tasks were aggregated to develop recommendations to optimize safety and mobility within Michigan work zones, including suggestions for incorporation or changes to MDOT's Work Zone Safety and Mobility Manual, a revised Safety & Mobility Decision Tree, and a Microsoft Excel tool. Specific recommendations are outlined in the final project report.

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5312 (2014)

# RESEARCH ADMINISTRATION
# MDOT RESEARCH PROJECT
# ANNUAL REPORT - FISCAL YEAR 2025

PROJECT TITLE: Unmanned Aircraft Systems Communications Mesh Test Deployment

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

PROJECT MANAGER: Bowers, Kenneth; Smith, Linn

| | | | |
|---|---|---|---|
| CONTRACT/AUTHORIZATION NO. | 2023-0679 | PROJECT START DATE | 1/9/2024 |
| PROJECT NO. | 219527 | COMPLETION DATE (Original) | 6/30/2025 |
| OR NO. | OR24-012 | COMPLETION DATE (Revised) | |
| RESEARCH AGENCY | WSP of Michigan | | |
| PRINCIPAL INVESTIGATOR | Wheeler, Paul | | |

## BUDGET STATUS

| *FY 2025 Budget | | Total Budget | |
|---|---|---|---|
| Vendor Budget FY 2025 | $438,575.66 | Total Vendor Budget | $717,907.42 |
| MDOT Budget FY 2025 | $0.00 | Total MDOT Budget | $0.00 |
| Vendor FY 2025 Expenditures | $425,733.47 | Total Budget | $717,907.42 |
| MDOT FY 2025 Expenditures | $0.00 | Total Expenditures | $705,065.23 |
| * Project start was delayed | | **Total Amount Available** | $12,842.19 |

## PURPOSE AND SCOPE

In several deployments of Unmanned Aircraft Systems (UAS) and autonomous ground-based vehicle technology, a gap has been discovered when vehicles are transiting between locations that may have strong 4G/5G cellular communication availability and those locations that may have little. Several new technologies exploring the possibility of a communications mesh network have entered the market and may have strong benefits for a variety of connected and autonomous vehicle (air and ground) applications. This research explores the ability of this technology to support beyond visual line of sight unmanned aircraft deployments and may support ground-based applications as well. The selected team will research and field a test scenario of a communications mesh system in a remote environment, including specific locations over water, on remote islands, or other rural communities.

## FISCAL YEAR 2023 ACCOMPLISHMENTS

Contracting for this project was delayed pushing the date to begin work into FY 2024.

## FISCAL YEAR 2024 ACCOMPLISHMENTS

The research team coordinated the needed Right of Way (ROW) licensing with MDOT experimental license from the Federal Communications Commission (FCC), and prepared a waiver for the Federal Aviation Administration (FAA) which will allow drone pilots to deviate from certain rules under part 107 by demonstrating they can still fly safely using alternative methods beyond the visual line of sight (BVLOS). The research team performed an extensive investigation of potential test site locations, analyzing the strengths, weaknesses, opportunities, and threats (SWOT) of each candidate site. Upon selection of the Lansing location near Canal and Ricks Roads they examined flyable paths in the area which included 21 different criteria (i.e., population, zoning, roadways and traffic monitoring, obstructions, railway, bodies of water, etc.). The research team designed, purchased, and fabricated the needed equipment and modifications for flight testing and installed two roadside units for radio performance trials.

## FISCAL YEAR 2025 ACCOMPLISHMENTS

This research sought to explore the ability of communication mesh technology to support beyond visual line of sight unmanned aircraft deployments and possible support of ground-based applications. This project, which was completed in August of 2025, documented the following discoveries in its final report:

- Testing confirmed that using DSRC and C-V2X mesh-based communication networks can enable reliable communications for BVLOS UAS operations and support multimodal coordination with existing connected vehicle infrastructure. Real-time data transmission and Command, Control, Communicate, Compute, Cyber, Intelligence, Surveillance, Reconnaissance (C5ISR) functionality were successfully demonstrated, validating the core hypothesis of the project.
- Tests also revealed critical deployment considerations, most notably, that communication performance depends heavily on the strategic placement of roadside units (RSUs) due to radio signals' limited range and sensitivity to physical obstructions like terrain, vegetation, and buildings. These findings underscore the importance of environmental awareness and infrastructure optimization when planning for future UAS deployments.
- As transportation owner-operators increasingly deploy these communication systems for ground vehicles, the opportunity grows for shared use between air and surface modes, enhancing coordination, situational awareness, and safety across multimodal transportation networks.
- The project demonstrates that integrating UAS into Michigan’s intelligent transportation systems (ITS) using shared wireless communications infrastructure is both feasible and promising.

| JUSTIFICATION(S) FOR REVISION(S) |
| --- |
| None. |
| **SUMMARY OF THE IMPLEMENTATION RECOMMENDATION** |
| The findings highlight a critical path forward for developing and deploying a unified, scalable mobility ecosystem that incorporates air and ground autonomous systems. While several overlapping federal and state rules can limit or shape a UAS communication mesh deployment, continued research is recommended to expand on these findings, particularly through three dimensional UAS swarm testing and cooperative behavior modeling in dynamic environments. |

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# RESEARCH ADMINISTRATION
# MDOT RESEARCH PROJECT
# ANNUAL REPORT - FISCAL YEAR 2025

PROJECT TITLE: Multi-Objective Decision Analysis and Optimization Model for Transportation Investment Decision-Making at MDOT

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

PROJECT MANAGER: Case, Michael

| | | | |
|---|---|---|---|
| CONTRACT/AUTHORIZATION NO. | 2024-0192 | PROJECT START DATE | 1/30/2024 |
| PROJECT NO. | 219734 | COMPLETION DATE (Original) | 1/30/2026 |
| OR NO. | OR24-004 | COMPLETION DATE (Revised) | |
| RESEARCH AGENCY | Spy Pond Partners, LLC | | |
| PRINCIPAL INVESTIGATOR | Robert, William | | |

**BUDGET STATUS**

| FY 2025 Budget | | Total Budget | |
|---|---|---|---|
| Vendor Budget FY 2025 | $124,613.49 | Total Vendor Budget | $249,226.97 |
| MDOT Budget FY 2025 | $4,964.90 | Total MDOT Budget | $12,544.00 |
| Vendor FY 2025 Expenditures | $97,826.84 | Total Budget | $261,770.97 |
| MDOT FY 2025 Expenditures | $5,070.51 | Total Expenditures | $158,117.05 |
| | | **Total Amount Available** | $103,653.92 |

**PURPOSE AND SCOPE**

Fair and objective resource allocation is key to effective transportation asset management. Despite resource constraints, MDOT must invest in projects that simultaneously improve asset conditions, safety, accessibility, and mobility. To optimize decision-making, it is critical to forecast the short and long-term impacts of these projects on system performance, as well as the trade-offs of deferring investments in other competing areas to a later time. This research project is intended to develop a Multiple Objective Decision Making (MODA) approach and model to advise decision-making for the highway capital program, where available data can be analyzed to prioritize projects by considering multiple agency objectives and trade-offs. Public and private market software that utilize this approach is available and used in a variety of business settings, including by transportation agencies, but vary widely in method. Therefore, it is vital to first understand how these methods differ in their benefits and drawbacks, and how they could improve and integrate with decision-making processes at MDOT. Once a core approach has been established that is consistent with needs and MDOT's mission, a broader decision-making model that addresses the issues outlined above will be developed and tested for potential implementation in the process for prioritizing pavement rehabilitation projects and potentially other asset areas, pending available data and need.

**FISCAL YEAR 2024 ACCOMPLISHMENTS**

Spy Pond has performed the following activities:

- Project management (Task 1) which included:
  - Attended March 13, 2024, a kickoff meeting with the MDOT Research Advisory Panel (RAP). Meeting activities included the review of projects tasks, schedule, milestones, deliverables, and reporting requirements.
  - Attended update meetings on June 17, 2024, and August 12, 2024, with the MDOT RAP to review progress on project tasks and project timeline.
  - Complete quarterly progress reports for research administration.
- Submitted to MDOT a Technical Memo 1 on best practices/applications of MODA based on research in the field as well as interviews with agencies that have implemented a similar process (Task 2). The memo examined what similarities and differences with the approach between five agencies (Caltrans, North Carolina DOT, Texas DOT, Vermont DOT, and Pennsylvania DOT). including asset types, it applies to, goals and objectives, and analytical approaches. The findings were summarized and compared against MDOT's existing project identification process to identify a recommendation for an initial approach to MODA that will best fit the readiness to apply it.
- Began coordinating MDOT working groups (Task 3) to identify the objectives and goals needed to guide the development of subobjectives and measures for prioritizing MDOT's Transportation Asset Management (TAM) using MODA. The working groups will work to define goals and objectives, select performance measures and evaluate criteria, assess data and analytical capabilities and evaluate existing solutions.

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

Spy Pond, with feedback from the Research Advisory Panel developed for the project, has completed the following tasks and deliverables:

- Project management (Task 1) which included: (1) Attended quarterly update meetings with the MDOT RAP to review progress on project tasks and project timeline; (2) Submitted quarterly progress reports for research administration; and (3) Submitted routine invoices for payment.
- Develop Best Practices and Applications of MODA Methods (Task 2). This involved researching best practices and implementation examples of performing resource allocation using MODA, Multiple Criteria Decision Analysis (MCDA), Multiple

Criteria Decision Management (MCDM), and other multi-objective decision-making methods. Research findings were provided to the MDOT RAP in Technical Memoranda 1.

- Completed the MDOT working groups (Task 3) to identify the requirements needed to develop an approach for prioritizing MDOT's Transportation Asset Management (TAM) using MODA. This approach was thoroughly detailed and provided to the MDOT RAP in Technical Memoranda 2. Working groups that met included: (1) Pavement Group - October 8, 2024; (2) Mobility Group - October 23, 2024; and (3) Safety Group – October 24, 2024.
- Developed a requirements summary for the prototype model using the approach detailed in the previous task (Task 4) with sample data obtained from MDOT for testing. The results of the data used, and the priorities generated through the process are being documented in a "State of Practice" report.
- Begin documentation on a base model (Task 5) that will incorporate the results from the prototyping, extend to the full prioritization process, and include a sensitivity analysis. A MDOT weighting workshop was developed to refine the prototype and prepare the base model. The workshop tasks included the development of handouts to ensure understanding of MODA approach, as well as materials for implementation of hybrid approach.

**FISCAL YEAR 2026 PROPOSED ACTIVITES**

Anticipated FY26 activities will include the completion of Task 4 and Task 5 which will include developing and testing a base model that includes refinements to the prototyped model and the submittal of a final "State of Practice" Report including materials from the technical memoranda 1 and 2 reports and incorporating comments on these deliverables provided by MDOT.

**JUSTIFICATION(S) FOR REVISION(S)**

None.

**SUMMARY OF THE IMPLEMENTATION RECOMMENDATION**

Project expected completion FY 2026.

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# RESEARCH ADMINISTRATION
# MDOT RESEARCH PROJECT
# ANNUAL REPORT - FISCAL YEAR 2025

PROJECT TITLE: Digital Process Methods and Implementations for Field Applications

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

PROJECT MANAGER: Douglas, Scott

| | | | |
|---|---|---|---|
| CONTRACT/AUTHORIZATION NO. | 2025-0229 | PROJECT START DATE | 3/26/2025 |
| PROJECT NO. | 219736 | COMPLETION DATE (Original) | 3/25/2027 |
| OR NO. | OR24-009 | COMPLETION DATE (Revised) | |
| RESEARCH AGENCY | CRAFT | | |
| PRINCIPAL INVESTIGATOR | Mona Ketterl | | |

**BUDGET STATUS**

| FY 2025 Budget | | Total Budget | |
|---|---|---|---|
| Vendor Budget FY 2025 | $121,086.48 | Total Vendor Budget | $332,898.13 |
| MDOT Budget FY 2025 | $25,747.50 | Total MDOT Budget | $59,330.00 |
| Vendor FY 2025 Expenditures | $0.00 | Total Budget | $392,228.13 |
| MDOT FY 2025 Expenditures | $0.00 | Total Expenditures | $0.00 |
| | | **Total Amount Available** | $392,228.13 |

**PURPOSE AND SCOPE**

Static information created by siloed production methods can lead to duplication of effort and lack of connectivity between phases as information is passed between survey, design, construction, and asset management. In addition, not utilizing effective change management strategies to update processes and train staff can slow progress in adoption of new digital processes and approaches. This research will build on previously completed research to investigate and provide actionable methods and change management strategies for utilizing digital processes and technology for construction field applications. This research will identify and present strategies for streamlining processes for construction including but not limited to, equipment procurement, staff training, integration of tools, and digital inspection methods.

**FISCAL YEAR 2024 ACCOMPLISHMENTS**

Contracting for the project was delayed into the next fiscal year (FY).

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

A kickoff meeting was held and contracting was finalized. Stakeholder engagement meetings were initiated and the risk assessment report and matrix, and data mapping, began.

**FISCAL YEAR 2026 PROPOSED ACTIVITES**

Coordination of remaining Stakeholder engagements and Data maps is expected, along with compiling results for creating a risk and opportunity matrix while working through the six tasks of the project. Meetings are expected throughout the next fiscal year.

**JUSTIFICATION(S) FOR REVISION(S)**

None.

**SUMMARY OF THE IMPLEMENTATION RECOMMENDATION**

Project expected completion FY 2027.

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5312 (2014)

# RESEARCH ADMINISTRATION
# MDOT RESEARCH PROJECT
# ANNUAL REPORT - FISCAL YEAR 2025

PROJECT TITLE: Enhance Bridge Image Attribution Through Automated Post Image Processing

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

PROJECT MANAGER: Armour, Jacob

| | | | |
|---|---|---|---|
| CONTRACT/AUTHORIZATION NO. | 2022-0434 Z7 | PROJECT START DATE | 9/1/2024 |
| PROJECT NO. | 219771 | COMPLETION DATE (Original) | 2/28/2026 |
| OR NO. | OR24-008 | COMPLETION DATE (Revised) | |
| RESEARCH AGENCY | Western Michigan University (WMU) | | |
| PRINCIPAL INVESTIGATOR | Attanayake, Upul B. | | |

## BUDGET STATUS

| FY 2025 Budget | | Total Budget | |
|---|---|---|---|
| Vendor Budget FY 2025 | $117,709.72 | Total Vendor Budget | $140,900.77 |
| MDOT Budget FY 2025 | $23,760.00 | Total MDOT Budget | $10,000.00 |
| Vendor FY 2025 Expenditures | $70,155.57 | Total Budget | $150,900.77 |
| MDOT FY 2025 Expenditures | $0.00 | Total Expenditures | $70,155.57 |
| | | **Total Amount Available** | $80,745.20 |

## PURPOSE AND SCOPE

MDOT currently captures images with every bridge inspection. These images contain bridge components including decks, barrier walls and piers or they could contain defects and other areas of interest on the bridge. They may also contain load posting signs or traffic control devices. These images are only able to have one attribute indicating what the image contains. This one image description limits the rich data potential these images may truly contain. With more meaningful information on each image, MDOT has an opportunity to utilize more imagery in a more efficient manner to make asset management decisions on our network.

## FISCAL YEAR 2024 ACCOMPLISHMENTS

The kickoff meeting was held, and the research team began reviewing available tools that could be used to analyze MDOT's bridge images. The capabilities and limitations of several tools including Bentley's Blyncsy and YOLOv8 were reviewed. The Port Authority of New York and New Jersey, City of Plano, Alaska DOT, Hawaii DOT, and New York City DOT have completed or have on-going projects utilizing Bentley's Blyncsy. We will continue to follow up with such projects to learn from their experience. Data sharing agreements were started and are set to be finalized before MDOT data is shared. WMU confirmed no costs hit their accounting before the fiscal year-end deadline.

## FISCAL YEAR 2025 ACCOMPLISHMENTS

WMU has been analyzing the bridge inspection imagery from MDOT. These images have been utilized to apply attribution to them as necessary. Analysis of this imagery using a preconfigured tool has been done and then it has been used for analysis and comparison against other commercially available tools.

## FISCAL YEAR 2026 PROPOSED ACTIVITES

Researchers will finish their analysis this fiscal year. WMU's analysis is expected to provide recommended requirements on what MDOT should look for in an image attribution tool. A set of images to compare and train models on is also expected to be developed and provided as part of the project.

## JUSTIFICATION(S) FOR REVISION(S)

None.

## SUMMARY OF THE IMPLEMENTATION RECOMMENDATION

Project expected completion FY 2026.

Michigan Department
Of Transportation
5312 (2014)

# RESEARCH ADMINISTRATION
# MDOT RESEARCH PROJECT
# ANNUAL REPORT - FISCAL YEAR 2025

PROJECT TITLE: Safety Effectiveness of Non-Freeway Sinusoidal Shoulder Corrugations

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

PROJECT MANAGER: Bramble, Mary

| | | | |
|---|---|---|---|
| CONTRACT/AUTHORIZATION NO. | 2024-0232 | PROJECT START DATE | 4/24/2024 |
| PROJECT NO. | 220847 | COMPLETION DATE (Original) | 4/24/2026 |
| OR NO. | OR24-006 | COMPLETION DATE (Revised) | |
| RESEARCH AGENCY | Michigan State University (MSU) | | |
| PRINCIPAL INVESTIGATOR | Gates, Tim | | |

**BUDGET STATUS**

| FY 2025 Budget | | Total Budget | |
|---|---|---|---|
| Vendor Budget FY 2025 | $130,768.15 | Total Vendor Budget | $264,706.18 |
| MDOT Budget FY 2025 | $16,500.00 | Total MDOT Budget | $11,507.00 |
| Vendor FY 2025 Expenditures | $90,523.37 | Total Budget | $276,213.18 |
| MDOT FY 2025 Expenditures | $354.82 | Total Expenditures | $96,382.01 |
| | | **Total Amount Available** | $179,831.17 |

**PURPOSE AND SCOPE**

MDOT needs to determine the safety effectiveness of a newer design of rumble strips (called sinusoidal or "mumble" strips). To date no crash modification factors (CMFs) have been developed for mumble strips, and there have been no safety or vibration and limited noise comparisons done between traditional rumble strips and the mumble strips for motorized or nonmotorized travelers (bicyclists). Most installations of mumble strips are not at new locations, but rather traditional rumble strips have been in place and are being replaced with mumble strips. However, we have an opportunity in Michigan as we have several hundred miles of mumble strips placed where there were no previous strips.

**FISCAL YEAR 2024 ACCOMPLISHMENTS**

The research team started their Literature Review. The team also began collecting and analyzing historical data. MSU settled on locations and obtained the necessary equipment for noise and vibration field data collection and were able to collect data utilizing both a minivan and an MDOT snowplow truck. The team also worked with MDOT to recruit motorcyclists and bicyclists for future participation.

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

Motorcyclist vibration data collection is planned for spring of 2025. The bicyclist stability and comfort study is proposed for May 2025. The research team will also analyze data from noise and vibration field evaluation to present to the MDOT RAP, and continue to assemble database of MDOT sinusoidal rumble strip locations, roadway inventory data, traffic volume data, and traffic crash data.

**FISCAL YEAR 2026 PROPOSED ACTIVITES**

Continued data analysis is expected during FY 2026. This will include data from the bicyclist field study, a nationwide bicyclist survey, and motorcyclist survey with preparation of manuscripts on methods and findings. MDOT will be provided with discrepancies in rumble strip installation information for further clarification once the Street View validation task is complete. The database of MDOT sinusoidal rumble strip locations, roadway inventory data, traffic volumes, and crash data will be finalized. The highway safety performance analysis for sinusoidal rumble strips will also begin.

**JUSTIFICATION(S) FOR REVISION(S)**

While the contract did not require modification, MDOT approved a shift in budget during FY 2024 to correct MSU's Indirect Cost Rate and shift the overage from that to cover additional costs on equipment beyond what was originally expected.

**SUMMARY OF THE IMPLEMENTATION RECOMMENDATION**

Project expected completion FY 2026.

Michigan Department
Of Transportation
5312 (2014)

# RESEARCH ADMINISTRATION
# MDOT RESEARCH PROJECT
# ANNUAL REPORT - FISCAL YEAR 2025

PROJECT TITLE: Covid and Traffic Crashes/Impact on Safety Targets

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

PROJECT MANAGER: McQuiston, Carissa

| | | | |
|---|---|---|---|
| CONTRACT/AUTHORIZATION NO. | 2024-0558 | PROJECT START DATE | 5/15/2024 |
| PROJECT NO. | 220848 | COMPLETION DATE (Original) | 5/14/2026 |
| OR NO. | OR24-007 | COMPLETION DATE (Revised) | |
| RESEARCH AGENCY | Michigan State University (MSU) | | |
| PRINCIPAL INVESTIGATOR | Savolainen, Peter | | |

## BUDGET STATUS

| FY 2025 Budget | | Total Budget | |
|---|---|---|---|
| Vendor Budget FY 2025 | $141,113.86 | Total Vendor Budget | $310,589.63 |
| MDOT Budget FY 2025 | $628.80 | Total MDOT Budget | $2,096.00 |
| Vendor FY 2025 Expenditures | $187,268.55 | Total Budget | $312,685.63 |
| MDOT FY 2025 Expenditures | $0.00 | Total Expenditures | $196,933.47 |
| | | **Total Amount Available** | $115,752.16 |

## PURPOSE AND SCOPE

This project will conduct a comprehensive before-after safety analysis to better understand what factors may have driven the increase in fatalities and serious injuries since the COVID-19 pandemic. The researcher will assist MDOT in determining suitable strategies and countermeasures to revert the negative safety-trends and set future safety performance targets.

## FISCAL YEAR 2024 ACCOMPLISHMENTS

The researcher has completed a draft Literature Review related to COVID-19 and its impact on crashes, injuries, and fatalities. Collected data relating to state DOT targets/goals, and how these goals were impacted by the pandemic.

Developed a draft set of questions for the State of the State Survey. These questions will be sent to the Research Advisory Panel (RAP) members for review. Data collection activity is underway. The research team is assembling an extensive state and county level dataset for the purpose of a state-by-state comparison of travel and fatality trends, as well as for Michigan at the roadway and crash level.

## FISCAL YEAR 2025 ACCOMPLISHMENTS

Data and safety analysis activities continued in FY25.

## FISCAL YEAR 2026 PROPOSED ACTIVITES

Countermeasures and strategies will be identified, and project meetings/updates will be held with the RAP.

## JUSTIFICATION(S) FOR REVISION(S)

None.

## SUMMARY OF THE IMPLEMENTATION RECOMMENDATION

Project expected completion FY 2026.

Michigan Department
Of Transportation
5312 (2014)

# RESEARCH ADMINISTRATION
# MDOT RESEARCH PROJECT
# ANNUAL REPORT - FISCAL YEAR 2025

PROJECT TITLE: Replacement of Outside Beams on Adjacent Box-Beam Structures

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

PROJECT MANAGER: Zakrzewski, Brian

| | | | |
|---|---|---|---|
| CONTRACT/AUTHORIZATION NO. | 2025-0206 | PROJECT START DATE | 1/21/2025 |
| PROJECT NO. | 221858 | COMPLETION DATE (Original) | 1/21/2027 |
| OR NO. | OR25-004 | COMPLETION DATE (Revised) | |
| RESEARCH AGENCY | Lawrence Technological University (LTU) | | |
| PRINCIPAL INVESTIGATOR | Grace, Nabil | | |

**BUDGET STATUS**

| FY 2025 Budget | | Total Budget | |
|---|---|---|---|
| Vendor Budget FY 2025 | $157,537.30 | Total Vendor Budget | $350,905.19 |
| MDOT Budget FY 2025 | $13,200.00 | Total MDOT Budget | $26,400.00 |
| Vendor FY 2025 Expenditures | $18,020.90 | Total Budget | $377,305.19 |
| MDOT FY 2025 Expenditures | $0.00 | Total Expenditures | $18,020.90 |
| | | **Total Amount Available** | $359,284.29 |

**PURPOSE AND SCOPE**

The design and construction of precast, prestressed concrete side-by-side box-beam bridges became popular in Michigan in the mid 50's mainly due to their ease and speed of construction. In recent years, the preference for specifying this bridge type has declined significantly due to various performance issues. Durability, inspection, and sustainability of this bridge type have become a concern. Surface water leaking through the cracked longitudinal joints into the shear keys leads to concealed corrosion of reinforcement as well as prestressing strands along the beam sides. The corrosion activity remains concealed until cracking, delamination, or spalling occurs. Often fascia and second beams have significant deterioration due to a combined action of material response to exposure conditions and moisture. With this background, there are numerous adjacent box-beam structures with significantly deteriorated fascia, and in some cases second-line, beams that may benefit from replacement of beams. Additionally, removing and re-installing transverse post tensioning, both tensioned non-grouted steel rods and grouted post tensioned steel cables, can be a concern. The primary area of focus for this project will be on assessing and determining best practices for addressing the deterioration (repair/replacement) of these outside beams.

THE MAJOR TASKS TO ACCOMPLISH THE RESEARCH OBJECTIVES:

1. Map and quantify the extent of the problem in Michigan.
2. Identify a representative sample set including Local Agency owned and MDOT owned structures that show signs of fascia beam deterioration and conduct assessments of these structures based on drawings of record and inspection records.
3. Conduct site visits on a subset of the representative sample set to further understand the site conditions of these structures including deck drainage conditions, and the current levels of beam distress.
4. Review state-of-the-art and practice literature to document inspection practices, structural integrity evaluation methods, load capacity assessment methods, drainage solutions, repair/replacement decision-making, and replacement procedures and techniques.
5. Review and identify best-practices utilized by other states dealing with the replacement of outside beams and replacing the transverse post-tensioning on adjacent box-beam structures.
6. Develop decision making procedures that MDOT and Local Agency bridge owners can apply to determine the best improvement strategy for a structure and guidelines for the selection of beam repair and replacement construction alternatives including the replacement of transverse post-tensioning.
7. Analyze data collected and report findings including: distress types, assessment results and their impact on load capacity, asset management decision-making procedures, viable construction techniques.

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

Project kickoff occurred with opportunities for the LTU to observe several locations and begin data collection.

**FISCAL YEAR 2026 PROPOSED ACTIVITES**

Work will continue on data collection and analysis, which will require site visits. It is expected that detailed development will begin next fiscal year.

| JUSTIFICATION(S) FOR REVISION(S) |
| --- |
| None. |
| **SUMMARY OF THE IMPLEMENTATION RECOMMENDATION** |
| Project expected completion FY 2027. |

Michigan Department
Of Transportation
5312 (2014)

# RESEARCH ADMINISTRATION
# MDOT RESEARCH PROJECT
# ANNUAL REPORT - FISCAL YEAR 2025

PROJECT TITLE: Evaluation Model for Equitable Prioritization of Bridge Investments

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

PROJECT MANAGER: Phaneuf, Heidi and Dowswell, Lindsey

| | | | |
|---|---|---|---|
| CONTRACT/AUTHORIZATION NO. | 2025-0228 | PROJECT START DATE | 2/5/2025 |
| PROJECT NO. | 221863 | COMPLETION DATE (Original) | 2/4/2027 |
| OR NO. | OR25-008 | COMPLETION DATE (Revised) | |
| RESEARCH AGENCY | Michigan State University (MSU) | | |
| PRINCIPAL INVESTIGATOR | Zockaie, Ali | | |

## BUDGET STATUS

| FY 2025 Budget | | Total Budget | |
|---|---|---|---|
| Vendor Budget FY 2025 | $92,258.92 | Total Vendor Budget | $248,952.69 |
| MDOT Budget FY 2025 | $9,225.00 | Total MDOT Budget | $15,375.00 |
| Vendor FY 2025 Expenditures | $70,584.51 | Total Budget | $264,327.69 |
| MDOT FY 2025 Expenditures | $24,600.00 | Total Expenditures | $95,184.51 |
| | | **Total Amount Available** | $169,143.18 |

## PURPOSE AND SCOPE

After two decades of consistent improvements in bridge condition, inflation combined with an aging bridge inventory has exceeded available resources. As bridges deteriorate, owners must take action to maintain public safety by repairing structures, reducing allowable loads, or closing bridges. Restricting bridge traffic can greatly disrupt the economic viability of a community. Closed bridges can increase travel distance to jobs, schools, grocery stores, medical facilities, and other essential destinations, increase emergency response times, and pose challenges for non-motorized access across transportation barriers. Additionally, restricting traffic and bridge closures can lead to greater distances traveled, congestion, and increased emissions. Because bridges are relatively long-lived structures, the number of projects that can be performed each year is constrained by available funding, evaluation models for project selection need to balance the immediate needs of the overall bridge inventory with the potential future needs of bridges that have a higher socio-economic impact. Current MDOT bridge maintenance practices utilize a mix-of-fixes strategy to prioritize addressing bridges with critical needs, reduce risks such as unmitigated scour critical bridges, and achieve the greatest state of good repair for the trunkline network over a 10-year timeframe as defined in the Transportation Asset Management Plan. As the potential for permanent closures increases with the projected severe decline in bridge conditions, there is a need to extend this analysis of bridges to a 30-year timeframe and to incorporate fairness, risk, social, and economic factors.

THE MAJOR TASKS TO ACCOMPLISH THE RESEARCH OBJECTIVES

1. Literature review.
2. Review and evaluate the existing bridge posting/closure prediction tool.
3. Make recommendations for improvement based on best practices.
4. Identify quantitative and qualitative data sources (and data gaps) for potential inclusion in updated data analysis.
5. Engage partners (including at least one small Metropolitan Planning Organization (MPO), one Transportation Management Association (TMA), one Regional Planning Agency (RPA), and FHWA) for feedback on preliminary analysis methodology and factors, and key project milestones.
6. Prepare interim report for panel approval on items 1-5 prior to proceeding to task 7.
7. Combine data sets and analysis results to create bridge prioritization evaluation model.
8. Expand on the bridge prioritization model developed in step 7 to support bridge project selection.
9. Prepare final deliverables.

## FISCAL YEAR 2025 ACCOMPLISHMENTS

FY 2025 Accomplishments included:

- Literature review of bridge equity and prioritization practices.
- Developed and implemented a survey of other state DOTs and some MPOs to see how other states and MPOs are prioritizing bridge investments.
- Reviewed MDOT current practices and our pilot research project for bridge investment analysis.

## FISCAL YEAR 2026 PROPOSED ACTIVITES

Proposed FY 2026 Activities include the following: 1) develop a preliminary prioritization model based on research from year 1 reviews, 2) Gather feedback on the draft model, 3) begin conversations with key partners in transportation planning (MPOs, RPAs, FHWA, the Federal Transit Administration (FTA), and other local partners), and 4) evaluate responses on national survey and incorporate feedback into proposed model.

| JUSTIFICATION(S) FOR REVISION(S) |
| --- |
| None. |
| **SUMMARY OF THE IMPLEMENTATION RECOMMENDATION** |
| Project expected completion FY 2027. |

Michigan Department
Of Transportation
5312 (2014)

# RESEARCH ADMINISTRATION
# MDOT RESEARCH PROJECT
# ANNUAL REPORT - FISCAL YEAR 2025

PROJECT TITLE: Spun Concrete Poles: Guidelines for Fabrication, Condition Assessment, Repair, and Replacement

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

PROJECT MANAGER: O'Neill, Michelle

| | | | |
|---|---|---|---|
| CONTRACT/AUTHORIZATION NO. | 2025-0360 | PROJECT START DATE | 4/10/2025 |
| PROJECT NO. | 221864 | COMPLETION DATE (Original) | 11/30/2026 |
| OR NO. | OR25-014 | COMPLETION DATE (Revised) | |
| RESEARCH AGENCY | Michigan Technological University (MTU) | | |
| PRINCIPAL INVESTIGATOR | Darestani | | |

## BUDGET STATUS

| FY 2025 Budget | | Total Budget | |
|---|---|---|---|
| Vendor Budget FY 2025 | $98,139.65 | Total Vendor Budget | $176,022.01 |
| MDOT Budget FY 2025 | $5,760.00 | Total MDOT Budget | $19,200.00 |
| Vendor FY 2025 Expenditures | $36,743.39 | Total Budget | $195,222.01 |
| MDOT FY 2025 Expenditures | $3,761.11 | Total Expenditures | $40,504.50 |
| | | **Total Amount Available** | $154,717.51 |

## PURPOSE AND SCOPE

As per the Appendix A of the Michigan Ancillary Structure Inspection Manual (MiASIM), Spun Concrete Poles (SCPs) are "high mast prestressed precast concrete poles used to support ITS [Intelligent Transportations System] infrastructure such as cameras and radar detectors." The Michigan Department of Transportation (MDOT) is managing more than 300 poles with ITS infrastructure. Cracking and deterioration documented during field inspections highlight the need for developing guidelines and recommendations for fabrication quality improvement, condition assessment, and supporting repair and replacement decisions.

THE MAJOR TASKS TO ACCOMPLISH THE RESEARCH OBJECTIVES:
1. Perform literature review. Review industry best practices and specifications for the fabrication and handling of spun concrete poles. Synthesize and propose construction specifications updates for MDOT.
2. Evaluate the actual design life of spun concrete poles. Analyze existing structure condition and age-related data. Review MDOT's current condition assessment procedures in the MiASIM and propose updates using the research data to guide the field condition rating assessment. Provide a deterioration/performance curve based on historic condition data provided by MDOT.
3. Develop a capacity analysis and determine the load capacity recommendations for in service poles incorporating common deficiencies and varying levels of deterioration.
4. Develop maintenance repair recommendations and procedures for in services poles of various levels of deterioration.
5. Develop recommendations associated with specific types of deterioration to the Request for Action (RFA) procedures in the MiASIM. Identify the key levels of deterioration which would warrant the three levels of RFA's. Propose updates to the MiASIM condition state tables for spun concrete poles.

## FISCAL YEAR 2025 ACCOMPLISHMENTS

The team held a kickoff meeting and one update meeting.
Tasks completed in FY 2025 include:

- Completed literature review.
- Developed the framework to assess cracking and bending moment capacity of spun concrete poles.
  - Created a MS Excel datasheet to perform the Monte Carlo simulation to determine the ultimate bending capacity of spun poles; draft will be presented to the MDOT team in November 2025.
  - Created a Sequential Monte Carlo simulation for thermal cracking evaluation.
- Began developing the framework of Non-Destructive Testing to determine corrosion rate in spun poles and time dependent capacity models.
  - Task started in FY 2025 and will continue into FY 2026.
  - Received a sample spun pole from MDOT in lab and began initial testing.
  - Used lab data to calibrate models.

## FISCAL YEAR 2026 PROPOSED ACTIVITES

Tasks that were initiated in FY 2025 will continue into FY 2026 along with the final four tasks. Work on the time-dependent capacity curves, interim report, results from data analysis, and remaining draft final deliverables are expected.

| JUSTIFICATION(S) FOR REVISION(S) |
| --- |
| None. |
| **SUMMARY OF THE IMPLEMENTATION RECOMMENDATION** |
| Project expected completion FY 2027. |

Michigan Department
Of Transportation
5312 (2014)

# RESEARCH ADMINISTRATION
# MDOT RESEARCH PROJECT
# ANNUAL REPORT - FISCAL YEAR 2025

PROJECT TITLE: Evaluation of Digital Speed Limit Signs in Work Zones

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

PROJECT MANAGER: Hoffman, Sarah

| | | | |
|---|---|---|---|
| CONTRACT/AUTHORIZATION NO. | 2025-0430 | PROJECT START DATE | 5/5/2025 |
| PROJECT NO. | 221865 | COMPLETION DATE (Original) | 4/30/2027 |
| OR NO. | OR25-017 | COMPLETION DATE (Revised) | |
| RESEARCH AGENCY | Michigan State University (MSU) | | |
| PRINCIPAL INVESTIGATOR | Gates, Timothy | | |

**BUDGET STATUS**

| FY 2025 Budget | | Total Budget | |
|---|---|---|---|
| Vendor Budget FY 2025 | $69,488.38 | Total Vendor Budget | $193,797.45 |
| MDOT Budget FY 2025 | $2,500.00 | Total MDOT Budget | $12,000.00 |
| Vendor FY 2025 Expenditures | $0.00 | Total Budget | $205,797.45 |
| MDOT FY 2025 Expenditures | $974.99 | Total Expenditures | $974.99 |
| | | **Total Amount Available** | $204,822.46 |

**PURPOSE AND SCOPE**

Digital Speed Limit signs (DSLs) have been implemented in a restricted number of MDOT freeway work zone locations with 60/45 (mph) “WHERE WORKERS PRESENT” (WWP) speed limits. DSLs allow for the speed limit to be displayed on a digital panel, which may be modified based on worker presence at the location, providing an advantage over the traditional 60/45 WWP signs by removing the ambiguity regarding the speed limit in place at that time and location. Preliminary testing of the DSLs has identified challenges related to the manual changing of the displayed speed limit, such as signs being left in the wrong speed limit status, with the potential to cause confusion for drivers or potential unsafe situations for workers. Issues with incorrect manual setting of the speed limit may be remediated with proximity (mobile on-person at location) sensors that would change the digital speed limit display automatically based on worker presence. Research is needed to determine the appropriate worker proximity sensor settings to activate/deactivate the 45 mph WWP display, understand DSLs impact on driver behavior and travel speed through the work zones under various conditions as compared to standard static 60/45 WWP signage. Also, additional research would help in determining the appropriate placement, spacing, and duration of placement of the DSLs for the highest rate of work zone speed limit compliance.

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

This project started in late FY 2025. A project kickoff was held and approximately 15% of work activities were accomplished by fiscal year-end.

**JUSTIFICATION(S) FOR REVISION(S)**

None.

**SUMMARY OF THE IMPLEMENTATION RECOMMENDATION**

Project expected completion FY 2027.

Michigan Department
Of Transportation
5312 (2014)

# RESEARCH ADMINISTRATION
# MDOT RESEARCH PROJECT
# ANNUAL REPORT - FISCAL YEAR 2025

PROJECT TITLE: Evaluation of Roadsoft and the Modernization Data Exchange and Migration

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

PROJECT MANAGER: Reynolds, Michael

| | | | |
|---|---|---|---|
| CONTRACT/AUTHORIZATION NO. | 2025-0308 | PROJECT START DATE | 4/1/2025 |
| PROJECT NO. | 221866 | COMPLETION DATE (Original) | 9/30/2026 |
| OR NO. | OR25-013 | COMPLETION DATE (Revised) | |
| RESEARCH AGENCY | Michigan Technological University (MTU) | | |
| PRINCIPAL INVESTIGATOR | Colling | | |

**BUDGET STATUS**

| FY 2025 Budget | | Total Budget | |
|---|---|---|---|
| Vendor Budget FY 2025 | $55,164.92 | Total Vendor Budget | $128,409.57 |
| MDOT Budget FY 2025 | $5,800.00 | Total MDOT Budget | $17,400.00 |
| Vendor FY 2025 Expenditures | $29,861.47 | Total Budget | $145,809.57 |
| MDOT FY 2025 Expenditures | $4,294.70 | Total Expenditures | $34,156.17 |
| | | **Total Amount Available** | $111,653.40 |

**PURPOSE AND SCOPE**

Roadsoft is a software tool designed for local transportation agencies in the State of Michigan. Roadsoft is used for asset management, traffic, and safety analysis. Roadsoft uses the Michigan Department of Transportation's (MDOT) federally required All Road Network of Linear Referenced Data (ARNOLD) as its Geographic information System (GIS) map base with events provided by MDOT's ESRI Roads & Highway (R&H) software system. Several years ago, the department upgraded to Esri R&H software to manage our roadway data and as a result we found we had to rebuild how the roadway deliverables were created and distributed to Roadsoft to ensure compatible data transfer. MDOT and our partners have had to create complex models and data transformation techniques to accommodate these legacy methodologies, of which the long-term sustainability has always been a concern. These models and techniques have proven costly in both resource requirements and lengthy downtime, to process for MDOT and Roadsoft. They also contain risk due to key person dependencies that may prevent the process from occurring in the future and a lack of documentation and knowledge sharing of current processes. The purpose of the research is to evaluate new technologies and processes that can reduce single source dependencies, streamline services, and decrease turnaround time in a resource-effective manner.

LIST OF THE MAJOR TASKS TO ACCOMPLISH THE RESEARCH OBJECTIVES:

- Task 1: Determine a list of migration use cases that exist and evaluate what behavior sets of migration are needed.
  - Assess the current utilization of Roadsoft to identify areas for improvement in the migration of R&H data.
  - Research and evaluate possible transfer tools or services able to connect directly between MDOT R&H and Roadsoft.
  - Identify and analyze possible alternatives on how Roadsoft could consume the R&H data in a much-timelier, efficient, and simpler manner than the present process.
  - Research needs links, point ID's, and their relationship to migration.
  - Research methodologies to improve the timeliness and efficiency of the overall process.
- Task 2: Determine collaborative processes and evaluate the options.
  - Research different strategies for sharing data that avoid creating high-risk single-source dependencies.
  - Develop recommendations on how to reduce single source dependencies.
  - Develop hour/effort estimates on task lengths to reduce time.
- Task 3: Pilot testing of solutions to meet the objectives with performance metrics.
  - Explore the utilization of existing commercial off-the-shelf (COTS) solutions in addressing process improvement.
  - Ensure the maintained functionality of the current Roadsoft. using web-based interface.
- Task 4: Investigate and document recommended changes that are needed to the Roadsoft software engine and code to achieve the recommended solution(s).

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

The kickoff meeting was held April 17, 2025, where the MDOT RAP, MTU, and Esri research teams discussed project objectives and tasks. Since then, monthly work meetings were held to achieve the following:

- Task 1: Completed documentation of the Current Migration Process. MTU and the MDOT team have collaborated to document Roadsoft's framework migration process which includes:
  - Estimate of the quantity of each type of user data, its source, other users of each data type, and description of key migration issues associated with each data type.

- Outline of pain points in the Roadsoft framework migration process identifying items which impact data quality, including impacts to accuracy and data loss, calendar time, and labor.
- Listing of all data products completed for the Roadsoft migration from MDOT and an outline of pain points for developing these products, identifying which steps are most troublesome from a calendar time and labor standpoint.

- Task 2: Research Alternatives in-person workshop was held August 5-6, 2025, between staff from MDOT, MTU, and Esri.
  - The workshop provided opportunities for team members to share updates, clarify roles, and discuss integration between MDOT's Roadsoft platform and Esri's technology.
  - Esri presented its tools and data management capabilities, while MTU explained Roadsoft's structure and functionality.
  - The workshop was an important step toward aligning technical objectives and identifying practical approaches to data migration and modernization.

**FISCAL YEAR 2026 PROPOSED ACTIVITES**

In FY26 the MDOT RAP and MTU and Esri research teams anticipate the completion of Task 2, Task 3 pilot testing, and Task 4 to prepare a final report for the project that includes all task activities and recommendations on next steps covering the following:

- Implementation timeline for any necessary Roadsoft modification necessary for each option.
- Results of tested alternatives including benchmarking scores.
- An evaluation of the recommended option(s) impact (reduce, increase, or remain the same) on the migration process including an assessment of the overall the impact of calendar time and staff time from RH validation of version to Roadsoft release.
- A list of any additional software/services/hardware-server support required and an estimate of their associated cost.
- Timeline estimates include hours and costs of recommended implementation plans.

**JUSTIFICATION(S) FOR REVISION(S)**

None.

**SUMMARY OF THE IMPLEMENTATION RECOMMENDATION**

Project expected completion FY 2026.

Michigan Department
Of Transportation
5312 (2014)

# RESEARCH ADMINISTRATION
# MDOT RESEARCH PROJECT
# ANNUAL REPORT - FISCAL YEAR 2025

PROJECT TITLE: Improve MDOT's Understanding of the Acceptance and Performance of Riprap

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

PROJECT MANAGER: Snook, Ryan

| | | | |
|---|---|---|---|
| CONTRACT/AUTHORIZATION NO. | To be determined | PROJECT START DATE | 12/1/2025 |
| PROJECT NO. | 221867 | COMPLETION DATE (Original) | 2/28/2028 |
| OR NO. | OR25-016 | COMPLETION DATE (Revised) | |
| RESEARCH AGENCY | University of Michigan (UM) | | |
| PRINCIPAL INVESTIGATOR | Garcia | | |

**BUDGET STATUS**

| **FY 2025 Budget** | | **Total Budget** | |
|---|---|---|---|
| Vendor Budget FY 2025 | $141,602.45 | Total Vendor Budget | $306,927.04 |
| MDOT Budget FY 2025 | $9,800.00 | Total MDOT Budget | $34,600.00 |
| Vendor FY 2025 Expenditures | $0.00 | Total Budget | $341,527.04 |
| MDOT FY 2025 Expenditures | $0.00 | Total Expenditures | $0.00 |
| | | **Total Amount Available** | $341,527.04 |

**PURPOSE AND SCOPE**

The long-term performance of riprap has been an issue because some local sources of riprap have known durability issues and will degrade/dissolve over time. In addition, the acceptance of riprap size and gradation is currently done by performing a Wolman count. Performing the Wolman count involves walking over large rocks, which can be a safety hazard and takes a significant amount of time to do. There are challenges in assessing the performance and durability of riprap in riverine, lightly acidic and other environments that need to be addressed. The potential exists that there may be technological and electronic solutions that need to be utilized to enhance or replace existing processes.

THE MAJOR TASKS TO ACCOMPLISH THE RESEARCH OBJECTIVES:

1. Literature review.
2. Literature review on test parameters for riprap durability.
3. Literature review on riprap dissolution in marine and/or freeze-thaw climate conditions. This should also include dissolution of riprap in slightly acidic environments. Riprap from carbonate materials need to be considered.
4. Determine test parameters to determine riprap durability, including riprap dissolution.
5. Develop an update methodology to determine both the size and gradation of riprap in the field.
6. Develop recommendations to update current MDOT specifications and special provisions.
7. Develop final deliverables.

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

Contracting was delayed to FY 2026.

**FISCAL YEAR 2026 PROPOSED ACTIVITES**

1. Contracting process.
2. Literature review.
3. Literature review on test parameters for riprap durability.
4. Literature review on riprap dissolution in marine and/or freeze-thaw climate conditions. This should also include dissolution of riprap in slightly acidic environments. Riprap from carbonate materials need to be considered.
5. Determine test parameters to determine riprap durability, including riprap dissolution.

**JUSTIFICATION(S) FOR REVISION(S)**

None.

**SUMMARY OF THE IMPLEMENTATION RECOMMENDATION**

Project expected completion FY 2028.

Michigan Department
Of Transportation
5312 (2014)

# RESEARCH ADMINISTRATION
# MDOT RESEARCH PROJECT
# ANNUAL REPORT - FISCAL YEAR 2025

PROJECT TITLE: Modeling and Assessment of the Remaining Service Life for Steel Bridge Piles in Michigan

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

PROJECT MANAGER: Snook, Ryan

| | | | |
|---|---|---|---|
| CONTRACT/AUTHORIZATION NO. | 2025-0251 | PROJECT START DATE | 3/1/2025 |
| PROJECT NO. | 221868 | COMPLETION DATE (Original) | 5/31/2028 |
| OR NO. | OR25-005 | COMPLETION DATE (Revised) | |
| RESEARCH AGENCY | Western Michigan University (WMU) | | |
| PRINCIPAL INVESTIGATOR | Attanayake, Upul | | |

**BUDGET STATUS**

| FY 2025 Budget | | Total Budget | |
|---|---|---|---|
| Vendor Budget FY 2025 | $103,254.71 | Total Vendor Budget | $416,963.10 |
| MDOT Budget FY 2025 | $4,307.69 | Total MDOT Budget | $20,000.00 |
| Vendor FY 2025 Expenditures | $14,758.61 | Total Budget | $436,963.10 |
| MDOT FY 2025 Expenditures | $0.00 | Total Expenditures | $14,758.61 |
| | | **Total Amount Available** | $422,204.49 |

**PURPOSE AND SCOPE**

Steel piles have been widely used in bridge construction in Michigan. Most common are 12” & 14” inch H-pile sections, and 10”, 12”, 14” and 16” diameter pipe pile sections. Corrosion of the steel piles is becoming a major concern for the bridges, especially for those being in service for over 50 years. The localized corrosion of steel pile foundations may result in considerable loss of loadbearing capacity and eventually could lead to the collapse of the structure. Therefore, a comprehensive understanding of the population of in-service steel piles, and prediction of pile corrosion is essential to avoid excessive deflection or failure. However, there are certain challenges to investigate the corrosion of steel bridge piles, including but not limited to: MDOT does not have a comprehensive inventory of the number, type, and age of steel piles currently in service. Existing soil type and groundwater levels and details of the pile sections used need to be extracted case by case from as-bult plans. 1. On-site measurement of corrosion extent is difficult and not cost-effective, especially for those steel piles buried in soil. Moreover, the measurement over a certain area of the steel pile may not be reliable due to pit corrosion. The pit corrosion is usually concentrated in a small area, but it can be more dangerous than uniform corrosion damage. 2. The corrosion of steel piles is influenced by numerous factors. (a) Soil resistivity. Resistivity, which is the reciprocal of conductivity, indicates the corrosion current carrying ability of the environment. Typically, lower soil resistivity promotes a higher corrosion rate and level of steel piles. (b) Chemical composition of soil. Chemical composition of the soil is of key importance to understanding the influence of soil on corrosion of buried steel. Chlorides (>100 ppm) and sulfates (>200 ppm) have been identified as indicatives of corrosive soil in Federal Highway Administration guidelines for mechanically stabilized earth walls. Chloride ions, which directly participate in the anodic reaction of corrosions, could be a major threat for bridges in Michigan due to the large amount of de-icing agent applied in snow season. (c) Moisture content. Moisture is necessary for corrosion. Therefore, highest level of corrosion is usually found in water table fluctuation zone. (d) Bacteria. Microbiologically Influenced Corrosion (MIC), an electrochemical corrosion affected by the presence of biological agents, can also severely degrade the steel surfaces. (e) Pile type and loading history. The material, dimension and loading history of the steel piles can have impact on their corrosion rate. 3. There is no widely accepted method to predict pile corrosion. Current single variable or multivariable regression models do not consider all factors listed above and thus lack generalizability. More importantly, the corrosion environment in Michigan may require its unique regression model. With these unsolved issues, the threat of influencing factors cannot be ranked. 4. There is lack of accurate prediction of the remaining load-bearing capacity of corroded steel piles. While several methods (AISC, AISI-EWM, AISI-DSM, etc.) have been developed, the localized corrosion as well as stiffness change make their assumption invalid and cause conservative prediction of the remaining life. 5. Many retrofit or repair techniques have been implemented for strengthening the corroded steel piles, but a detailed cost-effectiveness analysis (CEA) for those techniques should be conducted to minimize future construction costs in Michigan. Based on the above discussion, it is essential to investigate the effect of various factors on corrosion rate of steel bridge piles and predict the remaining load-bearing capacity of corroded piles. Consequently, proper repair techniques can be applied at appropriate time to maintain and prolong the service life of bridges in Michigan.

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

Kick off meeting was held and the beginning tasks of the effort were started. The literature review, survey of other DOTs, beginning stages of the database of information, beginning an understanding of potential sites with risk and the start of the multivariate regression modeling occurred.

| FISCAL YEAR 2026 PROPOSED ACTIVITES |
| --- |
| The literature review and survey are expected to be completed in FY 2026 with tasks 2 through 4a continuing until FY 2028. The beginning of characterizing the remaining load bearing capacity of corroded piles is expected with the beginning of another survey on how piles are being repaired. |
| **JUSTIFICATION(S) FOR REVISION(S)** |
| None. |
| **SUMMARY OF THE IMPLEMENTATION RECOMMENDATION** |
| Project expected completion FY 2028. |

Michigan Department
Of Transportation
5312 (2014)

# RESEARCH ADMINISTRATION
# MDOT RESEARCH PROJECT
# ANNUAL REPORT - FISCAL YEAR 2025

PROJECT TITLE: Evaluation and Prioritization of MDOT's Highway Rest Areas for Potential Closure

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

PROJECT MANAGER: Greenway, Jane

| | | | |
|---|---|---|---|
| CONTRACT/AUTHORIZATION NO. | 2025-0250 | PROJECT START DATE | 5/1/2025 |
| PROJECT NO. | 221869 | COMPLETION DATE (Original) | 12/31/2026 |
| OR NO. | OR25-007 | COMPLETION DATE (Revised) | |
| RESEARCH AGENCY | Michigan State University (MSU) | | |
| PRINCIPAL INVESTIGATOR | Gates, Timothy | | |

**BUDGET STATUS**

| FY 2025 Budget | | Total Budget | |
|---|---|---|---|
| Vendor Budget FY 2025 | $95,469.36 | Total Vendor Budget | $183,901.40 |
| MDOT Budget FY 2025 | $5,460.00 | Total MDOT Budget | $15,600.00 |
| Vendor FY 2025 Expenditures | $1,797.12 | Total Budget | $199,501.40 |
| MDOT FY 2025 Expenditures | $0.00 | Total Expenditures | $1,797.12 |
| | | **Total Amount Available** | $197,704.28 |

**PURPOSE AND SCOPE**

As transportation funding becomes increasingly constrained, areas within the Department are continuously evaluating their priorities and attempting to determine where best to allocate funding. The Department's rest area system requires such an evaluation and update. Prior research was performed as OR10-045, but there is a need to update this to consider access elements as considerations, along with other attributes, to further assist in meeting MDOT's mission, values and vision, while also being fiscally responsible for each rest area. The goal is to provide an overall understanding of rest area's performance through an objective analysis. Final deliverable should be a ranking prioritization for fiscal management that when combined with existing data from Transportation Systems Management and Operations (TSMO) regarding rest area conditions, can be used to guide the Department in future actions ensuring limited funding is being allocated to the highest priority

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

- Project kick-off occurred between MSU and the Research Advisory Panel (RAP) with discussion on project direction.
- An interim meeting was held between MSU and the RAP.
- MSU continued to collect and analyze data.
- Meetings have also been held internally to review data.
- MSU made progress on the literature review.
- MSU has made considerable progress on reviewing and updating data from OR10-045 (prior project with Wayne State University)

**FISCAL YEAR 2026 PROPOSED ACTIVITES**

It is expected that the project will continue with a continued review and updated data from OR10-045 while developing a method for maximizing accessibility. Analysis of data to assist in prioritizing rest areas as part of a decisions support tool is expected to begin FY 2026.

**JUSTIFICATION(S) FOR REVISION(S)**

None.

**SUMMARY OF THE IMPLEMENTATION RECOMMENDATION**

Project expected completion FY 2026.

Michigan Department
Of Transportation
5312 (2014)

# RESEARCH ADMINISTRATION
# MDOT RESEARCH PROJECT
# ANNUAL REPORT - FISCAL YEAR 2025

PROJECT TITLE: Connected and Automate Vehicle (CAV) Readiness Survey: Are MDOT Roads Machine Readable

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

PROJECT MANAGER: Gordon, Tom

| | | | |
|---|---|---|---|
| CONTRACT/AUTHORIZATION NO. | To be determined | PROJECT START DATE | To be determined |
| PROJECT NO. | 221871 | COMPLETION DATE (Original) | To be determined |
| OR NO. | OR25-012 | COMPLETION DATE (Revised) | |
| RESEARCH AGENCY | To be determined | | |
| PRINCIPAL INVESTIGATOR | To be determined | | |

## BUDGET STATUS

| FY 2025 Budget | | Total Budget | |
|---|---|---|---|
| Vendor Budget FY 2025 | $113,236.44 | Total Vendor Budget | $342,120.24 |
| MDOT Budget FY 2025 | $0.00 | Total MDOT Budget | $13,740.00 |
| Vendor FY 2025 Expenditures | $0.00 | Total Budget | $355,860.24 |
| MDOT FY 2025 Expenditures | $0.00 | Total Expenditures | $0.00 |
| | | **Total Amount Available** | $355,860.24 |

## PURPOSE AND SCOPE

Considering MDOT Mission, Values, and Vision, with the evolving landscape of technologies within the connected and automated vehicle (CAV) industry, there is a pressing need to investigate the requisite support from DOTs to enable seamless integration of CAVs with infrastructure. As core sensors and systems defining these technologies become more established, understanding the precise infrastructure requirements becomes paramount. Therefore, the research aims to address the question: "What specific support and infrastructure enhancements are necessary from MDOT to facilitate effective detection and interaction of connected and automated vehicles with the surrounding infrastructure?"

THE MAJOR TASKS TO ACCOMPLISH THE RESEARCH OBJECTIVES:

1. Literature Review
2. Survey and Interview of Internal and External Stakeholders
3. Data Analysis
4. Analysis of Current MDOT CAV readiness
5. Perform gap analysis of potential future CAV needs
6. Develop recommended MDOT Guidelines with actionable processes
7. Develop recommended engagement processes for stakeholders
8. Develop an expandable risk and opportunity matrix/model for CAV needs
1. 9. Develop Final Deliverables

## FISCAL YEAR 2025 ACCOMPLISHMENTS

Project start is delayed to FY 2026. The request for proposal was posted and selection is underway.

## FISCAL YEAR 2026 PROPOSED ACTIVITIES

Vendor selection, contracting and project kick-off are expected.

## JUSTIFICATION(S) FOR REVISION(S)

None.

## SUMMARY OF THE IMPLEMENTATION RECOMMENDATION

Project expected completion FY 2028.

Michigan Department
Of Transportation
5312 (2014)

# RESEARCH ADMINISTRATION
# MDOT RESEARCH PROJECT
# ANNUAL REPORT - FISCAL YEAR 2025

PROJECT TITLE: Evaluate Speed Estimation Techniques for EPA Moves Model Input Using Big Data and Travel Demand Models for Regional Conformity Analysis

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

PROJECT MANAGER: Robert Maffeo

| | | | |
|---|---|---|---|
| CONTRACT/AUTHORIZATION NO. | 2025-0425 | PROJECT START DATE | 6/2/2025 |
| PROJECT NO. | 224029 | COMPLETION DATE (Original) | 6/1/2027 |
| OR NO. | OR25-010 | COMPLETION DATE (Revised) | |
| RESEARCH AGENCY | Texas A&M University (TAMU) | | |
| PRINCIPAL INVESTIGATOR | Li | | |

**BUDGET STATUS**

| FY 2025 Budget | | Total Budget | |
|---|---|---|---|
| Vendor Budget FY 2025 | $33,178.00 | Total Vendor Budget | $152,053.44 |
| MDOT Budget FY 2025 | $0.00 | Total MDOT Budget | $12,000.00 |
| Vendor FY 2025 Expenditures | $10,650.67 | Total Budget | $164,053.44 |
| MDOT FY 2025 Expenditures | $0.00 | Total Expenditures | $10,650.67 |
| | | **Total Amount Available** | $153,402.77 |

**PURPOSE AND SCOPE**

MDOT's Statewide and Urban Travel Analysis (SUTA) Section is required to run the Environmental Protection Agency's (EPA) Motor Vehicle Emission Simulator (MOVES) Model for regional transportation conformity analysis, and for other purposes. One crucial input to the MOVES model is an average speed distribution configured into sixteen-speed bin classifications, categorized by MOVES road type and source type, hour of the day, and for base and future analysis years. SUTA's current methodology incorporates average speeds from their statewide and urban [regional] travel demand models (traditional four-step trip-based models administered in the Caliper TransCAD Platform). There exists a gap between the travel demand model outputs (average speed) and the required inputs (sixteen speed bin distribution) to the MOVES Model. SUTA staff are proposing a research project to identify how archived real time speed data available to MDOT (currently INRIX speed data available through the CATT Lab's RITIS Platform) can be used to fill this gap between travel demand and air quality models, as well as forecast speed distributions using the results from the travel demand model(s). The results are to be organized into a useable format to generate a reliable average speed distribution that can be used as input into the EPA MOVES Model.

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

Texas A&M Transportation Institute (TTI) performed the following activities in FY 2025:

- Project management (Task 1) including:
  - Attended quarterly progress updates with the Research Advisory Panel (RAP).
  - Completed quarterly progress reports.
  - Developed detailed work plan to manage project.
- Research Team began to review MDOT internal processes for developing speed distributions for EPA MOVES Model input (part of Task 2).
- Began conducting a literature search/review of other agency methods for developing speed distributions for EPA MOVES Model input (part of Task 2).
- Completed a Task 2 report outline in preparation for the written draft of the final report.
- Began the data collection stage, which will support future tasks of the project.

**FISCAL YEAR 2026 PROPOSED ACTIVITES**

In FY 2026 the RAP and TAMU research teams anticipate the completion of Task 2, along with the following tasks:

- Task 3: Literature review – Conduct a comprehensive literature review of the MOVES requirements for speed estimation and forecasting models.
- Task 4: Technical memorandum – Develop a standalone document that consolidates the findings from Task 2 (state-of-practice review) and Task 3 (literature review) to provide the following:
  - Comprehensive overview of how MDOT and other transportation agencies utilize Transportation Demand Management (TDM) for conformity analysis.
  - Examination of supplemental data sources used to address gaps between TDM outcomes and conformity analysis requirements.
  - Evaluation of effectiveness of these methods in meeting conformity goals.
- Task 5: Interim project status report – Review the information obtained from previous tasks and outline a detailed work plan for the next steps to include:
  - Strategy for developing a new speed estimation process, considering the available dataset, the scope of the conformity analysis, and relevant practices.

- Schedule and framework for an in-person workshop, covering participant availability, venue logistics, a detailed agenda, breakout session plans, and task assignments.
- Timeline for final deliverables, outlining due dates and the expected content for each project deliverable.

• Task 6: New Speed Estimation Process – Develop a technical report that documents the work performed, findings and recommendations and tools to assess INRIX data and convert TDM speed estimates to speed bin distributions.

**JUSTIFICATION(S) FOR REVISION(S)**

None.

**SUMMARY OF THE IMPLEMENTATION RECOMMENDATION**

Project expected completion FY 2027.

Michigan Department
Of Transportation
5312 (2014)

# RESEARCH ADMINISTRATION
# MDOT RESEARCH PROJECT
# ANNUAL REPORT - FISCAL YEAR 2025

PROJECT TITLE: Evaluation of Traffic Speed Deflectometer Data (TSD) for Potential Use in Michigan

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

PROJECT MANAGER: Shapter, Paul

| | | | |
|---|---|---|---|
| CONTRACT/AUTHORIZATION NO. | 2025-0362 | PROJECT START DATE | 5/1/2025 |
| PROJECT NO. | 224034 | COMPLETION DATE (Original) | 10/31/2027 |
| OR NO. | OR26-006 | COMPLETION DATE (Revised) | |
| RESEARCH AGENCY | Applied Research Associates (ARA) | | |
| PRINCIPAL INVESTIGATOR | Morovatdar | | |

**BUDGET STATUS**

| FY 2025 Budget | | Total Budget | |
|---|---|---|---|
| Vendor Budget FY 2025 | $174,408.88 | Total Vendor Budget | $446,453.28 |
| MDOT Budget FY 2025 | $16,600.00 | Total MDOT Budget | $86,163.31 |
| Vendor FY 2025 Expenditures | $100,530.10 | Total Budget | $532,616.59 |
| MDOT FY 2025 Expenditures | $3,163.31 | Total Expenditures | $103,693.41 |
| | | **Total Amount Available** | $428,923.18 |

**PURPOSE AND SCOPE**

The collection of continuous pavement deflection data is a technology that is starting to mature and is getting a lot of attention from many state agencies around the country. The cost of obtaining these data collection services can be significant. The Michigan DOT would like to explore whether there is a benefit in spending money on this type of data. Does it provide sufficient structural information that can be useful in the scoping or design phases of upcoming projects? Does it provide useful information in the evaluation of the performance of in-situ pavements? In what situations does it make sense to gather this data? These are some of the questions that need to be answered so that a determination can be made on the cost effectiveness of moving forward with this relatively new technology.

THE MAJOR TASKS TO ACCOMPLISH THE RESEARCH OBJECTIVES:

1. Search literature and/or send a survey to determine ways TSD is being incorporated for transportation uses.
2. Review MDOT TSD data and locations already collected in Michigan. Choose a selection of locations to compare data collected from the TSD equipment to similar types MDOT has stored in its Pavement Management System (PMS) database and provide an assessment of the accuracy and completeness of the TSD data collected.
3. In conjunction with the RAP, choose additional locations to collect, or previous locations to collect again.
4. Using locations determined in Task #3, subcontract to collect up to 400 miles during the contract period. This can be up to 400 miles in year one of the project or split between the two years of the project.
5. Analyze TSD data to determine what can be used for MDOT's scoping, design, and performance monitoring processes. The beneficial uses may be different for the different pavement types: flexible, rigid, and composite. If TSD data is not applicable for any of these uses, explain what the shortcomings are. If GPR data is collected along with the TSD, investigate how this data can be analyzed and used.
6. Prepare options for incorporating TSD data in Michigan including policies such as project-level collection, network level collection, frequency of collection, whether to include ramps, what lane(s) to collect, time of year to collect, etc. This must include consideration of what MDOT is already collecting with its current PMS data collection.
7. In conjunction with the RAP, develop a TSD implementation plan that includes how it can be incorporated in conjunction with current PMS data collected and MDOT's FWD data collection practices.
8. Produce a final report documenting all work completed, and a class to disseminate this information to MDOT stakeholders.

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

**Task 1 – Literature Review and Gap Assessment**

The research team, under Task 1, provided a comprehensive review of the relevant studies conducted by previous researchers and other state agencies, outlined current Michigan DOT (MDOT) practices related to Falling Weight Deflectometer (FWD) testing, pavement design, and pavement maintenance scoping and strategies. The research team then summarized various approaches used to analyze Traffic Speed Deflectometer (TSD) data for different pavement types. A synthesized draft document was prepared and shared with the MDOT's Project Manager on September 29, 2025. The report provides a comprehensive review and synthesis of more than 100 published and unpublished papers and technical reports relevant to TSD technology and its application in pavement management and evaluation. The review covered key MDOT manuals and guidelines, including the Pavement Selection Manual (2021), Capital Preventive Maintenance Manual (2020), Performance-Based Planning and

Programming for Pavement Management (2016), MDOT User Guide for Mechanistic-Empirical Pavement Design (2025), and Procedures for In-situ Resilient Modulus Testing Using FWD. Key accomplishments made under Task 1:

- Conducted an extensive review of over 100 sources, encompassing journal articles, technical reports, and agency documents.
- Structured the report into major sections, including:
- Overview of TSD Technology.
- Analysis of Pavements Using TSD Data.
- State Highway Agencies' Implementation Practices.
- MDOT Practices.
- Initial Implementation Strategies for Michigan.
- Provided a detailed explanation of available analysis methods for flexible, rigid, and composite pavements, highlighting their suitability for network-level evaluation.
- Reviewed current MDOT practices for project selection based on pavement condition assessments.
- Evaluated the potential use of TSD-derived distress indicators for determining Pavement Condition Measures (PCM) and Pavement Distress Score (PDS).
- Developed a preliminary implementation strategy tailored to Michigan's network-level pavement management framework.

**Task 2 – Review of MDOT's Available TSD Data**

The research team reviewed approximately 4,800 miles of TSD data collected in Michigan between 2019 and 2024 and organizing existing datasets from multiple MDOT-provided sources for analysis at selected sections. As a precursor to data analysis, additional information was incorporated into each individual TSD data point, including location features (as specified in the MDOT Roads and Highways [R&H] Inventory), pavement type, roadway functional classification, traffic data, distress data, and pavement condition categories. Specific subtasks performed under Task 2 include:

- Incorporated traffic, pavement type, distress, and other relevant information into the TSD spreadsheet and generating a consolidated database.
- Developed a process to ensure that TSD data collected by ARRB Systems aligns correctly with MDOT's roadway inventory and Linear Referencing System (LRS) definitions. It also highlights potential errors such as mismatched road names, possible incorrect direction assignments, LRS milepost range issues, potential rubber banding, and GPS inconsistencies.
- Checked whether the 2019-2024 TSD data are properly tied to the MDOT's LRS, flagged potential mismatches, and added Physical Reference (PR) and Mile Point information to each TSD record.
- Performed a comprehensive data quality assessment of deflection and deflection slope data collected in Michigan between 2019 and 2024 and prepared summary statistics for each pavement type and surveyed roadway.
- Various TSD data quality assessment criteria were developed tailored towards the TSD data collected in Michigan.
- Identified candidate routes for further structural analysis. The research team emphasized statewide coverage, road functional diversity, and pavement type distribution to achieve comprehensive representation across Michigan's network.

The results for LRS checks, quality assessment of TSD data, consolidated TSD database, and selected candidate sections for analysis will be finalized and shared with the MDOT in the next quarter in terms of Excel spreadsheet and shapefiles for review and feedback.

**Task 3 – Selection of Additional Sections**

The research team selected additional road sections for TSD testing in 2025. This process was guided by an incremental, criteria-based screening process to identify the most appropriate routes for TSD data collection and pavement condition evaluation. Key considerations included:

- Ensuring route continuity to minimize re-routing and allow sufficient survey time and mileage as defined by MDOT.
- Revisiting previously surveyed routes where significant gaps in survey years exist, particularly major highways suitable for tracking structural condition trends using PCM metrics.
  Incorporating MDOT-recommended 2025 routes to maintain continuous coverage and evaluate new routes.

The Shapefile and PowerPoint presentation justifying route selection was submitted to MDOT on August 16, 2025, and the research team received the green light to proceed with the suggested route.

**Task 4 – TSD Data Collection**

The research team shared the TSD survey routing package with ARRB Systems on September 2, 2025. This package included the shapefile of the selected sections along with a memorandum for TSD operators. The shared shapefile was derived from the inventory data but was cleaned and processed to include clear instructions for the data collection vendor, aiming to facilitate the georeferencing of TSD data points to MDOT's LRS after testing. The intent was to provide clear guidance upfront to ensure smooth data collection and processing, while minimizing the need for re-processing. Data collection was conducted in mid-September, and ARRB Systems is currently processing the data, with data delivery expected by the end of October.

**FISCAL YEAR 2026 PROPOSED ACTIVITES**

**Task 1 – Literature Review and Gap Assessment**

Receive and address comments raised by the MDOT team on the literature review document.

**Task 2 – Review of MDOT's Available TSD Data**

Below are the major subtasks planned to be performed under Task 2:

- Finalize quality assessment and LRS checks for the 2019-2024 TSD data.
- Finalize selection of pavement sections surveyed in 2019-2024 for further analysis.
- Extraction and compilation of pavement layer thicknesses and ESAL information from available MDOT databases. This task may require input from MDOT.
- Initiate structural analysis of pavement sections identified to support structural condition and performance assessments.

**Task 4 – TSD Data Collection**

The research team will plan and coordinate the TSD data delivery with ARRB Systems. The tentative data delivery date is end of October.

**Task 5 – Analysis of TSD Data and Recommend Applications**

The research team will begin the review and quality assessment of the 2025 TSD data collected under the current project for selected roadway segments as part of Task 3.

**JUSTIFICATION(S) FOR REVISION(S)**

None.

**SUMMARY OF THE IMPLEMENTATION RECOMMENDATION**

Project expected completion FY 2028.

Michigan Department
Of Transportation
5312 (2014)

# RESEARCH ADMINISTRATION
# MDOT RESEARCH PROJECT
# ANNUAL REPORT - FISCAL YEAR 2025

PROJECT TITLE: Research Program Technology Transfer

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

PROJECT MANAGER: Hoffmeyer, Mary

| | | | | |
|---|---|---|---|---|
| CONTRACT/AUTHORIZATION NO. | 2025-0718 | | PROJECT START DATE | 10/1/2025 |
| PROJECT NO. | 224827 | | COMPLETION DATE (Original) | 9/1/2030 |
| OR NO. | OR25-018 | | COMPLETION DATE (Revised) | |
| RESEARCH AGENCY | CTC & Associates | | | |
| PRINCIPAL INVESTIGATOR | Hirt, Brian | | | |

**BUDGET STATUS**

| FY 2025 Budget | | | Total Budget | |
|---|---|---|---|---|
| Vendor Budget FY 2025 | $4,902.40 | | Total Vendor Budget | $479,459.17 |
| MDOT Budget FY 2025 | $0.00 | | Total MDOT Budget | $0.00 |
| Vendor FY 2025 Expenditures | $0.00 | | Total Budget | $479,459.17 |
| MDOT FY 2025 Expenditures | $0.00 | | Total Expenditures | $0.00 |
| | | | **Total Amount Available** | $479,459.17 |

**PURPOSE AND SCOPE**

Research Administration (RAd) assists in the coordination, development, management, and implementation of research for the Michigan DOT to deliver enhanced and new business technologies and innovations that improve operations and services and make better use of resources. Identifying and developing these findings through our research project efforts without sharing the results creates silos that directly affect our department activities and inhibit collaboration with other organizations. RAd believes circulating our research findings and implementation efforts through technology transfer activities is an imperative step in our research process. To effectively communicate and articulate research efforts both within the department and beyond RAd needs to utilize efficient and effective technology transfer approaches to disseminate research findings and implementation guidance. The purpose of this project will be to increase research exposure through technology transfer products including documents, reports, publications, videos, and other multimedia tools over various communication platforms.

THE MAJOR TASKS TO ACCOMPLISH THE RESEARCH OBJECTIVES:
1. Develop requested communication materials and distribution strategies for research findings and implementation efforts. These communication materials include but are not limited to:
a. Research Spotlight Newsletters
b. Implementation Highlight Newsletters
c. At-A-Glance Research Program Briefs
d. Research/Implementation Story Maps
e. Research Spotlight Videos
f. Display posters for department and national research forums.
g. PowerPoint presentations for national research forums.
2. Provide writing and editorial review assistance:
a. Prepare technical papers for submittal to state government and national organizations.
b. Perform editorial review of research reports.
c. Prepare research related to internal technical process/procedural materials.
3. Assist with the planning, facilitation, and documentation of events and organization efforts:
a. Peer exchange conferences.
b. Training activities and workshops/webinars with companion materials.
4. Assist with the development of performance measures and implementation procedures:
a. National synthesis identifying best practices and processes, and benefit quantification.

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

No fiscal year 2025 activities took place on project OR25-018. The contract (2025-0718) for this project was not officially signed and did not take effect until October 7, 2025.

**FISCAL YEAR 2026 PROPOSED ACTIVITES**

It is anticipated in FY2026 that project activities will include work on the following - the At-A-Glance report summary of funding statistics and project progress for FY25, various spotlight newsletters and videos which summarize project activities, development of communication distribution strategies for spotlight newsletters and videos, technical editing on research reports, and program assistance as needed.

| JUSTIFICATION(S) FOR REVISION(S) |
| --- |
| None. |
| **SUMMARY OF THE IMPLEMENTATION RECOMMENDATION** |
| Project expected completion FY 2030. |

Michigan Department
Of Transportation
5312 (2014)

# RESEARCH ADMINISTRATION
# MDOT RESEARCH PROJECT
# ANNUAL REPORT - FISCAL YEAR 2025

PROJECT TITLE: Efficacy, Advancement, and Monitoring of Carbon Fiber Composite Cable (CFCC)

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

PROJECT MANAGER: Kahl, Steve

| | | | |
|---|---|---|---|
| CONTRACT/AUTHORIZATION NO. | To be determined | PROJECT START DATE | 10/1/2025 |
| PROJECT NO. | 224829 | COMPLETION DATE (Original) | 9/30/2030 |
| OR NO. | OR24-018 | COMPLETION DATE (Revised) | |
| RESEARCH AGENCY | Lawrence Technological University (LTU) | | |
| PRINCIPAL INVESTIGATOR | Grace, Nabil | | |

**BUDGET STATUS**

| FY 2025 Budget | | Total Budget | |
|---|---|---|---|
| Vendor Budget FY 2025 | $105,478.89 | Total Vendor Budget | $634,216.92 |
| MDOT Budget FY 2025 | $0.00 | Total MDOT Budget | $24,000.00 |
| Vendor FY 2025 Expenditures | $0.00 | Total Budget | $658,216.92 |
| MDOT FY 2025 Expenditures | $0.00 | Total Expenditures | $0.00 |
| | | **Total Amount Available** | $658,216.92 |

**PURPOSE AND SCOPE**

Carbon Fiber Composite Cable (CFCC), and the Carbon Fiber Reinforced Polymer (CFRP) materials are being used for prestressing applications in Michigan bridge rehabilitation and replacement projects with the most recent generation of CFCC is a 0.7-inch strand configuration. The quantity of stands is similar to conventional strands, and concomitant updated design criteria. Determining the efficacy of the new 0.7-inch CFCC strand long-term behavior is essential for future design and construction considerations. Monitoring the CFCC elements in newly constructed bridges (with 0.7-inch strands) and some prior construction (from OR14-039) will provide an understanding of the long-term behavior and realizations of recommendations on future designs, and continued considerations of field deployment.

THE MAJOR TASKS TO ACCOMPLISH THE RESEARCH OBJECTIVES:

1. Utilize and summarize information from prior research.
2. Begin the data collection and analysis processes.
3. Maintain/update/plan sensor infrastructure.
4. Develop long-term trends for 0.7-inch CFCC prestressing strands for both stress and strain.
5. Perform load test on completed structure prior to opening to traffic. correlate with finite element model results.
6. Document and make recommendations for analysis, design, fabrication, inspection, and construction of CFCC elements in future projects.
7. Make recommendations for enhancements to MDOT manuals, guides, and specifications.
8. Develop training, workshops, and other outreach materials, such as TRB/ACI/AASHTO journal publications.
9. Develop Final Deliverables.

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

The project will be fully contracted after 10/01/2025.

**FISCAL YEAR 2026 PROPOSED ACTIVITES**

The intent is to continue the overall CFCC monitoring, with the addition of monitoring of 0.7 in diameter CFCC strand. The first structure of intended monitoring, M30 over US10, was not constructed with CFCC due to fabrication issues. The next structure to be utilizing 0.7 in CFCC has yet to be constructed. Continued monitoring of existing CFCC structures, and a focus on monitoring structures utilizing 0.7 in diameter CFCC strands. Once a structure utilizing 0.7 in diameter CFCC strand is constructed, it will be added.

**JUSTIFICATION(S) FOR REVISION(S)**

None.

**SUMMARY OF THE IMPLEMENTATION RECOMMENDATION**

Project expected completion FY 2030.

# 100% FEDERALLY FUNDED PROJECTS

Sequentially Listed by TPF Number

Michigan Department
Of Transportation
5312 (2014)

# RESEARCH ADMINISTRATION
# MDOT RESEARCH PROJECT
# ANNUAL REPORT - FISCAL YEAR 2025

PROJECT TITLE: Michigan (One Point) Cone Test Evaluation – University Transportation Center (UTC)

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

PROJECT MANAGER: Koepke, Kenneth

| | | | |
|---|---|---|---|
| CONTRACT/AUTHORIZATION NO. | 2024-0433 | PROJECT START DATE | 5/16/2024 |
| PROJECT NO. | 219547 | COMPLETION DATE (Original) | 9/30/2025 |
| OR NO. | OR24-014 | COMPLETION DATE (Revised) | 5/15/2026 |
| RESEARCH AGENCY | Michigan State University (MSU) | | |
| PRINCIPAL INVESTIGATOR | Surya S. C. Congress, Ph.D. | | |

**BUDGET STATUS**

| *FY 2025 Budget | | *Total Budget | |
|---|---|---|---|
| Vendor Budget FY 2025 | $74,315.20 | Total Vendor Budget | $90,465.63 |
| MDOT Budget FY 2025 | $0.00 | Total MDOT Budget | $0.00 |
| Vendor FY 2025 Expenditures | $69,291.28 | Total Budget | $90,465.63 |
| MDOT FY 2025 Expenditures | $0.00 | Total Expenditures | $85,441.71 |
| | | **Total Amount Available** | $5,023.92 |

***University Transportation Center (UTC) project.**

| | Total Contract Budget | Expenditures FY 2024 | Expenditures FY 2025 |
|---|---|---|---|
| **MDOT SPRII Funding (~71.81%)** | $ 90,465.63 | $16,150.43 | $69,291.28 |
| **University Match (~28.19%)** | $ 35,506.95 | $ 6,338.90 | $17,803.31 |
| **UTC Project Totals** | $125,972.58 | $22,489.33 | $87,094.59 |

**PURPOSE AND SCOPE**

Recent use of Open Graded Drainage Course (OGDC) has drawn the attention of MDOT to our current practice of using One-Point Michigan Cone tests to determine the Maximum Density for such soils. The material is relatively new to MDOT, and we desire to discover if current field tests involving the Michigan cone correlate with other industry standard tests. Studies from the 1960's, 70's and early 2000's indicate that for many applications, Michigan Cone Maximum density values exceed those garnered by other acceptable testing methods. The department would like to explore if Michigan Cone testing practices as written are an effective determination of Maximum density for OGDC, or if modifications to this current process are more appropriate for determining this maximum density. MDOT would prefer to keep our current equipment for field testing without investing in ovens for oven dry moisture, generators, new volumetric molds or hammers, so a preference exists to manipulate our current processes to give a representative sample of the maximum density.

**FISCAL YEAR 2024 ACCOMPLISHMENTS**

MSU has performed the following activities:

- Attend July 23, 2024, a kickoff meeting with the MDOT RAP. Meeting activities included the review of projects tasks, schedule, milestones, deliverables, and reporting requirements.
- Attend monthly check-in meetings with PM and MDOT RAP on project progress.
- Conducted a comprehensive literature review of testing practices, related to the American Society for Testing and Materials (ASTM), followed by MDOT and various State Departments of Transportation (DOTs) in the US (Task 1). Compiled a detailed table outlining each state's testing methods. Created a comparative table to depict modifications from each state for each test and method. Identified key differences in testing protocols and highlighted innovative practices adopted by certain states.
- Contacted vendors and collected 4G materials from various sources (i.e., Stone, Great Lakes, LaFarge, etc.) (Task 2).
- Characterized the material collected from vendors and conducted material testing using various methods for identifying density (Task 3) which included but was not limited to the proctor test and vibratory table test.
- The repeatability and reliability of the Michigan cone test will be evaluated by conducting several tests over the range of OGDC materials selected. For this task a compact accelerometer to be attached to the MDOT cone was purchased and two graduate students that are working on this project were provided with safety training certification to execute test methods. They were trained by MDOT personnel on the MDOT Cone test to execute it and evaluate the repeatability and reliability of the density values (Task 4).

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

This research is determining whether Michigan Cone testing practices are as effective as written determination of Maximum density for OGDC or if modifications to this current process are more appropriate for determining this maximum density. Activities completed in FY25 include the following:

- Task 3: Comparison with Other Test Methods. The research team is testing different OGDC materials using Michigan Cone and comparing them with other widely accepted maximum density determination methods, including Sieve analysis, Modified proctor, Vibratory table, and Gyratory compaction. The research team additionally acquired new source materials bringing the total to 10 for continued testing.
- Task 4: Recommendations for Testing Improvements. The research team is currently working on providing recommendations for any needed updates to the density testing and inspection manual. This has involved confirming the repeatability and reliability testing of OGDC using Michigan cone apparatus and others via the field or in the laboratory. The MSU team has met regularly with the MDOT RAP to provide us with updates and discuss the results of their findings to date.

**FISCAL YEAR 2026 PROPOSED ACTIVITES**

Anticipated FY26 activities include the completion of Task 4 along with Task 5, which will include the written final report evaluating the continued suitability of Michigan Cone test vessel for OGDC density determination. Also expect completion of Task 6, which includes discussion on suitable/relevant text to add to the Density Testing and Inspection Method in support of findings from this study.

**JUSTIFICATION(S) FOR REVISION(S)**

There was a small increase in cost authorized in FY 2024 to cover additional travel necessary once final sampling locations were identified.

**SUMMARY OF THE IMPLEMENTATION RECOMMENDATION**

Project expected completion FY 2026.

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# RESEARCH ADMINISTRATION
# MDOT RESEARCH PROJECT
# ANNUAL REPORT - FISCAL YEAR 2025

PROJECT TITLE: Digital Collaboration using Industry Foundation Classes (IFC) and Building Information Model (BIM) Technology – University Transportation Center (UTC)

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

PROJECT MANAGER: Arnold, Luke

| | | | |
|---|---|---|---|
| CONTRACT/AUTHORIZATION NO. | 2024-0580 | PROJECT START DATE | 6/3/2024 |
| PROJECT NO. | 219737 | COMPLETION DATE (Original) | 6/3/2025 |
| OR NO. | OR24-010 | COMPLETION DATE (Revised) | 8/31/2025 |
| RESEARCH AGENCY | Michigan State University (MSU) | | |
| PRINCIPAL INVESTIGATOR | Cetin, Kristen | | |

**BUDGET STATUS**

| ***FY 2025 Budget** | | ***Total Budget** | |
|---|---|---|---|
| Vendor Budget FY 2025 | $78,344.02 | Total Vendor Budget | $96,799.99 |
| MDOT Budget FY 2025 | $0.00 | Total MDOT Budget | $0.00 |
| Vendor FY 2025 Expenditures | $78,285.70 | Total Budget | $96,799.99 |
| MDOT FY 2025 Expenditures | $0.00 | Total Expenditures | $96,741.67 |
| | | **Total Amount Available** | $58.32 |

***This is a University Transportation Center (UTC) project.**

| | **Total Contract Budget** | **Expenditures** | |
|---|---|---|---|
| | | **FY 2024** | **FY 2025** |
| **MDOT SPRII Funding (80%)** | $ 96,799.99 | $18,455.97 | 78,285.70 |
| **University Match (20%)** | $ 24,200.00 | $ 4,613.99 | $19,571.43 |
| **UTC Project Totals** | $120,999.99 | 23,069.96 | 97,857.13 |

**PURPOSE AND SCOPE**

Traditional project delivery includes the development of information rich 2D and 3D models which are then printed to PDF files for construction purposes. Printing a model to a PDF causes the loss of important data that can be embedded in the design objects such as pay items, specifications, material requirements and asset data. This data must be recreated in other parts of the plans in a fashion that is not connected to the original design object. In addition, asset information is not collected until after the completion of the project. This is an inefficient process which could be optimized to produce considerable cost and time savings. The use of BIM technology should allow for users of the data to have the data that they need within the model of the project.

In 2019, AASHTO adopted Industry Foundation Classes (IFC) as the national standard for AASHTO states to exchange digital information. In theory, this should provide a mechanism for the seamless transfer of data throughout the lifecycle of an asset. Adopting the use of IFC models should allow for a collaborative environment where data about MDOT's assets can be housed, tracked, and transferred to other databases.

The purpose of this research is to document current MDOT dataflows for MDOT design objects and to understand how IFC or other technologies will allow for the transfer of relevant business data at specific data handoff points.

**FISCAL YEAR 2024 ACCOMPLISHMENTS**

MSU has performed the following activities:

- Attend July 1, 2024, a kickoff meeting with the MDOT RAP. Meeting activities included the review of projects tasks, schedule, milestones, deliverables, and reporting requirements.
- Attend monthly check-in meetings with PM and MDOT RAP on project progress.
- Conducted a literature review (Task 1) of manuals, guidelines, research and technical reports, handbooks, and research articles that have been conducted in the past 10-15 years focusing on the (1) current and future use of digital data asset management both within and outside of transportation applications; (2) available technologies, methods, and software packages for digital asset management and data handover; (3) advantages and disadvantages of different methods used for digital asset management and data handover; and (4) case studies showing the results of real-world implementation.
- Developed a survey (Task 1) to distribute to DOTs to look at questions 1) what kind of data is generated/used to represent a transportation asset; 2) how is data transferred between DOT & contractors; 3) are there certain data requirements; 4) what is the current version of IFC used and how does schema map to the transportation assets we are focused on; and 5) how compatible are currently utilized software packages with IFC. What other software package options are there?
- Coordinate interviews with the asset groups within MDOT for pavements, drainage structures, storm sewer systems, culverts, guardrails, signs, and pavement markings, to understand how each of the different assets flows from start to finish, how things are exchanged between the different groups, with the contractors (Task 2).

- Create maps of the data structure and workflow of each studied transportation asset thus far, including data handoffs between asset stages (Task 3).
- Begin to identify points within the data workflows of each asset where there is a possibility of data loss (Task 4).

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

This research project sought to investigate the challenges associated with design, construction and asset management data storage, mapped the digital data workflow and exchange requirements for multiple assets, and evaluated potential digital solutions— specifically Building Information Modeling (BIM), Industry Foundation Classes (IFC), and Common Data Environments (CDE)—as potential tools to improve workflows and improve data accuracy and consistency across all project phases.

This project produced a final research report detailing the following research efforts:
- Used literature reviews to evaluate the state of the art.
- Surveys determined the current state of adoption of such technologies across state DOTs.
- Interviews with MDOT personnel and contractors.
- Process mapping to identify data exchange requirements and key challenges

Challenges identified included disconnected databases, manual data entry, and inconsistent updating of asset databases across the lifecycle of the studied assets. It also highlighted the limitations of relying on 2D plan sets, where asset information is provided as text annotations, making retrieval and reuse difficult. From the contractor interviews, feedback suggested the need for accurate, consistent data, whether in 2D plan sets or 3D models, and anticipated challenges related to technology adoption and workforce training, particularly for contractors, if such technologies are fully adopted. The research project also examined digital solutions of BIM, IFC, and CDE which offer alternatives to current practices that should help to address these challenges, including advantages and disadvantages of each. A detailed case study was conducted on pavement asset management using IFC, supporting the feasibility and benefits of these digital approaches, but also demonstrating their limitations.

**JUSTIFICATION(S) FOR REVISION(S)**

None.

**SUMMARY OF THE IMPLEMENTATION RECOMMENDATION**

The overall findings of the research suggest that a transition toward integrated digital asset management systems would enhance efficiency, reduce manual errors, and support more effective long-term infrastructure management. Short-term implementation strategies include the development of BIM standards for designers at MDOT so that important business data is captured as properties of the geospatial objects being modeled in design, as a supplement to plan notes and dimensions. This is planned to be implemented by the Engineering Support unit at MDOT over the next several years.

Longer term implementation would include strategy development within MDOT across multiple areas of MDOT to address internal inefficiencies with data management. This could potentially be tackled one asset class at a time focusing on the most important assets first. The lifecycle of data describing MDOT assets flows to many different areas, both within MDOT and outside of MDOT, and would require a large cross disciplinary effort.

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# RESEARCH ADMINISTRATION
# MDOT RESEARCH PROJECT
# ANNUAL REPORT - FISCAL YEAR 2025

| | |
|---|---|
| PROJECT TITLE: | Effectiveness of Inductive Vehicle Charging to Alleviate EV Range Anxiety – University Transportation Center (UTC) |
| FUNDING SOURCE: | ☒ SPR, Part II ☐ OTHER (*PLEASE EXPLAIN)* |
| PROJECT MANAGER: | Mueller, Michelle |

| | | | |
|---|---|---|---|
| CONTRACT/AUTHORIZATION NO. | 2022-0433 Z4 | PROJECT START DATE | 3/1/2024 |
| PROJECT NO. | 219864 | COMPLETION DATE (Original) | 5/20/2026 |
| OR NO. | OR24-003 | COMPLETION DATE (Revised) | |
| RESEARCH AGENCY | University of Michigan (UM) | | |
| PRINCIPAL INVESTIGATOR | Yin, Yafeng | | |

**BUDGET STATUS**

| FY 2025 Budget | | Total Budget | |
|---|---|---|---|
| Vendor Budget FY 2025 | $122,151.86 | Total Vendor Budget | $176,667.80 |
| MDOT Budget FY 2025 | $0.00 | Total MDOT Budget | $0.00 |
| Vendor FY 2024 Expenditures | $101,261.00 | Total Budget | $176,667.80 |
| MDOT FY 2024 Expenditures | $0.00 | Total Expenditures | $128,660.95 |
| | | **Total Amount Available** | $48,006.85 |

***This is a University Transportation Center (UTC) project.**

| | Total Contract Budget | Expenditures FY 2024 | Expenditures FY 2025 |
|---|---|---|---|
| **MDOT SPRII Funding (80%)** | $176,667.80 | $27,399.95 | $101,261.00 |
| **University Match (20%)** | $ 44,166.95 | $ 6,849.99 | $ 25,315.25 |
| **UTC Project Totals** | $220,834.75 | $34,249.94 | $126,576.25 |

## PURPOSE AND SCOPE

The Infrastructure Investment and Jobs Act (IIJA) has made the transition from fossil fuel-powered vehicles to electric vehicles (EVs) a priority in the United States, and as a state transportation agency with one of the nation's mobility hubs, the Michigan Department of Transportation (MDOT) is tasked with making EVs more accessible to the public. One major challenge for EVs' broad acceptance is "range anxiety," which describes an EV user's worry that the car battery will run out before they can reach a charging point. MDOT is aiming to be the first in the nation to ease range anxiety with a new innovative solution: inductive vehicle charging. This technology allows EVs to wirelessly charge in motion while driving over a road with embedded charging coils. The proposed research will evaluate, analyze, and validate the effectiveness of this technology and identify ideal locations for implementation. Researching this system in Michigan allows this technology to be tested in a variety of weather conditions and potentially proves its usefulness to the public. If proven effective, this technology could be expanded across the country for the benefit of the public

## FISCAL YEAR 2024 ACCOMPLISHMENTS

UM has performed the following activities:

- Attend July 8, 2024, kickoff meeting (Task 1) with the MDOT RAP. Meeting activities included the review of projects tasks, schedule, milestones, deliverables, and reporting requirements.
- Attend monthly check-in meetings with Co-PM Caitlin Day on project progress.
- Attend October 17, 2024, an update meeting with the MDOT RAP to review progress on project tasks and project timeline.
- Identify different IVC use cases targeting various types of EV users, specify scenarios under which IVC technology can effectively overcome users' range anxiety or will be favored over charging stations, and assess the potential benefits of IVC technology for each use case (Task 2). These have included:
  - Intercity highways which serve private vehicles and long-haul trucks,
  - Central business district serving private vehicles, ride-sourcing vehicles and delivery trucks,
  - Border crossings serving private vehicles and long-haul trucks,
  - Transit routes serving transit buses, and
  - Pick up/drop off areas of points of interest such as airport or central station serving ride sourcing vehicles.

## FISCAL YEAR 2025 ACCOMPLISHMENTS

Activities completed in FY25 include the following:

- UM has provided monthly check-in meetings with the PM and quarterly progress updates with the MDOT RAP.
- Complete the identification and analysis of the IVC use cases (Task 2).
- Complete the investigation of IVC technology (Task 3). This task involved collecting and analyzing data on IVC technology by reviewing literature, examining the industry, meeting with IVC technology manufacturers, and gathering information from the

IVC pilots. Information will be used to develop IVC technology performance metrics, to evaluate the ability of IVC technology to extend the target user group(s) range and recommend the minimum requirements such as lane length for IVC technology implementation to be successful.

- Begin the research and establish a mathematical model to identify the optimal locations for implementing IVC technology, with the objective of mitigating range anxiety for the selected high impact use case (Task 4). A custom model will be created tailored to meet the requirements of the chosen high impact use case. This model can then act as a decision-support tool for MDOT when selecting optimal locations for IVC technology implementation.
- Begin the conceptual cost-benefit analysis (Task 5) considering the revenue generated based on different technology adoption scenarios by potential user groups for the selected high impact use case to help MDOT in their return-on-investment analysis.

**FISCAL YEAR 2026 PROPOSED ACTIVITES**

Anticipated FY 2026 activities will include the completion of Tasks 4-5 and Tasks 6-8, which include the final report, presentation, and project wrap-up.

**JUSTIFICATION(S) FOR REVISION(S)**

None.

**SUMMARY OF THE IMPLEMENTATION RECOMMENDATION**

Project expected completion FY 2026.

Michigan Department
Of Transportation
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# RESEARCH ADMINISTRATION
# MDOT RESEARCH PROJECT
# ANNUAL REPORT - FISCAL YEAR 2025

PROJECT TITLE: Finite Element Method (FEM) Matrix Study for Rapid Travel Profiler Curl/Warp Correlations – University Transportation Center (UTC)

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

PROJECT MANAGER: Byrum, Chris

| | | | |
|---|---|---|---|
| CONTRACT/AUTHORIZATION NO. | 2024-0565 | PROJECT START DATE | 8/1/2024 |
| PROJECT NO. | 220837 | COMPLETION DATE (Original) | 8/31/2025 |
| OR NO. | OR24-005 | COMPLETION DATE (Revised) | 2/28/2026 |
| RESEARCH AGENCY | Michigan State University (MSU) | | |
| PRINCIPAL INVESTIGATOR | Haider, Syed | | |

**BUDGET STATUS**

| *FY 2025 Budget | | *Total Budget | |
|---|---|---|---|
| Vendor Budget FY 2025 | $85,023.56 | Total Vendor Budget | $137,600.00 |
| MDOT Budget FY 2025 | $0.00 | Total MDOT Budget | $0.00 |
| Vendor FY 2025 Expenditures | $60,305.60 | Total Budget | $137,600.00 |
| MDOT FY 2025 Expenditures | $0.00 | Total Expenditures | $60,305.60 |
| | | **Total Amount Available** | $77,294.40 |

***This is a University Transportation Center (UTC) project.**

| | Total Contract Budget | Expenditures FY 2024 | Expenditures FY 2025 |
|---|---|---|---|
| **MDOT SPRII Funding (80%)** | $137,600.00 | $0.00 | $60,305.60 |
| **University Match (20%)** | $ 34,400.00 | $0.00 | $15,076.40 |
| **UTC Project Totals** | $172,000.00 | $0.00 | $75,382.00 |

**PURPOSE AND SCOPE**

It is known from experience over the years that development of unusual large warp curvatures in jointed concrete pavement slabs can cause accelerated or rapid deterioration rates for the pavement and result in poor ride quality. MDOT has experienced occasional events of large upwarp or downwarp; a complex phenomenon not well understood or easily simulated with structural analysis tools. It has also been shown that typical variation in daily slab curvatures caused by morning to afternoon thermal gradient variations (curling) can affect International Roughness Index (IRI) calculations used for initial smoothness specifications control and for pavement management systems.

MDOT's current focus is to undertake studies of how warp and curl related slab curvature affects initial smoothness IRI calculations and long-term pavement management system IRI values. Rapid travel profiling devices can accurately measure average concrete pavement slab curvature and daily curvature changes caused by varying temperature gradients. These profiling devices measure variations in curvature present along the traveled wheel paths in the slabs. Procedures exist for quantifying curvature in slabs from rapid travel profile data.

Thus, the problem to address under this proposed research is to develop a structural back-calculation or matching tool from modern finite element type analysis methods that will match observed slab curvature magnitudes and variations in the wheel path location, to those predicted using FEM models. This tool is to replace existing simplified tools that use Westergaard's equations for "infinite strip" slab shape from the 1920s, with a more realistic tool based on wheel path shapes predicted from a suitable modern FEM structural analysis model.

**FISCAL YEAR 2024 ACCOMPLISHMENTS**

MSU has performed the following activities:

- Attend August 13, 2024, a kickoff meeting with the MDOT RAP. Meeting activities included the review of projects tasks, schedule, milestones, deliverables, and reporting requirements.
- Attend bi-weekly check-in meetings with PM on project progress.
- Provide the MDOT team with comparison data on the available Finite Element Method (FEM) models and software. The evaluation considered various slab lengths, joint stiffness parameters and thermal gradient variations, ensuring comprehensive analysis capabilities for JCP slabs. This is to ensure the chosen FEM model can properly handle different thermal loading scenarios, boundary conditions, and provide accurate simulation of slab curvatures and related parameters essential for pavement analysis (Task 1).
- Begin developing a test matrix for FEM runs to enable the development of Neural Networks (NNs) for prediction of slab shape profiles (Task 2). The chosen FEM model used should be able to predict slab shape profiles and have the following

characteristics: 1) an extended model with at least 3 slabs with two simulated joints. The data from the middle slab will be used for curled slab shape within wheel paths for a 12-ft slab width; 2) the modeled slabs will be placed on a single composite subgrade model (k-values between 150 and 450 psi/inch); 3) Typical MDOT concrete physical properties representing typical in-service values will be used; 4) slab thickness is between 9 and 15 inches, and joint spacing is between 12 and 24 feet; 5) thermal gradients ranging from -6 degF/in (afternoon) to +8 degF/in (morning); and 6) joint stiffness to vary from low load transfer efficiency (30 to 40 percent for winter/old conditions) to high load transfer efficiency (75 to 85 percent for newer working joints and warm weather).

MSU does not bill until costs hit their accounting and confirmed nothing was billed for FY 2024.

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

Activities completed in FY25 include:

- Task 2: Develop a test matrix of FEM runs to enable development of a back-calculation or matching tool for rapid travel profile data slab curvature analyses. In this task, the MSU research team developed a test matrix for FEM runs to enable the development of Neural Networks (NNs) for prediction of curling profiles.
- Task 3: Slab Shape Analyses. Using the Neural Networks (NNs) developed in Task 2 the research team calculated surface deformation output in the wheel path and diagonal in a similar system. The research team developed a deflection prediction tool to be used for testing.
- Task 4: Slab Stress Analyses. Using the NNs developed in Task 2 the research team calculated the peak transverse and longitudinal curling stresses in a similar system. The research team developed a stress prediction tool for testing.
- Task 5: Slab shape IRI calculations. The research team developed a tool based on the FEM results to investigate the pure impact of curvature on IRI. The tool can be used at the design stage to evaluate the influence of various variables on expected surface-roughness during different days and seasons.
- Task 6: Relational Database and Predictive Model. The research team has been developing a relational database based on the results of FEM analyses for input variables considered in the test matrix from Tasks 2-4. They have also been developing an artificial neural network (ANN) which will be trained as a practical tool to calculate slab shape and stresses (the ANN model can be used to predict slab shapes and stresses without the FEM model). The team has also been developing a separate tool to estimate surface roughness (i.e., IRI) based on the longitudinal profiles in the wheel path from the ANN tool. A graphic interface will be designed to input various parameters and data visualization.

**FISCAL YEAR 2026 PROPOSED ACTIVITES**

Anticipated FY26 activities include the completion of Task 6 and Task 7, which consists of the final report.

**JUSTIFICATION(S) FOR REVISION(S)**

None.

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

Project expected completion FY 2026.

Michigan Department
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5312 (2014)

# RESEARCH ADMINISTRATION
# MDOT RESEARCH PROJECT
# ANNUAL REPORT - FISCAL YEAR 2025

| | |
|---|---|
| PROJECT TITLE: | Research and Development of a 3-Item Transportation Security Index Mobility Measurement Tool – University Transportation Center (UTC) |

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

PROJECT MANAGER: Richard Bayus and James Dell

| | | | |
|---|---|---|---|
| CONTRACT/AUTHORIZATION NO. | 2022-0433 Z5 | PROJECT START DATE | 5/22/2024 |
| PROJECT NO. | 221109 | COMPLETION DATE (Original) | 6/5/2025 |
| OR NO. | OR24-017 | COMPLETION DATE (Revised) | |
| RESEARCH AGENCY | University of Michigan (UM) | | |
| PRINCIPAL INVESTIGATOR | Murphy, Alexandra | | |

**BUDGET STATUS**

| ***FY 2025 Budget** | | ***Total Budget** | |
|---|---|---|---|
| Vendor Budget FY 2025 | $89,270.21 | Total Vendor Budget | $126,504.00 |
| MDOT Budget FY 2025 | $0.00 | Total MDOT Budget | $0.00 |
| Vendor FY 2025 Expenditures | $89,270.21 | Total Budget | $126,504.00 |
| MDOT FY 2025 Expenditures | $0.00 | Total Expenditures | $126,504.00 |
| | | **Total Amount Available** | $0.00 |

***This is a University Transportation Center (UTC) project.**

| | **Total Contract Budget** | **Expenditures** | |
|---|---|---|---|
| | | **FY 2024** | **FY 2025** |
| **MDOT SPRII Funding (63%)** | $126,504.00 | $37,233.79 | $ 89,270.21 |
| **University Match (37%)** | $ 74,296.00 | $20,072.33 | $ 52,428.54 |
| **UTC Project Totals** | $200,800.00 | $59,101.25 | $141,698.75 |

**PURPOSE AND SCOPE**

Transportation security index mobility measurement tool offers new insights into who is experiencing transportation insecurity and the severity of the experience. The transportation security index is an essential measurement tool the Michigan DOT could utilize to (1) assess populations and geographies where mobility infrastructure investments are needed, (2) evaluate the impact of department investments on mobility approaches, and (3) trace the progress the department is making on transportation equity goals. Therefore, this research project will focus on the research and development of a cost effective, reduced 3-item TSI mobility measurement tool. Once research is complete this tool may be utilized by the department on future mobility infrastructure investments to identify travel behavior trends and patterns to inform future mobility approaches with respect to transportation equity. In this way the problem to address will be limited to the research and development of a data collection tool and not include the deployment of that tool.

**FISCAL YEAR 2024 ACCOMPLISHMENTS**

UM has performed the following activities:

- Attend June 18, 2024, kickoff meeting (Task 1) with the MDOT RAP. Meeting activities included the review of projects tasks, schedule, milestones, deliverables, and reporting requirements.
- Attend August 13, 2024, an update meeting with the MDOT RAP to review progress on project tasks and project timeline.
- Began a literature review on approaches that are currently used to assess the mobility needs of a population (Task 2). This review will help detail how the Transportation Security Index (TSI) evolved, including how it is different from other approaches used to assess mobility needs. It will also provide a synapsis of contemporary TSI research that led to the existing approaches available.
- Collect the data on the six-item transportation security index that was part of the survey conducted by the Detroit Metro Area Community Study (DMACS) which was administered to 2,300 City of Detroit residents. Analyze the data from the survey and produce a white paper on Transportation Insecurity in the Motor City and for MDOT review (Task 3).
- Identified a candidate 3-item index using existing nationally representative data (Task 4).
- Conducted a new survey, using the new 3-item index on an independent, nationally representative sample using a split-ballot experiment (Task 5). Each ballot had approximately 2,000 respondents.
- Began analyzing the results of the survey to validate the 3-item index to determine if it is as predictive and the previous TSI-6 (Task 6).
- Completed the 3rd and 4th quarter progress reports (Task 7).

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

This research project sought to build off a study published in 2022 that developed and validated a novel mobility measurement tool, the Transportation Security Index (TSI), to quantify the prevalence of transportation insecurity in the United States. Using nationally representative survey data, cognitive interview data, and content feedback from experts, the research project was able to develop and validate a 3-item TSI (comparable to the established TSI-6 tool from the 2022 study). The TSI-3 is comprised of three questions that capture both the material and the relational symptoms of transportation insecurity and that, together, can be used to identify whether an individual is experiencing transportation insecurity. Additionally, the project was able to demonstrate that the TSI-3 takes less time to complete than the TSI-6 and that it is less costly and burdensome to administer. Through the research, several use cases for the TSI were identified for potential MDOT use.

- Establish a baseline and track prevalence changes over time: To understand the prevalence of transportation insecurity in the State of Michigan, the TSI could be included on statewide surveys representative of the State of Michigan, thereby establishing a baseline prevalence estimate. If included on reoccurring statewide surveys, changes in the prevalence of insecurity could be tracked over time, alongside other things likely to impact transportation insecurity like changing demographics and vehicles, gas, insurance costs, and changes in investments in transportation infrastructure.

- Identify geographic “hot spots” of transportation insecurity: If included on surveys that collect data at fine-grained spatial scales (i.e. census tracts, block groups), the TSI can be used to identify spatial “hot spots” where transportation insecurity spatially clusters. Such information can be used in decisions about how to allocate transportation resources and investments to areas most in need of such interventions.

- Investigate the causes of transportation insecurity to identify solutions: When included in surveys with other questions about mode use, travel patterns, finances, among other things, MDOT can examine what factors are driving transportation insecurity across different demographic groups and geographic areas.

- Investigate attitudes and perceptions by transportation insecurity: If included on the MI Attitudes and Perceptions Survey, MDOT could examine how the attitudes of Michigan residents towards the state’s transportation systems differ by whether residents are transportation insecure versus those who are transportation secure.

- Evaluate whether investments are effectively moving residents from transportation insecurity to transportation security: MDOT could use the TSI to evaluate whether their programs, systems, and investments are alleviating residents’ experiences with transportation insecurity.

**JUSTIFICATION(S) FOR REVISION(S)**

None.

**SUMMARY OF THE IMPLEMENTATION RECOMMENDATION**

The TSI-3 questions developed through this research project have already been included in the Household Travel Survey and the Attitudes and Perceptions Survey which were administered in 2025.

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# RESEARCH ADMINISTRATION
# MDOT RESEARCH PROJECT
# ANNUAL REPORT - FISCAL YEAR 2025

PROJECT TITLE: Automatic Signal Retiming Using Vehicular Trajectory Data – University Transportation Center (UTC)

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

PROJECT MANAGER: Seeger, William

| | | | |
|---|---|---|---|
| CONTRACT/AUTHORIZATION NO. | 2022-0433 Z6 | PROJECT START DATE | 5/22/2024 |
| PROJECT NO. | 221177 | COMPLETION DATE (Original) | 5/22/2025 |
| OR NO. | OR24-015 | COMPLETION DATE (Revised) | 11/30/2025 |
| RESEARCH AGENCY | University of Michigan (UM) | | |
| PRINCIPAL INVESTIGATOR | Liu, Henry | | |

**BUDGET STATUS**

| *FY 2025 Budget | | *Total Budget | |
|---|---|---|---|
| Vendor Budget FY 2025 | $132,575.20 | Total Vendor Budget | $199,999.99 |
| MDOT Budget FY 2025 | $0.00 | Total MDOT Budget | $0.00 |
| Vendor FY 2025 Expenditures | $132,575.20 | Total Budget | $199,999.99 |
| MDOT FY 2025 Expenditures | $0.00 | Total Expenditures | $179,772.55 |
| | | **Total Amount Available** | $20,227.44 |

***This is a University Transportation Center (UTC) project.**

| | Total | Expenditures | |
|---|---|---|---|
| | **Contract Budget** | **FY 2024** | ****FY 2025** |
| **MDOT SPRII Funding (70%)** | $199,999.99 | $67,424.79 | $132,575.20 |
| **University Match (30%)** | $ 98,000.00 | $28,896,34 | $ 56,817.94 |
| **UTC Project Totals** | $285,714.27 | $96,321.13 | $189,393.14 |

**Represents costs through 3/31/2025. MDOT has submitted requests for invoicing through fiscal year end.

**PURPOSE AND SCOPE**

Traffic signal optimization is a cost-effective method for reducing congestion and energy consumption in urban areas. However, due to the high cost of manual data collection and the labor-intensive modeling, only minimum amounts of data are typically collected and traffic signals and are not regularly optimized. More cost-effective methods for signal optimization need to be explored, such as the use of vehicle trajectory data that is now available. Research is needed to determine if this process can provide optimized timings at more frequent and regular intervals, yielding better overall signal performance.

**FISCAL YEAR 2024 ACCOMPLISHMENTS**

UM has performed the following activities:

- Attend July 31, 2024, a kickoff meeting with the MDOT RAP. Meeting activities included the review of projects tasks, schedule, milestones, deliverables, and reporting requirements.
- Attend October 15, 2024, an update meeting with the MDOT RAP to review progress on project tasks and project timeline.
- Developed a network setup procedure by configuring the Optimizing Signals as a Service (OSaaS) platform in preparation for signal retiming activities in the operational network area network of Oakland County (Task 1).
- Acquired trajectory data from General Motors (GM) for the Oakland County operational area and processed it for compatibility with the OSaaS system. To standardize and automate the signal process, this data was matched to the map network stored on the cloud, splitting vehicle trips at the intersection level, performance index calculations, and trajectory aggregation (Task 2).
- Determined traffic flow model calibration (Task 3) by developing methods for automatically extracting model input parameters (i.e., saturation flow rate, free-flow speed, and start-up loss time) from aggregated historical measurements representative of the time of interest for the traffic flow model.
- The traditional method of signal optimization was completed (Task 6).
- Completed the 3rd and 4th quarter progress reports (Task 8).

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

This research project sought to evaluate the technical readiness of a UM developed traffic signal optimization system that uses a small percentage of vehicle trajectory data as the only input.

The system was tested through a real-world deployment conducted in coordination with MDOT and the Road Commission for Oakland County (RCOC) where the research used vehicle trajectory data from an estimated 7% of vehicles in the traffic network to update cycle lengths, splits, offsets, and timing schedules at seven intersections along a 2.5-mile stretch of a coordinated-

actuated arterial in Pontiac, MI. This corridor recently went through a traditional signal optimization based on vehicle count data, providing a unique opportunity to directly compare the performance of the new vehicle trajectory-based system against conventional methods. The vehicle trajectory-based system outperformed the traditional approach, reducing the overall control delay by 17.4% and the number of stops by 20.4%, compared to reductions of 13.7% and 14.9%, respectively, achieved by traditional optimization.

The research findings promote that by utilizing increasingly available vehicle trajectory data as the only input and not requiring any additional infrastructure, the developed traffic signal optimization system could provide a more scalable and economical solution to traffic signal optimization that could be applied worldwide.

**FISCAL YEAR 2026 PROPOSED ACTIVITES**

This project is nearing completion with the final report and project closeout expected early in FY 2026.

**JUSTIFICATION(S) FOR REVISION(S)**

None.

**SUMMARY OF THE IMPLEMENTATION RECOMMENDATION**

Project expected completion FY 2026.

Michigan Department
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# RESEARCH ADMINISTRATION
# MDOT RESEARCH PROJECT
# ANNUAL REPORT - FISCAL YEAR 2025

PROJECT TITLE: End-to-End Learning Framework for Transportation Network Equilibrium Modeling – University Transportation Center (UTC)

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

PROJECT MANAGER: Maffeo, Robert

| | | | |
|---|---|---|---|
| CONTRACT/AUTHORIZATION NO. | 2022-0433 Z7 | PROJECT START DATE | 5/28/2024 |
| PROJECT NO. | 221183 | COMPLETION DATE (Original) | 10/25/2025 |
| OR NO. | OR24-016 | COMPLETION DATE (Revised) | 10/25/2026 |
| RESEARCH AGENCY | University of Michigan (UM) | | |
| PRINCIPAL INVESTIGATOR | Yin, Yafeng | | |

**BUDGET STATUS**

| FY 2025 Budget | | Total Budget | |
|---|---|---|---|
| Vendor Budget FY 2025 | $79,556.55 | Total Vendor Budget | $124,849.33 |
| MDOT Budget FY 2025 | $0.00 | Total MDOT Budget | $0.00 |
| Vendor FY 2025 Expenditures | $90,806.09 | Total Budget | $124,849.33 |
| MDOT FY 2025 Expenditures | $0.00 | Total Expenditures | $117,569.10 |
| | | **Total Amount Available** | $7,190.23 |

***This is a University Transportation Center (UTC) project.**

| | Total Contract Budget | Expenditures | |
|---|---|---|---|
| | | FY 2024 | FY 2025 |
| **MDOT SPRII Funding (80%)** | $124,849.33 | $33,566.26 | $ 90,806.09 |
| **University Match (20%)** | $ 31,212.33 | $ 8,391.56 | $ 22,701.52 |
| **UTC Project Totals** | $156,061.66 | $41,957.82 | $113,507.61 |

**PURPOSE AND SCOPE**

Transportation network equilibrium modeling plays a crucial role in the analysis and planning of transportation roadway network systems. However, historically, these modeling systems have relied on costly and time-consuming household surveys to gather data. As a result, planning agencies only update their models every few years, and limited efforts have been made to calibrate the systems due to a lack of empirical traffic data. Consequently, the resulting models often produce inaccurate results.

Moreover, previous models have been constructed using a "bottom-up" assembly approach, where the specification and calibration of individual components, whether on the supply or demand side, are divorced from the goal of the model: prescribing an equilibrium flow distribution that closely matches observations.

Fortunately, with the advent of vehicle connectivity, vehicle trajectory data has become more readily available. Leveraging this dataset and recent advancements in artificial intelligence, our proposed research aims to develop an end-to-end modeling framework. This framework will directly utilize empirical sampled trajectory data as inputs to learn the modeling components for both the supply and demand sides, as well as the equilibrium flow distribution. By doing so, the proposed framework has the potential to transform the way States and Metropolitan Planning Organizations (MPO) analyze and plan their transportation networks.

**FISCAL YEAR 2024 ACCOMPLISHMENTS**

UM has performed the following activities:

- Project management (Task 1) which included:
  - Attend July 19, 2024, a kickoff meeting with the MDOT RAP. Meeting activities included the review of projects tasks, schedule, milestones, deliverables, and reporting requirements.
  - UofM met with MDOT and the Southeast Michigan Council of Governments (SEMCOG) on August 9, 2024, to collect output information on the trip-based forecast, zone-level data, the auto-trip matrices and the network information from 2020 and 2025.
  - PM Robert Maffeo invited Zhichen Liu to attend the LOCUS Workshop on August 14, 2024.
  - Downloaded the 2022 INRIX data from the RITIS platform for analysis.
  - Attend October 24, 2024, an update meeting with the MDOT RAP to review progress on project tasks and project timeline.
  - Completed the quarter progress reports.

- Began developing a unified framework for end-to-end learning of transportation network equilibrium (Task 2). The required building from existing prototypes to analyze supply/demand components from empirical data and unify the use of model-based and model-free components.
- Acquired and leveraged General Motor's vehicle trajectory data and the proposed end-to-end learning framework from Task 2 to enhance the behavioral realism and prediction accuracy of a planning model maintained by Washtenaw Area Transportation Study to demonstrate the unifying end-to-end framework using Ann Arbor as the case study (Task 3).

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

UM anticipates performing the following activities:

- Project management (Task 1) including:
  - Attended quarterly progress updates with the MDOT RAP.
  - Completed quarterly progress reports.
- Completed the unified framework for end-to-end learning of transportation network equilibrium (Task 2) by conducting theoretical analysis on the feasibility of the proposed framework.
- Completed demonstrating the feasibility of the framework (Task 3) by developing a new trajectory-data driven feasible path set generation algorithm framework to account for unavailable data.
- Used the Ann Arbor case study and the developed framework investigate and prescribe improvement strategies to the framework (Task 4).

Produce a final draft report for the project and provide recommendations for MDOT on future use within the 90-day window prior to the contract end date (Task 5).

**FISCAL YEAR 2026 PROPOSED ACTIVITES**

Anticipated FY26 activities include the completion of the final report and deliverables.

**JUSTIFICATION(S) FOR REVISION(S)**

None.

**SUMMARY OF THE IMPLEMENTATION RECOMMENDATION**

Project expected completion FY 2026.

Michigan Department
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# RESEARCH ADMINISTRATION
# MDOT RESEARCH PROJECT
# ANNUAL REPORT - FISCAL YEAR 2025

PROJECT TITLE: Flood Fragility of Roads and Railroads – University Transportation Center (UTC)

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

PROJECT MANAGER: Zweng, Harold

| | | | |
|---|---|---|---|
| CONTRACT/AUTHORIZATION NO. | 2025-0454 | PROJECT START DATE | 10/1/2024 |
| PROJECT NO. | 221872 | COMPLETION DATE (Original) | 9/30/2026 |
| OR NO. | OR25-006 | COMPLETION DATE (Revised) | |
| RESEARCH AGENCY | Michigan State University (MSU) | | |
| PRINCIPAL INVESTIGATOR | Lanotte, Michael | | |

**BUDGET STATUS**

| FY 2025 Budget | | *Total Budget | |
|---|---|---|---|
| Vendor Budget FY 2025 | $48,427.84 | Total Vendor Budget | $177,510.87 |
| MDOT Budget FY 2025 | $18,833.05 | Total MDOT Budget | $0.00 |
| Vendor FY 2025 Expenditures | $4,822.23 | Total Budget | $177,510.87 |
| MDOT FY 2025 Expenditures | $0.00 | Total Expenditures | $4,822.23 |
| | | **Total Amount Available** | $172,688.64 |

***This is a University Transportation Center (UTC) project.**

| | Total Contract Budget | Expenditures **FY 2025 |
|---|---|---|
| **MDOT SPRII Funding (~72%)** | $177,973.21 | $4,822.23 |
| **University Match (~28%)** | $ 69,211.81 | $ 0.00 |
| **UTC Project Totals** | $247,185.02 | $4,822.23 |

**Matching funds were not included on the initial invoice and will be reported in FY 2026.

**PURPOSE AND SCOPE**

Rising water levels and frequent intense rain events have caused roads and railroads to be inundated in more locations and more frequently. Inundation impacts are unique to the location, road use, soils, pavement design, duration, and other factors, MDOT's approach to inundated roadways has generally been limited to observations and limited adaptation strategies. While pavement and embankments that have been washed out need to be repaired or replaced, roadways that remain visually intact during a flood event or extended high water events are not as well understood. This project will identify countermeasures and study the long-term and short-term effect of these inundation cycles.

**FISCAL YEAR 2024 ACCOMPLISHMENTS**

Project start was delayed into FY 2025.

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

The MDOT Research Advisory Panel (RAP) and MSU research teams met to discuss project objectives and tasks. Since the kickoff, the MSU research team has worked to complete the following:

- Completion of Task 1: Literature Review.
  MSU's review focused on flood-related damage mechanisms and mitigation strategies for roads, railroads, and embankments. They found that for roads, flooding weakens pavement layers through moisture infiltration, with drainage quality being the most critical factor for resilience. Agencies like FHWA and state DOTs have developed tools and technologies, including sensors, Artificial Intelligence (AI), and rapid-deployment barriers, to assess and mitigate damage. For railroads, the review identified ballast scour, embankment erosion, and seepage as key vulnerabilities with the Federal Railroad Administration (FRA) and Federal Transit Authority (FTA) advancing research on predictive maintenance, inspection methods, and flood-resilient materials. For embankments, six main flood-failure mechanisms were identified, including overtopping and internal erosion. Various countermeasures such as vegetation, geotextiles, riprap, and innovative erosion control mats were reviewed. Overall, the review synthesized best practices and federal and state research to guide Michigan's development of fragility models and resilience strategies for transportation infrastructure.
- Initial discussion on Task 2: Site Selection.
  The RAP provided potential site locations and site characteristics (i.e. history, soil heterogeneity, etc.) to MSU to begin the process of identifying the 6 flood-prone Michigan sites to be evaluated for vulnerability as the focus of this project.

| FISCAL YEAR 2026 PROPOSED ACTIVITES |
| --- |
| In FY 2026, the teams anticipate completion of:<br>• Task 2: Site Selection.<br>• Task 3: Preliminary investigations of the selected sites, which will include drone flights, geotechnical testing, piezometer and sensor installations<br>• Task 4: In-depth analysis of collected samples and data to quantify embankments, roadways, and railways' fragility under flood conditions. |
| **JUSTIFICATION(S) FOR REVISION(S)** |
| None. |
| **SUMMARY OF THE IMPLEMENTATION RECOMMENDATION** |
| Project expected completion FY 2026. |

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# RESEARCH ADMINISTRATION
# MDOT RESEARCH PROJECT
# ANNUAL REPORT - FISCAL YEAR 2025

PROJECT TITLE: Multimodal 3D Perception System for Active Safety at Accident-prone Locations - UTC

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

PROJECT MANAGER: Tom Gordon

| | | | |
|---|---|---|---|
| CONTRACT/AUTHORIZATION NO. | 2025-0257 | PROJECT START DATE | 2025-06-15 |
| PROJECT NO. | 223695 | COMPLETION DATE (Original) | 2027-06-15 |
| OR NO. | OR25-001 | COMPLETION DATE (Revised) | |
| RESEARCH AGENCY | University of Michigan (UM) | | |
| PRINCIPAL INVESTIGATOR | Zhang | | |

**BUDGET STATUS**

| FY 2025 Budget | | *Total Budget | |
|---|---|---|---|
| Vendor Budget FY 2025 | $193,051.46 | Total Vendor Budget | $432,000.00 |
| MDOT Budget FY 2025 | $0.00 | Total MDOT Budget | $0.00 |
| Vendor FY 2025 Expenditures | $0.00 | Total Budget | $432,000.00 |
| MDOT FY 2025 Expenditures | $0.00 | Total Expenditures | $0.00 |
| | | **Total Amount Available** | $432,000.00 |

***This is a University Transportation Center (UTC) project.**

| | Total Contract Budget | Expenditures **FY 2025 |
|---|---|---|
| **MDOT SPRII Funding (80%)** | $432,000.00 | $0.00 |
| **University Match (20%)** | $108,000.00 | $0.00 |
| **UTC Project Totals** | $540,000.00 | $0.00 |

**MDOT has submitted requests for project invoices through fiscal year-end.

**PURPOSE AND SCOPE**

Accident-prone locations, such as busy intersections, present challenging safety scenarios where many traffic-related injuries and fatalities occur throughout the state of Michigan. For example, according to the Michigan Traffic Crash Facts Report, more than 30% of fatal crashes take place at intersections. Furthermore, for each person killed in 2020 due to fatal crashes in Michigan, 56 people were injured according to the same report. While camera-based active safety systems used at intersections can mitigate some of these safety issues by detecting and tracking objects within captured video frames, these camera-based systems cannot provide accurate distance information and precise Bird-Eye-View (BEV) maps of the objects within the scene. Numerous technologies exist that could be utilized to provide solutions to these problems, such as LIDAR, cameras, etc.

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

The MDOT Research Advisory Panel (RAP) and UM research teams discussed project objectives and tasks. Since the kickoff, the UM research team has worked to complete the following:

- Completion of Task 1: Review of Existing Technologies. UM research team provided a detailed technology review, which evaluated multiple sensors and processing options. Based on the findings the team selected the following for the purposes of this research:
  - Fisheye cameras for broad coverage and mechanical spinning LIDARs for 360-degree detection and localization.
  - The C-V2X communication protocol was chosen over DSRC for its 5G-based reliability.
  - For processing, the team opted for dedicated GPU-powered edge boxes to support real-time AI inference.
  - The perception algorithms being tested include PointPillars and SECOND, both of which process point-cloud data into bird's-eye-view (BEV) formats for 3D detection.
  - Deployed hardware—including two LIDAR units and two fisheye cameras—at the Mcity intersection and established live data streaming to an on-site edge computing device.

- Partial Completion of Task 2: BEV base vehicle and VRU detection.
  - UM has made progress on the edge computing framework, which will serve as the system's central hub connecting all sensors, communication units, and algorithms. The design features modular "nodes" for data intake, processing, and output, supporting both real-time perception and cloud-based data archiving. The cloud component, "InsightSA," enables storage and review of experimental datasets.
  - The UM research team has completed data streaming from both camera and LIDAR sensors, and the infrastructure for detection and fusion algorithms is now operational.
  - Hardware installation and data flow from one LIDAR are complete, with a second LIDAR nearing full integration.

- Early visualization results were provided showing successful point-cloud recordings and introduced Supervisely, the tool that will be used for labeling.

- Partial Completion of Task 3: Conflict prediction algorithm development.
  - UM has reported strong progress on the conflict and near-miss prediction algorithms, which aim to forecast vehicle and pedestrian hazards before they occur.
  - The PI was able to highlight the challenge of balancing detection sensitivity with false alarm rates, emphasizing the importance of high-precision modeling to avoid “alert fatigue.”
  - Using fisheye camera data, the team has achieved a 92% precision rate in identifying conflict cases—an impressive result compared to typical benchmarks of around 50%.
  - The team provided demonstrated examples included lane-merging near misses, red-light violations, and pedestrian conflicts, showing how the system accurately recognized and flagged risky behaviors.

**FISCAL YEAR 2026 PROPOSED ACTIVITES**

The RAP and UM research teams anticipate the completion of the following:
- Task 2: BEV base vehicle and VRU detection.
- Task 3: Conflict prediction algorithm development.
- Task 4: Communication strategy design.
- Task 5: System integration.

**JUSTIFICATION(S) FOR REVISION(S)**

None.

**SUMMARY OF THE IMPLEMENTATION RECOMMENDATION**

Project completion expected FY 2027.

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# RESEARCH ADMINISTRATION
# MDOT RESEARCH PROJECT
# ANNUAL REPORT - FISCAL YEAR 2025

PROJECT TITLE: Enhancing Road Safety Through Video Analytics & Connected Vehicles – University Transportation Center (UTC)

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

PROJECT MANAGER: MacKay, Caitlin

| | | | |
|---|---|---|---|
| CONTRACT/AUTHORIZATION NO. | To Be Determined | PROJECT START DATE | To Be Determined |
| PROJECT NO. | 223991 | COMPLETION DATE (Original) | To Be Determined |
| OR NO. | OR25-015 | COMPLETION DATE (Revised) | |
| RESEARCH AGENCY | University of Michigan (UM) | | |
| PRINCIPAL INVESTIGATOR | Zhang, Rusheng | | |

**BUDGET STATUS**

| **FY 2025 Budget** | | ***Total Budget** | |
|---|---|---|---|
| Vendor Budget FY 2025 | $51,956.55 | Total Vendor Budget | $238,446.04 |
| MDOT Budget FY 2025 | $0.00 | Total MDOT Budget | $0.00 |
| Vendor FY 2025 Expenditures | $0.00 | Total Budget | $238,446.04 |
| MDOT FY 2025 Expenditures | $0.00 | Total Expenditures | $0.00 |
| | | **Total Amount Available** | $238,446.04 |

***This is a University Transportation Center (UTC) project.**

| | **Total Contract Budget** | **Expenditures **FY 2025** |
|---|---|---|
| **MDOT SPRII Funding (80%)** | $238,446.04 | $0.00 |
| **University Match (20%)** | $59,611.51 | $0.00 |
| **UTC Project Totals** | $298,057.55 | $0.00 |

**Project start was delayed to FY 2026.

**PURPOSE AND SCOPE**

The potential of connected vehicles to revolutionize road safety and traffic management is widely acknowledged. However, there is a critical gap in leveraging video analytics in conjunction with connected vehicles to push real-time alerts to drivers, aiming at preventing crashes. Despite the promising results of connected vehicle technology in crash prevention, previous research has been hindered by the lack of a seamless connection to smart vehicles. The focus of this research seeks to address whether advancements in video analytics can be effectively integrated with connected vehicle technology to enable the real-time transmission of safety alerts to drivers, thus enhancing crash prevention measures.

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

This project start was delayed to FY 2026. The contract was sent to the selected university; however, as of October 20, 2025, the contract had not been officially signed for work to begin.

**FISCAL YEAR 2026 PROPOSED ACTIVITES**

Once a contract has been authorized, the MDOT Research Advisory Panel (RAP) and Um research team will schedule a kickoff meeting to discuss the project and collaborate on project tasks as detailed in the approved workplan.

**JUSTIFICATION(S) FOR REVISION(S)**

None.

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

Project expected completion FY 2027.

Michigan Department
Of Transportation
5312 (2014)

# RESEARCH ADMINISTRATION
# MDOT RESEARCH PROJECT
# ANNUAL REPORT - FISCAL YEAR 2025

PROJECT TITLE: Examination of Light-Based Directed Vehicle to Everything Communications Systems for Bridge Strike Detection - UTC

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

PROJECT MANAGER: Tom Gordon

| | | | |
|---|---|---|---|
| CONTRACT/AUTHORIZATION NO. | 2025-0722 | PROJECT START DATE | 10/1/2025 |
| PROJECT NO. | 224831 | COMPLETION DATE (Original) | 1/31/2027 |
| OR NO. | OR25-019 | COMPLETION DATE (Revised) | |
| RESEARCH AGENCY | University of Michigan (UM) | | |
| PRINCIPAL INVESTIGATOR | Lakshmanan | | |

**BUDGET STATUS**

| FY 2025 Budget | | Total Budget | |
|---|---|---|---|
| Vendor Budget FY 2025 | $37,077.43 | Total Vendor Budget | $266,955.68 |
| MDOT Budget FY 2025 | $0.00 | Total MDOT Budget | $0.00 |
| Vendor FY 2025 Expenditures | $0.00 | Total Budget | $266,955.68 |
| MDOT FY 2025 Expenditures | $0.00 | Total Expenditures | $0.00 |
| | | **Total Amount Available** | $266,955.68 |

***This is a University Transportation Center (UTC) project.**

| | Total Contract Budget | Expenditures **FY 2025 |
|---|---|---|
| **MDOT SPRII Funding (80%)** | $266,955.68 | $0.00 |
| **University Match (20%)** | $ 66,783.92 | $0.00 |
| **UTC Project Totals** | $333,694.60 | $0.00 |

**MDOT has submitted requests for project invoices through fiscal year-end.

**PURPOSE AND SCOPE**

With the emergence of advanced driver assistance systems (ADAS) in most modern passenger vehicles, the need for reliable transmission of data from vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) has become apparent. However, many commercial vehicles such as buses and semi-trucks are technologically behind when it comes to sensing potential safety hazards, while having the potential to cause catastrophic damage due to their increased size and weight. One of the most common safety incidents involving large commercial vehicles are bridge strikes and tunnel strikes, where the driver of a tall-load vehicle attempts to pass under a bridge or tunnel and the top of the load collides with the bottom of the overpass. According to the National Highway Safety Administration, there are approximately 15,000 bridge strikes in the USA annually, with potentially more going unreported. These bridge strikes cause a serious threat to the safety of all road users, as well as a substantial financial cost in the form of infrastructure repair, road closures, and traffic disruption.

THE MAJOR TASKS TO ACCOMPLISH THE RESEARCH OBJECTIVES:

1. Verify Height Sensor Reliability: Determination of over height vehicles is a core component of this proposal. There are a variety of off-the-shelf modules that can fill this role that will be examined. However, Due to the stringent sensor accuracy required, Lidar sensing will likely be used in this planning process.
2. Integrate ImpLi-Fi Rx Module with Height Sensor: Integration of the height detection module with the Li-Fi transmission system will require time and effort to accomplish. The Lidar system will need to receive measurements, analyze data, and serially transmit data to the Li-Fi transmitter with low latency and in near-real time.
3. Select Appropriate LED Light: The Li-Fi transmission source (aka, the LEDs) will need to be selected based on the application's approach. This includes but is not limited to optics, part selection, and the power system driving said transmission source. It also includes the transmission LED's physical position relative to the flow of traffic to ensure accurate measurements and reliable Li-Fi transmission.
4. Integrate Li-Fi Rx Module with Host Vehicle: Depending on the vehicle(s) selected for this project, integrating the Li-Fi receiver module may take a fair amount of effort. The level of difficulty this may pose could vary depending on said preexisting hardware. If this approach proves unobtainable, a more robust solution such as manufacturing a novel design to receive the modulated light signal will need to be developed.
5. Integrate Li-Fi Rx Output with Navigation Apps: Once the receiver module on the vehicle receives a message from the transmission module, it will need to relay this information to the driver of the vehicle. The prevailing current method for this would be through integration into the driver's navigation system (i.e., Google Maps, Waze).
6. Test and Evaluation: Once all other previous excursions have been conducted, system-wide test and evaluation will need to be performed to effectively draw conclusions on overall system performance.

| FISCAL YEAR 2025 ACCOMPLISHMENTS |
| --- |
| No fiscal year 2025 activities took place on project OR25-019. A contract was sent to the selected vendor, University of Michigan; however, as of October 20, 2025, no contract has been officially signed for work to begin. |
| **FISCAL YEAR 2026 PROPOSED ACTIVITES** |
| It is anticipated in FY26 once a contract has been authorized that the MDOT RAP and U-M research team will schedule a kickoff meeting to discuss the project and collaborate on project tasks as detailed in the approved workplan. |
| **JUSTIFICATION(S) FOR REVISION(S)** |
| None. |
| **SUMMARY OF THE IMPLEMENTATION RECOMMENDATION** |
| Project completion expected FY 2027. |

Michigan Department
Of Transportation
5307 (11/17)

# RESEARCH ADMINISTRATION
# MDOT TRANSPORTATION POOLED FUND STUDY
# ANNUAL REPORT - FISCAL YEAR 2025

STUDY TITLE: Designing Safer Streets

FUNDING SOURCE: ☒ FHWA ☐ OTHER (*PLEASE EXPLAIN*)

| | | | |
|---|---|---|---|
| TPF NO. | Sol. 1626 | MDOT START DATE | 10/02/2024 |
| OR NO. | OR25-214 | MDOT COMPLETION DATE (Original) | 9/30/2030 |
| | | ESTIMATED COMPLETION DATE (Revised) | |
| MDOT TECHNICAL CONTACT | John Martin, 517-582-8926<br>Email: MartinJ48@Michigan.gov | | |
| LEAD AGENCY | Federal Highway Administration (FHWA) | | |
| LEAD STUDY CONTACT | Josue Pluguez, 202-366-5019<br>Email: Josue.Pluguez@dot.gov | | |
| CONTRACTOR | To Be Determined | | |

## BUDGET STATUS

| FY 2025 MDOT Budget | | | MDOT Total Budget | | |
|---|---|---|---|---|---|
| FY25 FUNDS | (Original) | $0.00 | TOTAL BUDGET | (Original) | $125,000.00 |
| | (Revised) | $0.00 | | (Revised) | $0.00 |
| TOTAL FY 2025 EXPENDITURES | | $0.00 | TOTAL COMMITTED FUNDS AVAILABLE | | $125,000.00 |

## PARTICIPATING STATES

AK, IL, KY, MI, MN, NV, NY, PA, VA

## PURPOSE AND SCOPE

Complete Streets is an implementation strategy in which the transportation network is planned, designed, built, operated, and maintained to enable safe mobility within the transportation system, including, but not limited to, pedestrians, bicyclists, public transportation users, motorists, and freight vehicle operators. The purpose of this proposed Complete Streets (CS) pooled fund study is to conduct research on innovative strategies to design and implement safe streets through a Complete Streets approach.

Activities of the consortium include:

- Identify planning, roadway design, human factors, safety, and operational issues related to Complete Streets elements and projects
- Select new and existing Complete Streets elements and/or projects for evaluation
- Initiate and monitor research projects
- Disseminate results
- Facilitate collaboration and information sharing among members

## FISCAL YEAR 2025 ACCOMPLISHMENTS

This proposed study is still in active Solicitation status. No federal funds transferred in FY25.

## FISCAL YEAR 2026 PROPOSED ACTIVITIES

Awaiting FHWA project approval/assign TPF federal project number and partners transfer funds to lead agency to secure a research vendor.

## JUSTIFICATION(S) FOR REVISION(S)

None.

## SUMMARY OF THE IMPLEMENTATION RECOMMENDATION

Project expected completion FY 2030.

Michigan Department
Of Transportation
5307 (2011)

# RESEARCH ADMINISTRATION
# TRANSPORTATION POOLED FUND STUDY
# ANNUAL REPORT - FISCAL YEAR 2025

STUDY TITLE: AASHTO Engineering Technical Service Programs (TSP) – FY25

FUNDING SOURCE: ☒ FHWA ☐ OTHER (*PLEASE EXPLAIN*)

| | | | |
|---|---|---|---|
| | | MDOT START DATE | 10/01/2024 |
| FEDERAL PROJECT NO. | SPR1801(179) | MDOT COMPLETION DATE (Original) | 9/30/2025 |
| OR NO. | OR25-202 | COMPLETION DATE (Revised) | |
| MDOT TECHNICAL CONTACT | Andre Clover, 517-749-9001<br>Email: CloverA@Michigan.gov | | |
| LEAD AGENCY | American Association of State Highway and Transportation Officials (AASHTO) | | |
| LEAD STUDY CONTACT | Various - Based on technical focus matter | | |
| | | | |

**BUDGET STATUS**

| FY 2025 MDOT Budget | | | | MDOT Total Budget | | |
|---|---|---|---|---|---|---|
| FY25 FUNDS | (Original) | $195,000.00 | | TOTAL COST | (Original) | $195,000.00 |
| | (Revised) | $198,000.00 | | | (Revised) | $198,000.00 |
| TOTAL FY 2025 EXPENDITURES | | $198,000.00 | | TOTAL COMMITTED FUNDS AVAILABLE | | $0.00 |

**PARTICIPATING STATES**

Nationwide Departments of Transportation.

**PURPOSE AND SCOPE**

As a general practice, MDOT technical experts each fiscal year analyze the benefits to MDOT of services and information shared by respective TRB's Technical Service Programs (TSPs). The programs provide benefits to the member departments through the pooling of resources and expertise from across the country.

MDOT supports development and continued operation of each of the following critical programs:

- AASHTO Innovation Management (Formerly A.I.I.) - $6,000
- AASHTO Materials Guidelines (Formerly DAMS) - $10,000
- AASHTO Environmental Management (Formerly ETAP) - $10,000
- AASHTO Technical Training Solutions (Formerly TC3) - $20,000
- AASHTO Winter Weather Management (Formerly SICOP) - $4,000.
- AASHTO Preservation Management (Formerly TSP2) - $25,000.
- AASHTO Equipment Management (Formerly EMTSP) – $10,000.
- AASHTO Produce Evaluation and Audit Solutions (Formerly NTPEP) - $25,000.
- AASHTO Safety Management (Formerly SAFETY) - $10,000.
- AASHTO Structures Guidelines (Formerly LRFDSM) - $23,000.
- National Operations Center of Excellence (NOCoE) - $15,000.
- Operations TSP- $15,000.
- AASHTO Design Guidelines (Formerly DPM) - $15,000.
- AASHTO Safety Hardware Management (Formerly MASH) - $10,000.

Number of Programs/Projects Supported: 14

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

The Subject Matter Expert's (SME's) recommendations were approved by MDOT's Director. SME's shared technology advancements, new improvements, and championed implementation efforts throughout the Department during FY 2025.

**SUMMARY OF THE IMPLEMENTATION RECOMMENDATION**

Each fiscal year, MDOT will review and assess the return on its investment to the list of AASHTO TSP programs noted above. If value is added and the program benefits MDOT, the experts will recommend contributions continue. If no value is realized from a particular program, MDOT may choose to discontinue its contribution.

Michigan Department
Of Transportation
5307 (11/17)

# RESEARCH ADMINISTRATION
# MDOT TRANSPORTATION POOLED FUND STUDY
# ANNUAL REPORT - FISCAL YEAR 2025

STUDY TITLE: Highway Safety Manual Implementation

FUNDING SOURCE: ☒ FHWA ☐ OTHER (*PLEASE EXPLAIN*)

| | | | | |
|---|---|---|---|---|
| TPF NO. | TPF-5(255) | | MDOT START DATE [FY 2016] | 11/09/2015 |
| OR NO. | OR15-527 | | MDOT COMPLETION DATE (Original) [FY 2020] | 12/31/2019 |
| | | | COMPLETION DATE (Estimated) | 12/31/2025 |
| MDOT TECHNICAL CONTACT | Daniel Garcia, 586-634-7671<br>Email: GarciaD1@Michigan.gov | | | |
| LEAD AGENCY | Federal Highway Administration (FHWA) | | | |
| LEAD STUDY CONTACT | Sarah Pascual, 202-366-0087<br>Email: sarahpascual@dot.gov | | | |
| CONTRACTOR | Louisiana Transportation Research Center | | | |

## BUDGET STATUS

| FY 2025 MDOT Budget | | | | MDOT Total Budget | | |
|---|---|---|---|---|---|---|
| FY25 FUNDS | (Original) | $0.00 | | TOTAL BUDGET | (Original) | $100,000.00 |
| | (Revised) | | | | (Revised) | |
| TOTAL FY 2025 EXPENDITURES | | $0.00 | | TOTAL COMMITTED FUNDS AVAILABLE | | $0.00 |

## PARTICIPATING STATES

Louisiana Transportation Research Center, CA, CT, ID, IL, KS, KY, LA, MI, MO, MS, NC, NJ, NV, OH, OK, OR, PA, TX, UT, WA, WI, WV

## PURPOSE AND SCOPE

The objectives of the study are (1) to advance ongoing efforts by lead states to implement the Highway Safety Manual (HSM), and (2) to expand implementation to all states. This study would be coordinated with other ongoing and planned implementation activities sponsored by AASHTO, FHWA, and TRB, including NCHRP Project 17-50 "Lead States Initiative for Implementing the Highway Safety Manual" It will also be coordinated with projects that develop content for future editions of the HSM including NCHRP Project 17-45 "Enhanced Safety Prediction Methodology and Analysis Tool for Freeways and Interchanges" NCHRP Project 17-54 "Consideration of Roadside Features in the Highway Safety Manual" and Transportation Pooled-Fund Study TPF-5(099) "Evaluation of Low Cost Safety Improvements."

This study would conduct research tasks and develop products that would enable States to accelerate their implementation of the HSM. The specific tasks and products would be identified and prioritized by a Technical Working Group consisting of one representative each from participating agencies. Specific tasks may include: (1) developing a calibration manual to accompany the HSM that provides practical advice and examples on how best to adapt HSM calibration procedures to meet the needs of a particular agency, (2) developing technical guidance for agencies on developing safety performance functions, and (3) developing guidance for agencies on assembling and managing the data needed for safety analyses.

The study would also facilitate Technical Working Group representative's participation in peer exchanges and other forums through which agencies can exchange information, best practices, lessons learned, and remaining challenges in implementing the HSM appropriately into agencies' system planning, project planning and preliminary engineering, design and construction, and operations and maintenance procedures and processes. These exchanges would feed an annual process through which the Technical Working Group identifies and prioritizes future tasks to be conducted under the study.

## FISCAL YEAR 2016 ACCOMPLISHMENTS

- A finalized list of State-adapted HSM Part C spreadsheets based upon input from State representatives was developed for posting at the Crash Modification Factor (CMF) Clearinghouse.
- A finalized list of state developed or calibrated Safety Performance Functions (SPFs) based upon feedback from state representatives was developed for posting at the CMF Clearinghouse.
- A preliminary analysis comparing State developed SPFs and State calibration factors was conducted for HSM SPFs as a first step in an evaluation of the feasibility of a "quick and dirty" method that States could use to determine whether an existing SPF may be suitable for use in the State without calibration.
- The "Model State Policies and Procedures for Use of HSM" contractor delivered the draft final report on June 13, 2016. State representatives and FHWA staff provided review comments on July 5, 2016.
- The "Scale and Scope of HSM Implementation in the Project Development Project" contractor delivered the 3rd draft of the final report on June 19, 2016. State representatives and FHWA staff review comments are due July 15.
- Held a virtual quarterly business meeting on May 16, 2016.
- The payoff from participating in this pooled-fund study is minimizing duplication of efforts by all the states and maximizing our resources based on national priorities of delivering products that support the implementation of the HSM.

**FISCAL YEAR 2017 ACCOMPLISHMENTS**

- Virtual meetings were held on May 22 and June 27, 2017
- At the June 27th meeting participants provided feedback on the Life Cycle Benefit–Cost Analysis guide and an overview of an existing spreadsheet tool. The group is going through modifications of the tool to perform economic analysis of safety projects.
- A draft of the Safety Performance for Intersection Control Evaluation (SPICE) tool was developed and presented for feedback to state representatives.
- Modifications are being made to the Network Screening Best Practices contract for the NCHRP 17-50 project to enable the contractor to perform work for this study.

**FISCAL YEAR 2018 ACCOMPLISHMENTS**

- Meetings were held on January 26 and April 5, 2018.
- As part of the Highway Safety Benefit Cost analysis tool, the Crash Cost Values report was finalized and is posted at https://safety.fhwa.dot.gov/hsip/docs/fhwasa17071.pdf.
- A Safety Benefit Cost Analysis (BCA) Guide was completed, and the BCA Tool was finalized. (Report and tool are available online.)
- SPICE version 2.0 was completed and is currently undergoing testing.
- Safety Analysis Needs Assessment for Performance Based Practical Design (PBPD) and Transportation Systems Management and Operations (TSMO) project draft report was disseminated via webinar in April. (Comments were received in May.)

**FISCAL YEAR 2019 ACCOMPLISHMENTS**

- The lead agency conducted a project progress meeting with Technical Advisory Committee (TAC) members on May 29, 2019.
- The peer exchange summary report was completed and posted to pooled fund website.
- Safety Analysis Needs Assessment for PBPD and TSMO 3rd draft was completed and disseminated in May 2019.
- Ideas solicited and discussed for future projects.

**FISCAL YEAR 2020 ACCOMPLISHMENTS**

- Meeting was held on April 22, 2020.
- Two final reports were presented, and practical approaches guides on Safety Analysis Needs Assessment for PBPD and TSMO were completed.
- Further updates were discussed on HSM case Studies
- Development of a Data Dictionary was researched
- A statement of work was prepared to be awarded by fall 2020.
- Development of a Safety Countermeasures Service Life Guide a was awarded, and a kickoff meeting was held on July 6th.

**FISCAL YEAR 2021 ACCOMPLISHMENTS**

- Meeting held on May 6, 2021.
- Safety Countermeasure Service Life Guide was completed in April 2021
- Continued work on HSM Case studies highlighting projects in Michigan, Wisconsin, Massachusetts, Alabama, and others.
- Continued work on the need for a data dictionary.
- MDOT fulfilled its pledge commitment in FY 2019 and remains an active partner state DOT.
- FHWA will begin work to initiate a new HSM2 Implementation Fund Study anticipated to begin July 2022.

**FISCAL YEAR 2022 ACCOMPLISHMENTS**

- A kickoff meeting for the Advancing Applications of DDSA task order which included three primary tasks – 1) use of multiple analysis methods in alternatives analysis, 2) implementation approaches for NCHRP 17-62 (Improved prediction Models for Crash Types and Severities), and 3) communications guide for explaining safety analysis to non-safety professionals was held with the contractor (VHB) on April 26. Draft outlines for Tasks 2 and 3 were created and updated based on two rounds of review and comment. Work on all three tasks is progressing.
- The contractor (VHB) on the Data and Analysis Case Studies project has completed three case studies (District of Columbia, Arizona, and Florida) which will be posted to the FHWA RSDP case studies website soon. California and Vermont have been developed and are under review. The purpose of the project is to share information to overcome challenges faced by users attempting to perform HSM project-level safety performance analysis. https://highways.dot.gov/safety/data-analysis-tools/rsdp/safety-data-case-studies 14 are posted and 6 more will be posted in the next couple of months.
- On April 22, FHWA posted a new transportation pooled fund solicitation to create a Highway Safety Manual Second Edition (HSM2) Implementation pooled fund, anticipated to begin in 2023.

**FISCAL YEAR 2023 ACCOMPLISHMENTS**

- Advancing Applications of DDSA project - The contractor (VHB) continued work on all three primary tasks – 2) use of multiple analysis methods in alternatives analysis, 3) implementation approaches for NCHRP 17-62 (Improved Prediction Models for Crash Types and Severities), and 4) communications guide for explaining safety analysis to non-safety professionals. All tasks are being reviewed.
- Held first panel meeting for NCHRP 17-127 (Practitioner's Application Guide to the Highway Safety Manual) The objective of this research is to develop a practitioner's guide on the use of the HSM-2 for system planning, project planning, preliminary engineering, final design, construction, maintenance, and operations applications by identifying proper methods and applications and illustrating them with case studies.
- Developed research statements for consideration in 2024.
- Planning started for 2024 Peer Exchange in support of HSM 2nd Edition implementation TPF-5(516)

**FISCAL YEAR 2024 ACCOMPLISHMENTS**

- Completed Task 2 of Advancing Application of DDSA: Explore the Validity of Combining Predictive Methods
- Tasks 3 and 4 of Advancing DDSA kicked off.
- Developed scope and budget for three new projects identified by members as high interest. The projects are: HSM Screening Tool, Open-Source Tools and Processes, and Additional exploration of Empirical-Bayes in Predictive Analysis. Contract actions were prepared.

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

- Work continued on Tasks 3 and 4 of advancing Data Driven Safety Analysis (DDSA) with progress ongoing.
- The projects for Highway Safety Manual's (HSM's) screening tool, open source, tools and processes are underway.
- Project group lead change from Matthew Hinshaw to Sarah Wiseman Pascal of FHWA.
- In April of 2025 a group vote was taken on best ideas to determine what processes and/or projects should be considered for proceeding forward in the study.

**FISCAL YEAR 2026 PROPOSED ACTIVITIES**

- A bi-monthly meeting is scheduled for November 18. FHWA and the Contractor will develop the agenda, distribute to attendees, facilitate the meeting, and distribute a summary of the meeting.
- Continue work on remaining main tasks of the Advancing Application of DDSA project.
- Continue to solicit state partners to continue adding fund commitments.
- Continue work on the Open-Source Tools, processes, data dictionary efforts, along with soliciting working group volunteers.

**JUSTIFICATION(S) FOR REVISION(S)**

Based on the last quarterly report, this project will be extended upon FHWA action.

**SUMMARY OF THE IMPLEMENTATION RECOMMENDATION**

Project expected completion FY 2026.

Michigan Department
Of Transportation
5307 (11/17)

# RESEARCH ADMINISTRATION
# MDOT TRANSPORTATION POOLED FUND STUDY
# ANNUAL REPORT - FISCAL YEAR 2025

STUDY TITLE: Evaluation of Low-Cost Safety Improvements

FUNDING SOURCE: ☒ FHWA ☐ OTHER (*PLEASE EXPLAIN*)

| | | | |
|---|---|---|---|
| TPF NO. | TPF-5(317) | MDOT START DATE (Original) | 2/04/2015 |
| OR NO. | OR20-209 | MDOT COMPLETION DATE (Original) | 9/30/2022 |
| | | COMPLETION DATE (Revised) | Continuing Effort |
| MDOT TECHNICAL CONTACT | Garrett Dawe, 989-289-2388<br>Email: DaweG@Michigan.gov | | |
| LEAD AGENCY | Nevada DOT | | |
| LEAD STUDY CONTACT | Kim Woon, 202-493-3383<br>Email: woon.kim@fhwa.dot.gov | | |
| CONTRACTOR | | | |

**BUDGET STATUS**

| FY 2025 MDOT Budget | | | MDOT Total Budget | | |
|---|---|---|---|---|---|
| FY25 FUNDS | (Original) | $0.00 | TOTAL BUDGET | (Original) | $90,000.00 |
| | (Revised) | | | (Revised) | |
| TOTAL FY 2025 EXPENDITURES | | $0.00 | TOTAL COMMITTED FUNDS AVAILABLE | | $0.00 |

**PARTICIPATING STATES**

AR, AZ, CA, CO, CT, DC, FL, GA, IA, IL, IN, KS, KY, LA, MA, MD, ME, MI, MN, MO, MS, MT, NC, ND, NE, NH, NV, NY, OH, OK, OR, PA, RI, SC, SD, TN, TX, UT, VA, WA, WI, WY

**PURPOSE AND SCOPE**

FHWA has initiated the Low-Cost Safety Improvements study to encompass safety-effectiveness evaluations of priority strategies from the NCHRP Report 500. The goal of the proposed research is to develop reliable estimates of the safety effectiveness of safety improvements identified as strategies in the NCHRP Report 500 and guidebooks through scientifically rigorous “Before”-” After” (B/A) evaluations of sites within the U.S. where these strategies are being implemented. The data for the study will be gathered from those states that implement strategies throughout the US. The methodology utilized will typically be an Empirical Bayes evaluation or other appropriate method, using B/A data to help determine their effectiveness in reducing the number and severity of crashes. The data will be collected, and evaluation studies will be performed as strategies are implemented over the course of several years.

Originally a target of 20 strategies totaling $4.38 million over 5 years was planned for ELCSI–PFS studies in four phases. Currently, this study has outperformed its original goals and has added four extra phases for a total of eight phases. The original budget of $4.38 million remains the same. To provide much needed reliable measures for effectiveness of various low-cost safety improvements, this study's performance period has been extended beyond the initial date of 2017. This pooled fund study has contributed over 800 CMFs to the CMF Clearinghouse. This effort is on-going.

**FISCAL YEAR 2020 ACCOMPLISHMENTS**

- Safety Evaluation of Flashing Yellow Arrows at Signalized Intersections
- Development of Crash Modification Factors for High Friction Surface Treatments (HFST)
- HFST Quick Reference
- Safety Evaluation of Pedestrian Countdown Signals

All of these provide useful information for MDOT to further define our approach to safety. HFST is an area where MDOT wants to expand its use and with this information we can make efficient decisions.

**FISCAL YEAR 2021 ACCOMPLISHMENTS**

The annual meeting was held on June 28, 2021. ELCSI-PFS, PHASE X COMPLETED

- This phase was modified for no-cost POP extension to accommodate publication needs and completed July 2021.
- Variable speed limits (VSL).
- Safety Evaluation of Roadside for: Light Poles, Guardrails, and Side Slope Flattening.

**FISCAL YEAR 2022 ACCOMPLISHMENTS**

The 2022 Annual Technical Advisory Committee (TAC) meeting was conducted virtually on May 25-26, 2022. All presentations and documents were shared with the TAC members by email and on the Contractor (TTI) website after the meeting.

ELCSI-PFS, PHASE XIII
The FHWA awarded the PHASE XIII task order to the Texas A&M, Transportation Institute (TTI) in July of 2022.
This task order will study:

- Curve Enhanced Delineation (CED)
- Alternative Rumble Strip (ARS)

- Fixed Objects Delineation of (FOD)

This task order's kickoff meeting is on August 17, 2022.
Phase XIII is funded by the FHWA and the ELCSI-PFS.

ELCSI-PFS, PHASE XII
Innovative Intersection Design for Pedestrian and Bicycle Safety completion Date is October 30, 2022.
This phase is active. Quarterly progress highlights include:

- Continued reducing the video data at the three sites in Washington DC.
- Continued to reduce the aerial video data.
- Explored the possibility of obtaining right-turn speed from the sites with before and after data.
- Received bids for drone video for the Silver Spring, MD site. Selected vendor.
- Met with Montgomery County and the drone vendor to discuss data collection in Silver Spring, MD.

ELCSI-PFS, PHASE XI
This task is in progress (completion on 08/30/22). All deliverables were received, and the publication process has started for the following studies:

- Safety Evaluation of Mini-Roundabouts.
- Safety Evaluation of Bike Lane Configurations at Intersections.
- Safety Evaluation of Wrong Way Driving (WWD) Low-Cost Safety Improvements.
- Wrong-Way Driving Research and Technical Resources' Workshop (virtual) was conducted on March 9-10, 2022.

The ELCSI-PFS, Phase XI is mostly funded by the FHWA, DCMF program, and Intersection Road map.

PUBLICATIONS
Publications for Phase XI are in progress and expected to be completed by October 2022.
Please see list of all ELCSI-PFS with links at; https://highways.dot.gov/research/safety/evaluations-low-cost-safety-improvements-pooled-fund-study/publications

**FISCAL YEAR 2023 ACCOMPLISHMENTS**

- The 2023 Annual Technical Advisory Committee (TAC) meeting was conducted virtually on July 31st and August 7th. All presentations and documents were shared with the TAC members by email and on the Contractor (TTI) website after the meeting.
- Solicitation on going for future projects.
- ELCSI-PFS' old number TPF-5(317) is pending project close out and a new pooled fund project number, TPF-5(515) has been created. FHWA Acceptance Memo dated May 8, 2023.

**FISCAL YEAR 2024 ACCOMPLISHMENTS**

Held an annual meeting in Oklahoma City in June. Top safety needs were discussed, in addition to CMF development ideas and SLCI evaluation suggestions. The meeting also included topics on micromobility, motorcycles, MIRE data elements, and emerging topics.

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

Continued work on projects to study Rectangular Rapid Flashing Beacons (RRFBs), Left Turn Lanes, Alternate Rumble Strip designs, Curve Enhanced Delineation, and Fixed Object Delineation.

**FISCAL YEAR 2026 PROPOSED ACTIVITIES**

- Continue analyzing data for LTL study.
- Begin re-analysis of data for CED study per the MUTCD Team’s request.
- Draft the scope of additional analysis and cost estimate to allocate funds for ARS study.
- Prepare additional cost estimate to revise draft technical report in response to the MUTCD Team’s request for FOD study.

**JUSTIFICATION(S) FOR REVISION(S)**

None.

**SUMMARY OF THE IMPLEMENTATION RECOMMENDATION**

The Evaluation of Low-Cost Safety Improvements pooled fund study has been invaluable to both MDOT and the staff in the Safety Programs area. The annual meeting allows various staff members to attend to learn new and improved low-cost safety improvements and more importantly to network with fellow DOTs and researchers. From these meetings MDOT has expanded on its research of Crash Reduction Factors for our roadways, piloted wrong way electronic devices, developed mini roundabout criteria, established signing standards for all way and two way stops on high-speed non-freeways, increased delineation and sought further safety tools for pedestrians and bicyclists, a heightened awareness area for the department. We have also shared our successes with rumble strips, wider edge lines and reflective strips on signposts with other DOTs. MDOT will continue to review the results of the various studies and support all future research that can help shape the safety program in Michigan.

Michigan Department
Of Transportation
5307 (11/17)

# RESEARCH ADMINISTRATION
# MDOT TRANSPORTATION POOLED FUND STUDY
# ANNUAL REPORT - FISCAL YEAR 2025

STUDY TITLE: Roadside Safety Research for Mash Implementation – Phase 2

FUNDING SOURCE: ☒ FHWA ☐ OTHER (*PLEASE EXPLAIN*)

| | | | |
|---|---|---|---|
| TPF NO. | TPF-5(343) | MDOT START DATE | 10/1/2016 |
| OR NO. | OR15-528 | MDOT COMPLETION DATE (Original) | 12/31/2018 |
| | | COMPLETION DATE (Revised) | 9/25/2025 |
| MDOT TECHNICAL CONTACT | Carlos Torres, 517-335-2852<br>Email: TorresC@Michigan.gov | | |
| LEAD AGENCY | Washington DOT | | |
| LEAD STUDY CONTACT | Mustafa Mohamedali, 360-704-6307<br>Email: Mustafa.Mohamedali@wsdot.wa.gov | | |
| CONTRACTOR | | | |

## BUDGET STATUS

| FY 2025 MDOT Budget | | | | MDOT Total Budget | | |
|---|---|---|---|---|---|---|
| FY25 FUNDS | (Original) | $0.00 | | TOTAL BUDGET | (Original) | $220,000.00 |
| | (Revised) | $0.00 | | FY22 $50k | (Revised) | $270,000.00 |
| TOTAL FY 2025 EXPENDITURES | | $0.00 | | TOTAL COMMITTED FUNDS AVAILABLE | | $0.00 |

## PARTICIPATING STATES

AK, AL, CA, CO, CT, DE, FL, IA, ID, IL, LA, MA, MD, MI, MN, MO, MS, NM, OH, OK, OR, PA, TN, TX, UT, WA, WI, WV

## PURPOSE AND SCOPE

The objective of the Roadside Safety Pooled Fund Program is to provide a cooperative, cost-effective, and efficient approach to conducting research on roadside safety hardware meeting the functional needs of participating states. Emphasis will be placed on assisting state DOTs with their implementation of the Manual for Assessing Safety Hardware (MASH), transition to the use of MASH-compliant roadside safety devices in lieu of current National Cooperative Highway Research Program (NCHRP) 350-compliant devices as mandated in the revised Federal Highway Administration (FHWA) - American Association of State Highway Transportation

Officials (AASHTO) Joint Implementation Plan and addressing other roadside safety needs of common interest. Another objective of this pooled fund research is to provide each participating state with an opportunity to send a representative to an annual meeting to collaborate with other state DOT safety engineers to assess best practices, new regulatory issues, risk management strategies, and other matters pertaining to roadside safety. Roadside Safety Pooled Fund members will meet, review potential projects for inclusion as part of future MASH crash testing projects, develop a work plan that involves selecting projects for future MASH crash testing, and designate individuals that will serve as team leaders for overseeing these projects.

Specific research activities expected to be addressed within the program include the design, analysis, testing, and evaluation of crashworthy structures, and the development of guidelines for the use, selection, and placement of these structures. Crashworthy structures include bridge railings, guardrails, transitions, median barriers, cable barriers, temporary concrete barriers, end treatments, crash cushions (impact attenuators), culverts, breakaway support structures (e.g., sign supports, luminaire supports, mailboxes), and work zone traffic control devices. In addition, research is expected to address the influence of highway features such as driveways, slopes, ditches, shoulders, medians, and curbs on single vehicle collisions.

## FISCAL YEAR 2016 ACCOMPLISHMENTS

Completed the following projects:

1. MASH Transition from F-Shape Temporary Concrete Barrier Pinned on Asphalt to Rigid Single-Slope Concrete Barrier
   - Test Report No. 605641-1; Test Report Date: January 2016
   - Benefit: Provides insight into methods to anchor temporary concrete barrier to permanent concrete barrier.
2. Guidebook for Use of Pinned-Down Temporary Concrete Barriers in Limited Space Applications
   - Test Report No. 605071-1; Test Report Date: April 2016
   - Benefit: Provides insight into an alternative limited deflection temporary concrete barrier system that meets MASH.
3. MASH Finite Element Analysis and Full-Scale Crash testing of Stacked W-Beam Transition for 31-inch Guardrail
   - Test Report No. 604581-1; Test Report Date: May 2016
   - Benefit: Provides information on a MASH-compliant guardrail anchorage that MDOT could use if desired.

The Michigan Department of Transportation (MDOT) joined the Roadside Pooled Fund in mid-2016 and the first Roadside Safety Pooled Fund meeting with MDOT participation is slated to take place in late October 2016. As a result, there was no input or involvement from MDOT in the three completed projects identified above.

## FISCAL YEAR 2017 ACCOMPLISHMENTS

**Completed Projects:**

1. Barrier Deflection Characteristics of 31-inch W-Beam Guardrail Systems with 8-inch Blockouts.
   - Test Report No. 603481; Test Report Date: February 2017.
   - Benefit: Provides some insight on impact deflection characteristics for Type MGS-8 guardrail.
2. Guidance for Raising Beam Guardrail Composite Blockout for Rail Height Adjustment.
   - Test Report No. TM-605311; Test Report Date: February 15, 2017.
   - Benefit: Provides additional insight regarding guardrail height adjustments.

Pooled Fund Scorecard Development

The pooled fund, in conjunction with TTI, is in the process of developing scorecards for prioritizing MASH testing and evaluation of roadside safety devices. A scorecard (scorecard #1) was completed for guardrail and cast-in-place, permanent concrete barrier systems.

## FISCAL YEAR 2018 ACCOMPLISHMENTS

**Pooled Fund Scorecards**

The pooled fund, in conjunction with TTI, developed and completed a series of scorecards for prioritizing MASH testing and evaluation of roadside safety devices. The following scorecards were completed:

- #2: Guardrail terminals, cable barrier systems, and impact attenuators
- #3a: Transitions
- #3b: Portable barriers
- #3c: Other longitudinal barriers
- #3d: All other terminals
- #3e: Bridge railings

**Completed Projects**

1. Keyed-In, Segmented, Single Slope Reinforced Permanent Concrete Barrier
   - Objective: Perform a MASH, TL-4 (Test 4-12) crash test on a 120-foot-long installation (consisting of three 40-foot segments with no connections between adjacent segments) of 42” tall, Texas DOT (TxDOT), reinforced single slope permanent concrete barrier keyed into 1” thick asphalt pavement.
   - Results: The barrier successfully passed MASH Test 4-12. MASH Tests 4-10 (small car) and 4-11 (pickup truck) were not performed due to successful past testing.
2. MASH Testing of Oregon DOT, F-Shape Temporary Concrete Barrier (TCB) Pinned to Concrete Pavement
   - Objectives: Determine a suitable offset between the TCB and the edge of the concrete pavement, and perform a MASH, TL-3 (Test 3-11) crash test on the pinned TCB with the selected offset from the edge of pavement. The F-shape TCB design used on this project was the Oregon DOT, F-shape TCB design.
   - Results: A 9-inch (minimum) offset was determined to be suitable for the design to meet MASH, TL-3 requirements when pinned to an 8-inch thick (minimum) concrete pavement. The barrier successfully passed MASH Test 3-11 with a 9-inch offset from the edge of pavement and pinned to an 8-inch-thick concrete pavement.
3. 31-inch Tall Buried-in-Backslope (BIB) Terminal Compatible with MGS Guardrail
   - Objective: Develop a 31” tall buried-in-backslope that is compatible with MGS guardrail, MASH, TL-3 compliant, and suitable for installation on a V-ditch with a 1:4 or flatter foreslope, and a 1:2 or flatter backslope.
   - Results: The BIB terminal successfully passed MASH Tests 3-34 and 3-35.
4. MASH TL-3 T-Intersection (Short Radius) System Design Variations (Project Ended on 8/31/18)

   A meeting was held in September 2018 in Denver, Colorado with the pooled fund member states and TTI to discuss ongoing projects and select and prioritize future projects.

## FISCAL YEAR 2019 ACCOMPLISHMENTS

MASH Testing of W-beam Guardrail in Concrete Mow-Strip

1. Objectives: Determine MASH, TL-3 compliance of Type MGS-8 guardrail, with wood and steel posts, as installed in a concrete mow strip.
2. Results: Both MASH, TL-3 tests (i.e., tests 3-10 and 3-11) involving the steel post version of Type MGS-8 guardrail passed. However, with the wood post version of Type MGS-8 guardrail, only test 3-10 (i.e., small car test) passed. Test 3-11 (i.e., pickup truck test) failed. A subsequent test (3-11) was performed using a shorter (36” long) wood post, and this test also resulted in a failure. Therefore, additional research is needed to determine if Type MGS-8 guardrail with wood posts can meet MASH, TL-3 criteria when placed in a concrete mow strip.

## FISCAL YEAR 2020 ACCOMPLISHMENTS

**Completed Projects**

1. T4541-DA: Administrative Support
2. T4541-DI: Determination of Pedestrian Rail Offset Requirements to Eliminate Vehicle Interaction
3. T4541-DS: 2019 Travel and Meeting Assistance
4. T4541-CU: 2018 MASH Coordination Effort

**Ongoing Projects**

1. Engineering Support Services and Recommendations for Roadside Safety Issues/Problems for Member States
2. Testing of MGS System with Reduced Post Spacing for MASH Compliance
3. Testing and Evaluation of the MGS System with Maximum Flare at MASH Test
4. Thrie-Beam/W-Beam/Tubular Barrier Gap Rail for MASH TL-3
5. Placement of Guardrail on Slopes Phase IV: MASH TL-3 Testing of Guardrail
6. MASH TL-3 Transition Design with a Storm Drain Inlet
7. MASH Coordination Effort
8. Testing and Evaluation of Large Sign Slipbase Support on Slope at MASH Test Level 3 Impact Conditions

9. MASH TL-4 Investigation and Testing of the Critical Flare Rate for Cast-in-Place Single Slope 42" Concrete Barrier Flaring around a Fixed Object
10. Review and Investigation of W-Beam Guardrail Terminals with Curbs

**Approved Projects**

1. Shorter TL-3 MASH W-Beam Transition
2. MASH TL-4 Testing and Evaluation of a Concrete Median Barrier with Fence Mounted on Top of Barrier
3. MASH TL-3 Testing of Guardrail on 6H:1V Slope
4. Length of Need (LON) for Guardrail without Anchorage: Phase 1

**FISCAL YEAR 2021 ACCOMPLISHMENTS**

**Completed Projects**

1. 2020 MASH Implementation Support
2. 2020 Administrative Support
3. Engineering Support Services and Recommendations for Roadside Safety Issues/Problems for Member States
4. Testing of Midwest Guardrail Systems with Reduced Post Spacing for MASH Compliance
5. MASH TL-4 Investigation and Testing of the Critical Flare Rate for Cast-in-Place Single Slope 42” Concrete barrier Flaring Around a Fixed Object
6. MASH TL-4 Testing and Evaluation of a Concrete Median Barrier with Fence Mounted on Top
7. T4541-CR: Placement of Guardrail on Slopes Phase IV: MASH TL-3 Testing of Guardrail
8. T4541-DT: Determination of the Length-of-Need for Guardrail Without Anchorage: Phase 1

**Ongoing Projects**

1. 2021 MASH Implementation Support
2. 2021 Administrative Support
3. T4541-CV: Testing and Evaluation of the MGS System with Maximum Flare at MASH Test
4. T4541-CW: Testing of Midwest Guardrail Systems with Reduced Post Spacing for MASH Compliance
5. T4541-CZ: Thrie/W-Beam/Tubular Barrier Gap Rail for MASH TL-3
6. T4541-DB: Engineering Support Services and Recommendations for Roadside Safety Issues/Problems for Member States
7. T4541-DJ: Testing and Evaluation of Large Signs Slipbase Support on Slope at MASH TL-3 Impact Conditions
8. T4541-DL: A Study of Guardrail Placement on 6:1 Slope
9. T4541-DN: MASH TL-4 Testing and Evaluation of a Concrete Median Barrier with Fence Mounted on Top
10. T4541-DO: Shorter TL-3 MASH W-Beam Transition
11. T4541-DQ: 2019 MASH Coordination Effort
12. T4541-DV: Study of Acceptable Sidewalk Heights and Widths
13. T4541-DW: Design and Testing of a Thrie-Beam Guardrail System at a Fixed Object
14. T4541-DX: Design and Testing of a MASH TL-3 Thrie-Beam System for Roadside and Median Applications
15. T4541-DY: MASH TL-3 Transition Design with a Storm Drain Inlet
16. T4541-DZ: Determination of the Length-of-Need for Guardrail without Anchorage: Phase 2
17. T4541-EA: Development of a Thrie-Beam Retrofit for Upgrading Obsolete Bridge Railings
18. T4541-EB: 2021 Administrative Support
19. T4541-EC: Develop Non-Proprietary MASH-Compliant Three-Pound and Four-Pound Post Systems
20. T4541-ED: Develop Guidelines for Attaching MASH-Compliant Thrie-Beam Transitions to Rigid Concrete Barriers Other than the Rigid Barrier Tested when Evaluating the Thrie-Beam Transition
21. T4541-EE: Exploration into Variations in Beam Guard Approach Transitions to Rigid Barrier
22. T4541-EF: Engineering Support Services and Recommendations for Roadside Safety Issues/Problems for Member States
23. T4541-EG: 2021 Program Development and MASH Coordination Effort

**Approved Projects**

1. Continued Engineering Support Services and Recommendations for Roadside Safety Issues/Problems for Member States
2. Develop Non-Proprietary MASH-Compliant Three-Pound and Four-Pound Post Systems
3. Develop Guidelines for Attaching MASH-Compliant Thrie-Beam Transitions to Rigid Concrete Barriers Other than the Rigid Barrier Tested when Evaluating the Thrie-Beam Transition
4. Exploration into Variations in Beam Guard Approach Transitions to Rigid Barrier
5. Testing Type III Barricades with Aluminum Panels and Mounted Signs (proposal in development)
6. Transition Between Guardrail and Tangent Anchored Portable Concrete Barriers
7. Multi-Directional Base Design for Steel Beam Non-Proprietary Large Sign Supports
8. Proposal 2021-04-BR: MASH 4-12 Evaluation of a Fence Mounted System for Attachments to Concrete
9. Proposal 2021-06-LSRB (CONT): MASH TL-3 Transition Design with a storm drain inlet (continuation)
10. Proposal 2020-02-BD: Multi-directional base design for steel beam non-proprietary large sign supports—Phase II
11. Proposal 2021-02-LSRB: Crash testing a Guardrail on 1TO1 slope
12. Proposal 2021-01-BD: Crashworthy Pedestrian and Small Traffic Signals

**FISCAL YEAR 2022 ACCOMPLISHMENTS**

**Completed Projects**

1. T4541-CR: Placement of Guardrail on Slopes Phase IV: MASH TL-3 Testing of Guardrail
2. T4541-DT: Determination of the Length-of-Need for Guardrail Without Anchorage: Phase 1
3. T4541-EQ: 2022 Program Development and MASH Coordination Effort
4. T4541-ER: Engineering Support Services and Recommendations for Roadside Safety Issues/Problems for Member States
5. T4541-ES: MASH 4-12 Evaluation of a Fence Mounted System for Attachments to Concrete Bridge Barrier
6. T4541-ET: MASH Testing of a Guardrail System on 1H:1V Slope
7. T4541-EV: MASH Crashworthy Pedestrian and Small Traffic Signals

8. T4541-EW: 2022 Administrative Support
9. T4541-EX: Buried-in-Backslope Terminal Variations in Foreslope, Backslope, and Ditch Configurations
10. T4541-EO: Washington State I-90 Snoqualmie Pass Barrier Gap Design, Drafting, and Detailing

**Ongoing Projects**

1. T4541-CV: Testing and Evaluation of the MGS System with Maximum Flare at MASH Test
2. T4541-CW: Testing of Midwest Guardrail Systems with Reduced Post Spacing for MASH Compliance
3. T4541-CZ: Thrie/W-Beam/Tubular Barrier Gap Rail for MASH TL-3
4. T4541-DB: Engineering Support Services and Recommendations for Roadside Safety Issues/Problems for Member States
5. T4541-DG: MASH TL-4 Investigation and Testing of the Critical Flare Rate for Cast-in-Place Single Slope 42” Concrete barrier Flaring Around a Fixed Object
6. T4541-DJ: Testing and Evaluation of Large Signs Slipbase Support on Slope at MASH TL-3 Impact Conditions
7. T4541-DL: A Study of Guardrail Placement on 6:1 Slope
8. T4541-DN: MASH TL-4 Testing and Evaluation of a Concrete Median Barrier with Fence Mounted on Top
9. T4541-DO: Shorter TL-3 MASH W-Beam Transition
10. T4541-DQ: 2019 MASH Coordination Effort
11. T4541-DV: Study of Acceptable Sidewalk Heights and Widths
12. T4541-DW: Design and Testing of a Thrie-Beam Guardrail System at a Fixed Object
13. T4541-DX: Design and Testing of a MASH TL-3 Thrie-Beam System for Roadside and Median Applications
14. T4541-DY: MASH TL-3 Transition Design with a Storm Drain Inlet
15. T4541-DZ: Determination of the Length-of-Need for Guardrail without Anchorage: Phase 2
16. T4541-EA: Development of a Thrie-Beam Retrofit for Upgrading Obsolete Bridge Railings
17. T4541-EI: Crashworthy Enhanced Highway Sign Assemblies
18. T4541-EJ: Design and Evaluation of a MASH TL-2 Compliant Permanent Concrete Low-Profile Barrier
19. T4541-EN: Development of a MASH TL-3 Compliant Portable Concrete Barrier System
20. T4541-EO: Washington State I-90 Snoqualmie Pass Barrier Gap Design, Drafting, and Detailing
21. T4541-EP: Evaluation of Long-Span W-Beam Guardrail in Front of Fall-Protection Rail on Concrete Culverts
22. T4541-EB: 2021 Administrative Support
23. T4541-EC: Develop Non-Proprietary MASH-Compliant Three-Pound and Four-Pound Post Systems
24. T4541-ED: Develop Guidelines for Attaching MASH-Compliant Thrie-Beam Transitions to Rigid Concrete Barriers Other than the Rigid Barrier Tested when Evaluating the Thrie-Beam Transition
25. T4541-EE: Exploration into Variations in Beam Guard Approach Transitions to Rigid Barrier
26. T4541-EG: 2021 Program Development and MASH Coordination Effort
27. T4541-EK: Transition Between Guardrail and Tangent Anchored Portable Concrete Barriers
28. T4541-EL: Testing Type III Barricades with Aluminum Panels and Mounted Signs
29. T4541-EM: Multi-Directional Base Design for Steel Beam Non-Proprietary Large Sign Supports: Phase I

**Approved Project**

T4541-EH: MASH TL-4 Crash Testing of Bicycle Railing on Constant Slope Parapet

**FISCAL YEAR 2023 ACCOMPLISHMENTS**

**Completed Projects**

1. T4541-CV: Testing and Evaluation of the MGS System with Maximum Flare at MASH Test
2. T4541-ED: Develop Guidelines for Attaching MASH-Compliant Thrie-Beam Transitions to Rigid Concrete Barriers Other than the Rigid Barrier Tested when Evaluating the Thrie-Beam Transition
3. T4541-EG: 2021 Program Development and MASH Coordination Effort
4. T4541-EK: Transition Between Guardrail and Tangent Anchored Portable Concrete Barriers
5. T4541-EL: Testing Type III Barricades with Aluminum Panels and Mounted Signs
6. T4541-EZ: 2022 Travel & Meeting Assistance
7. T4541-DJ: Testing and Evaluation of Large Signs Slipbase Support on Slope at MASH TL-3 Impact Conditions
8. T4541-DZ: Determination of the Length-of-Need for Guardrail without Anchorage: Phase 2
9. T4541-EE: Exploration into Variations in Beam Guard Approach Transitions to Rigid Barrier
10. T4541-DY: MASH TL-3 Transition Design with a Storm Drain Inlet
11. T4541-EC: Develop Non-Proprietary MASH-Compliant Three-Pound and Four-Pound Post Systems

**Ongoing Projects**

1. T4541-EM: Multi-Directional Base Design for Steel Beam Non-Proprietary Large Sign Supports: Phase I
2. T4541-EQ: 2022 Program Development and MASH Coordination Effort
3. T4541-ER: Engineering Support Services and Recommendations for Roadside Safety Issues/Problems for Member States
4. T4541-ES: MASH 4-12 Evaluation of a Fence Mounted System for Attachments to Concrete Bridge Barrier
5. T4541-ET: MASH Testing of a Guardrail System on 1H:1V Slope
6. T4541-EV: MASH Crashworthy Pedestrian and Small Traffic Signals
7. T4541-EW: 2022 Administrative Support
8. T4541-EX: Buried-in-Backslope Terminal Variations in Foreslope, Backslope, and Ditch Configurations
9. T4541-FB: MASH TL-3 Evaluation of a Median Guide Rail Transition to Median F-Shape Concrete Barrier
10. T4541-FC: Evaluation of a Four Bolt Slip Base for breakaway Luminaire Supports with Various Pole Configurations
11. T4541-FD: Portable Sign Supports for Aluminum Signs with Variations on Mounting Height
12. T4541-FE: MASH Test level 3 Evaluation of a Shorter Thrie-Beam Approach Transition

**Approved Projects**

1. T4541-FB: MASH TL-3 Evaluation of a Median Guide Rail transition to Median F-Shape Concrete Barrier
2. T4541-FC: Evaluation of a Four Bolt Slip Base for Breakaway Luminaire Supports with Various Pole Configurations

3. T4541-FD: Portable Sign Supports for Aluminum Signs with Variations on Mounting Height
4. T4541-FE: MASH Test Level 3 Evaluation of a Shorter Thrie-Beam Approach Transition
5. T4541-FF: Steel-Post W-Beam Guardrail in Asphalt Mow Strip
6. T4541-FG: Evaluation of Open Joints in Concrete Bridge Rail Systems

A new pooled fund group, TPF-5(501), known as Roadside Safety Pooled Fund – Phase 3, was created to replace the current pooled fund group. MDOT joined TPF-5(501), Roadside Safety Pooled Fund – Phase 3.

**FISCAL YEAR 2024 ACCOMPLISHMENTS**

Completed Projects
1. T4541-FB: MASH TL-3 Evaluation of a Median Guide Rail Transition to Median F-Shape Concrete Barrier
2. T4541-FE: MASH Test Level 3 Evaluation of a Shorter Thrie-Beam Approach Transition
3. T4541-FF: Steel-Post W-Beam Guardrail in Asphalt Mow Strip
4. T4541-FG: Evaluation of Open Joints in Concrete Bridge Rail Systems
5. T4541-EM: Multi-Directional Base Design for Steel Beam Non-Proprietary Large Sign Supports: Phase I
6. T4541-ES: MASH 4-12 Evaluation of a Fence Mounted System for Attachments to Concrete Bridge Barrier
7. T4541-EV: MASH Crashworthy Pedestrian and Small Traffic Signals
8. T4541-EX: Buried-in-Backslope Terminal Variations in Foreslope, Backslope, and Ditch Configurations
9. T4541-FC: Evaluation of a Four Bolt Slip Base for Breakaway Luminaire Supports with Various Pole Configurations
10. T4541-FD: Portable Sign Supports for Aluminum Signs with Variations on Mounting Height
11. T4541-ET: MASH Testing of a Guardrail System on 1H:1V Slope
12. T4541-ES: MASH 4-12 Evaluation of a Fence Mounted System for Attachments to Concrete Bridge Barrier

All work was completed in the second quarter of calendar year 2024, and no further activities are expected as part of TPF-5(343).

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

This phase of the pooled fund project closed in FY 2025. Planned future pooled fund activities will be performed under the new federal pooled fund project, TPF-5(501), Roadside Safety Pooled Fund – Phase 3.

**JUSTIFICATION(S) FOR REVISION(S)**

None.

**SUMMARY OF THE IMPLEMENTATION RECOMMENDATION**

Implementation of MASH, TL-3 Thrie Beam Retrofit design. Evaluating MDOT's existing fencing on bridge railing standard plans to determine if modifications are needed based on research findings. Adopting tolerances on single-slope barrier faces based on TTI's professional opinion letter. Alternative designs that may be used by MDOT for special cases when deemed appropriate.

Michigan Department
Of Transportation
5307 (2011)

# RESEARCH ADMINISTRATION
# TRANSPORTATION POOLED FUND STUDY
# ANNUAL REPORT - FISCAL YEAR 2025

STUDY TITLE: Development of Maintenance Decision Support System

FUNDING SOURCE: ☒ FHWA ☐ OTHER (*PLEASE EXPLAIN*)

| | | | | |
|---|---|---|---|---|
| TPF NO. | TPF-5(347) | | MDOT START DATE | 6/08/2016 |
| OR NO. | OR14-034 | | MDOT COMPLETION DATE (Original) | 9/30/2022 |
| | | | COMPLETION DATE (Revised) | 9/30/2025 |
| MDOT TECHNICAL CONTACT | James Roath, 517-230-5361<br>Email: RoathJ1@Michigan.gov | | | |
| LEAD AGENCY | South Dakota Department of Transportation | | | |
| LEAD STUDY CONTACT | David Huft, 605-773-3358<br>Email: Dave.huft@state.sd.us | | | |
| CONTRACTOR | Iteris, Inc. | | | |

## BUDGET STATUS

| FY 2025 MDOT Budget | | | | Total Budget | | |
|---|---|---|---|---|---|---|
| FY25 FUNDS | (Original) | $0.00 | | TOTAL COST | (Original) | $170,000.00 |
| | (Revised) | | | | (Revised) | $230,000.00 |
| TOTAL FY 2025 EXPENDITURES | | $0.00 | | TOTAL COMMITTED FUNDS AVAILABLE | | $0.00 |

## PARTICIPATING STATES

CA, CO, CT, IL, IN, KY, MD, MI, MN, ND, NE, PA, SD, VA, WI

## 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. Under TPF-5(054) pilot the MDSS winter maintenance forecasting tool in the Southwest Region during the 2012 & 2013 winter seasons. Implement the forecasting tool statewide beginning in the 2014 winter season for use in seasons to come. Implementation deployment and enhancements continue under new TPF-5(347).

## FISCAL YEAR 2017 ACCOMPLISHMENTS

Completed tasks:

- Incorporated MDSS Graphic User Interface (GUI) functionality into WebMDSS.
- Refined and evaluated the capability and performance of MDSS software components, including surface condition prediction models and MDSS GUI.
- Recommend, developed, and evaluated methods for enhancing highway agencies' management through interfaces between MDSS and other management systems.
- Provided weather forecast support, MDSS configuration support, live MDSS operations, and necessary training for continuing limited deployment field trials.
- Prepared a final report summarizing methodology, findings in performance, conclusions, and recommendations.
- Made an executive presentation to the project's Technical Panel and provide electronic copies of the presentation material to participating states.

## FISCAL YEAR 2018 ACCOMPLISHMENTS

Completed tasks:

- Investigated ways to incorporate mobile road weather information system (RWIS) data into MDSS. Developed ways to display the data.
- Performed enhancements & adjustments to existing MDSS module.
- Continued efforts associated with Assessment of Recommendations (AoR) and reported results to the project's Technical Panel.
- Designed & developed & released an updated mobile application for MDSS.
- Continued to fine tune the WebMDSS interface.
- Explored additional route configuration capabilities to MDSS that will enhance route recommendations.
- Improved understanding of traffic in MDSS.
- Prepared a report summarizing research and an executive presentation was made to the Technical Panel.

## FISCAL YEAR 2019 ACCOMPLISHMENTS

Completed tasks:

- New Version of WebMDSS, improved Data Display, added overlay options to maps, favoriting capabilities and new lists views
- Ended the MDSS GUI and transitioned every user over to WebMDSS
- Provided training on the new MDSS App and WebMDSS

- Created a new Dashboard feature to improve the sites' user ability
- Continued efforts to improve Automatic Vehicle Location (AVL) integration. More agencies will be integrating AVL / Mobile Digital Computer (MDC) data.
- Continued to perform enhancements and adjustments to existing MDSS modules (on-going task).
- Continued MDSS Assessment of Recommendations (AoR) with the addition of AoR capabilities in WebMDSS.
- Assess Version 1 of mobile App. Add new features and fix user issues.
- Redesigned MDSS dashboard.
- Added any modules not yet complete from MDSS GUI into WebMDSS and address any user encountered bugs.
- Added additional routes to MDSS with the additional configurations. Receive more feedback from users on additional configurations.
- Completed two initial studies into traffic/MDSS relationships and identify potential next steps.
- Wrapped up documentation for MDSS-to-Automatic Terminal Information Service (ATIS) data feed.
- Made updates to the MDSS documentation based on activities during Phase 10.
- Prepared a report summarizing research and an executive presentation was made to the Technical Panel.

**FISCAL YEAR 2020 ACCOMPLISHMENTS**

Completed tasks:

- Continued design and development of web-based version of MDSS
- Performed enhancements and adjustments to existing MDSS module
- Developed a method to Collect and Provide Detailed Usage Statistics
- Continued design and development of a Mobile Friendly MDSS Application
- Developed a Route Configuration Optimization Process
- Assessed recommendations based on user feedback in real-time with post-recommendation analysis to improve MDSS modeling
- Conducted an analysis of traffic information within the MDSS modules and the impact of traffic on the MDSS recommendations

**FISCAL YEAR 2021 ACCOMPLISHMENTS**

Primary research areas selected by the technical panel for Phase XII of the project work plan are:

- Understand how MDSS can better support the use of Tow Plows, which are becoming more prevalent in member state winter operations (Task 14.5)
- Perform enhancements and adjustments to existing MDSS modules (Task 15.10)
- Assess recommendations based on user feedback in real-time with post-recommendation analysis to improve MDSS modeling. (15.13)
- Continue design and develop a mobile friendly MDSS application (15.18)
- Continued design and development of a web-based version of MDSS (Task 15.20)
- Integrate mobile RWIS data into MDSS (Task 15.23)
- Analyze the use of Level of Service in DOT operations and understand how this functionality can be improved within MDSS (Task 15.26)
- Develop MDSS screens to facilitate objective analysis of user acceptance or rejection of recommendations to understand the MDSS factors affecting each situation (Task 15.27)
- Integration of ESS friction into MDSS model (Task 15.28) – Year 2
- Improved forecast verification tools (Task 15.29) – Year 2

**FISCAL YEAR 2022 ACCOMPLISHMENTS**

Primary research areas selected by the technical panel for Phase XII of the project work plan are:

- Understand how MDSS can better support the use of Tow Plows, which are becoming more prevalent in member state winter operations (Task 14.5)
- Task 14.2: In-Vehicle MDSS Update
- Perform enhancements and adjustments to existing MDSS modules (Task 15.10)
- Assess recommendations based on user feedback in real-time with post-recommendation analysis to improve MDSS modeling. (15.13)
- Continued design and develop a mobile friendly MDSS application (15.18)
- Continued design and development of a web-based version of MDSS (Task 15.20)
- Integrate mobile RWIS data into MDSS (Task 15.23)
- Task 15.24 Develop a Method to Collect and Provide detailed use statistics
- Analyze the use of Level of Service in DOT operations and understand how this functionality can be improved within MDSS (Task 15.26)
- Develop MDSS screens to facilitate objective analysis of user acceptance or rejection of recommendations to understand the MDSS factors affecting each situation (Task 15.27) Including Task 15.29 Improved Forecast Verification Tools
- Integration of ESS friction into MDSS model (Task 15.28) – Year 3
- Improved forecast verification tools (Task 15.29) – Year 3

**FISCAL YEAR 2023 ACCOMPLISHMENTS**

- DTN will continue to provide operational support for the current VMDSS interfaces that are active in the field today. New development for the in-vehicle MDSS display is not anticipated during Phase XIII.
- Task 14.5 will be moved to operational mode. Guidance developed in the https://dtn.box.com/s/88jil47jmu77qeho7sekpz2cr2u50kqo MDSS Pooled Fund Study Phase XII, Task 14.5 Enhanced Tow Plow Support Plan will be utilized to assist additional states with integration of their tow plow data into MDSS. Specific information is available in this document to guide other MDC/AVL providers, in required data feed adjustments to accommodate tow plow data for their clients. The Enhanced Tow Plow Support Plan document will be updated as necessary to ensure all current information and guidelines are available to all PFS members.

Michigan Department
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# RESEARCH ADMINISTRATION
# MDOT TRANSPORTATION POOLED FUND STUDY
# ANNUAL REPORT - FISCAL YEAR 2025

STUDY TITLE: National Partnership to Determine the Life Extending Benefit Curves of Pavement Preservation Techniques (MnROAD/NCAT Joint Study – Phase II)

FUNDING SOURCE: ☒ FHWA ☐ OTHER (*PLEASE EXPLAIN*)

| | | | | |
|---|---|---|---|---|
| TPF NO. | TPF-5(374) | | MDOT START DATE | 10/01/2020 |
| OR NO. | OR21-206 | | MDOT COMPLETION DATE (Original) | 9/30/2022 |
| | | | COMPLETION DATE (Revised) | 9/30/2025 |
| MDOT TECHNICAL CONTACT | Kevin Kennedy, 517-749-9067<br>Email: KennedyK@Michigan.gov | | | |
| LEAD AGENCY | FHWA | | | |
| LEAD STUDY CONTACT | Kidada Dixon, 334-353-6940<br>Email: dixonk@dot.state.al.us | | | |
| CONTRACTOR | | | | |

**BUDGET STATUS**

| FY 2025 Budget | | | | MDOT Total Budget | | |
|---|---|---|---|---|---|---|
| FY 25 FUNDS | (Original) | $0.00 | | TOTAL COST | (Original) | $300,000.00 |
| | (Revised) | | | | (Revised) | |
| TOTAL FY 2025 EXPENDITURES | | $0.00 | | TOTAL COMMITTED FUNDS AVAILABLE | | $0.00 |

**PARTICIPATING STATES**

AL, FHWA, FL, GA, IL, KY, MD, MI, MN, MS, NC, NY, OK, SC, TN, TX, VA, WI, WV

**PURPOSE AND SCOPE**

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 aggregate hauling, liquid asphalt supply and delivery, rental of select construction equipment, plant production, and mix placement may all be procured via competitively bid subcontracts; 3. Installing both environmental (i.e., multi-depth pavement temperature probes) and response instrumentation (i.e., high speed stress and strain gages) in new experimental sections; 4. Operating a 5-truck heavy triple-trailer fleet in order to apply accelerated truck traffic on the NCAT test oval following the completion of construction. Human drivers operate NCAT vehicles to best induce representative vehicle wander, but it is expected that autonomous vehicles will be implemented in the future. Interstate traffic is used to load test sections at MnROAD; 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. Pavement deflection and surface friction will be measured on 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; and 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.

**FISCAL YEAR 2021 ACCOMPLISHMENTS**

**Pavement Preservation Experiment:**
Many of the same pavement preservation treatments installed in Alabama are being investigated in Minnesota using MnDOT materials and construction methods. The northern pavement preservation experiment sections are located on U.S. Route 169, a high-volume road, and County State Aid Highway (CSAH) 8 in Mille Lacs County, a low-volume road. This study includes treatment selection, test site selection and layout, scheduling, construction, performance monitoring, and data activities to quantify the life-extending benefits of pavement preservation treatments.

**Cracking Group Experiment:**
The aim of the cracking group experiment is to develop and implement asphalt performance tests to predict cracking for common pavement distresses found in North America. There are several lab tests that claim to relate to one or more modes of cracking. However, most of these tests lack robust validation outside of the state where the method was developed.
Both MnROAD and NCAT have developed test sections to validate laboratory cracking tests by establishing correlations between test results and measured cracking performance in real pavement test sections within a very short timeframe. This research will provide much-needed data on where to set criteria for specifications.

Test sections with differing asphalt mixtures that have a range of expected cracking susceptibilities have been constructed at MnROAD. A suite of laboratory cracking tests conducted on the mixes will identify which test results best correlate with field cracking as well as consider their variability, utility, and practicality of implementation for both mix design approval and quality control testing. A crucial component of the study is regular performance monitoring of the pavement test sections for ride quality, distresses, strength, and response.

| FISCAL YEAR 2022 ACCOMPLISHMENTS |
| --- |
| All tasks scheduled to be completed by the end of November. |
| **FISCAL YEAR 2023 ACCOMPLISHMENTS** |
| Activities toward complete construction and subsequent research efforts between NCAT and MnROAD continued. |
| **FISCAL YEAR 2024 ACCOMPLISHMENTS** |
| Completed construction and subsequent research efforts between NCAT and MnROAD. |
| **FISCAL YEAR 2025 ACCOMPLISHMENTS** |
| This pooled fund project closed in FY25. No final report posted. |
| **JUSTIFICATION(S) FOR REVISION(S)** |
| TAC and FHWA approval for a no cost time extension until November 30, 2022, to complete remaining project tasks. |
| **SUMMARY OF THE IMPLEMENTATION RECOMMENDATION** |
| The final report includes Implementation Synopses:<br>https://www.eng.auburn.edu/research/centers/ncat/files/technical-reports/rep21-03.pdf |

Michigan Department
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# RESEARCH ADMINISTRATION
# MDOT TRANSPORTATION POOLED FUND STUDY
# ANNUAL REPORT - FISCAL YEAR 2025

STUDY TITLE: National Cooperative Highway Research Program (NCHRP) for FY 2025

FUNDING SOURCE: ☒ FHWA ☐ OTHER (*PLEASE EXPLAIN*)

| | | | | |
|---|---|---|---|---|
| TPF NO. | TPF-5(425) | | MDOT START DATE | 10/01/2024 |
| OR NO. | OR25-201 | | COMPLETION DATE (Original) | 9/30/2025 |
| | | | COMPLETION DATE (Revised) | |
| MDOT TECHNICAL CONTACT | Andre Clover, 517-749-9001<br>Email: CloverA@Michigan.gov | | | |
| LEAD AGENCY | Federal Highway Administration (FHWA) | | | |
| LEAD STUDY CONTACT | Jean Landolt, 202-493-3146<br>Email: Jean.Landolt@dot.gov | | | |
| CONTRACTOR | | | | |

## BUDGET STATUS

| FY 2025 MDOT Budget | | | | MDOT Total Budget | | |
|---|---|---|---|---|---|---|
| FY25 FUNDS | (Original) | $1,500,000.00 | | BUDGETED AMT. | (Original) | $1,500,000.00 |
| | (Revised) | | | ACTUAL COST | (Revised) | $1,522,605.00 |
| TOTAL FY 2025 EXPENDITURES | | $522,605.00 | | TOTAL COMMITTED FUNDS AVAILABLE | | $0.00 |

## PARTICPATING STATES

50 states and DC

## PURPOSE AND SCOPE

Every federal fiscal year, state Departments of Transportation asked 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 2025 ACCOMPLISHMENTS

Each FFY the NCHP accomplishments follow a standard cycle that includes:

Problem Statements' Evaluations, Program Development, Project Development, and the start of the Research Phase.

Each NCHRP project panel evaluates submitted proposals to project solicitations and selects a contractor. Once each NCHRP research project starts NCHRP oversees progress by reviewing monthly progress schedules and quarterly progress schedules and maintains frequent contact with the research contractors.

## JUSTIFICATION(S) FOR REVISION(S)

None.

## SUMMARY OF THE IMPLEMENTATION RECOMMENDATION

NCHRP monitors the conduct of the research to ensure consistency with the approved research plan and consults with project panels for technical feedback on contractors' work.

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# RESEARCH ADMINISTRATION
# MDOT TRANSPORTATION POOLED FUND STUDY
# ANNUAL REPORT - FISCAL YEAR 2025

STUDY TITLE: Behavior of Reinforced and Unreinforced Lightweight Cellular Concrete for Retaining Walls

FUNDING SOURCE: ☒ FHWA ☐ OTHER (*PLEASE EXPLAIN*)

| | | | | |
|---|---|---|---|---|
| TPF NO. | TPF-5(433) | | MDOT START DATE | 6/14/2019 |
| OR NO. | OR20-206 | | MDOT COMPLETION DATE (Original) | 9/30/2024 |
| | | | COMPLETION DATE (Revised) | 1/31/2026 |
| MDOT TECHNICAL CONTACT | Joel Tichenor, 517-636-4933<br>Email: TichenorJ@Michigan.gov | | | |
| LEAD AGENCY | Utah DOT | | | |
| LEAD STUDY CONTACT | David Stevens, 801-589-8340<br>Email: davidstevens@utah.gov | | | |
| CONTRACTOR | Brigham Young University | | | |

## BUDGET STATUS

| FY 2025 MDOT Budget | | | | MDOT Total Budget | | |
|---|---|---|---|---|---|---|
| FY25 FUNDS | (Original) | $0.00 | | TOTAL BUDGET | (Original) | $30,000.00 |
| | (Revised) | | | | (Revised) | |
| TOTAL FY 2025 EXPENDITURES | | $0.00 | | TOTAL COMMITTED FUNDS AVAILABLE | | $0.00 |

## PARTICIPATING STATES

CA, FHWA, KS, LA, MI, NY, OR, UT, WA

## PURPOSE AND SCOPE

The overall objective of this study is to measure engineering design parameters and failure mechanisms for unreinforced and reinforced LCC backfills based on large-scale laboratory tests.

Funded tasks for this study include the following:

1. Perform literature review and survey to determine methods currently used in design of MSE walls with LCC backfill, and review performance of these walls since construction (where possible).
2. Conduct Unconfined Compressive Strength (UCS), triaxial shear, direct shear, unit weight, and other laboratory tests to define basic material properties of LCC backfill (Caltrans Class II) that is used during each of the five large-scale laboratory tests.
3. Perform a large-scale test on unreinforced LCC using a reinforced concrete, cantilever retaining wall on the open side of an existing BYU test box. Measure pressures on wall, wall deformations, and eventual failure planes during fill placement, curing, and after application of a surcharge load at the top of the cured fill surface. (This test will be performed after reviewing results of a similar test previously performed on a separate UDOT research project.)
4. Within the BYU test box, perform the following four large-scale tests using MSE wall panels with various arrangements of LCC fill reinforced with inextensible ribbed strip reinforcements:
   > Reinforced LCC Test 1 – MSE wall with LCC backfill,
   > Reinforced LCC Test 2 – MSE wall with LCC backfill against soil slope,
   > Reinforced LCC Test 3 – MSE walls on both sides of LCC and overlapping reinforcements, and
   > Reinforced LCC Test 4 – Pull-out tests on MSE wall.

   In these MSE reinforced LCC backfill tests, measure pressures on wall panels, wall deformations, force in reinforcements, and internal failure planes during fill placement and after application of a surcharge load at the cured fill surface. In the final test, the pull-out tests of reinforcements will be performed at a variety of vertical effective stress levels with and without surcharge.
5. Compare results with design methods. Define earth pressure coefficients, wall displacement, and failure surface geometry for the unreinforced LCC backfill test and the reinforced MSE wall LCC backfill tests. Define reinforcement pull-out resistance as a function of vertical stress and LCC strength. Compare measured earth pressure, tensile force, and pull-out resistance with available design methods.
6. Prepare two Final Reports that describe the test setup, test results, and provide comparisons with existing design procedures for (a) the unreinforced LCC test and (b) the reinforced LCC tests. The reports will also provide recommendations for design procedures based on test results and analyses of data relative to existing procedures.
7. Disseminate study results in periodic TAC update meetings and in other venues as funding allows.

## FISCAL YEAR 2020 ACCOMPLISHMENTS

Tasks 1, 2, 3, and 4 listed above have been completed. Data analysis and final reports have not been completed and disseminated.

## FISCAL YEAR 2021 ACCOMPLISHMENTS

Two additional tests were performed to acquire additional data related to MSE wall reinforcement in LCC Backfill. This brought the total number of tests to 6 (including the 4 tests originally listed in task 4 above). The first additional test involved MSE wall panels and LCC backfill with welded-wire reinforcements. The second additional test involved additional reinforcement pull-out tests. Data related to these additional tests was provided to the research team.

Task 5 started but has not been completed and disseminated.
Task 6 is in progress but has not been completed and disseminated.

**FISCAL YEAR 2022 ACCOMPLISHMENTS**

Task 5 completion pending.
Task 6 reports have been provided to the team for review and comment but have not been completed and disseminated.
Task 7 to be completed after review and comment of the reports.

**FISCAL YEAR 2023 ACCOMPLISHMENTS**

Status of each task at FYE are as follows:
Task 1- 70%
Tasks 2, 3, 4, and 5- 100%
Tasks 6* and 7- 50% [*Additional Task 6 reports were generated and disseminated to the group for review and comment]

Reports:
6- Short Interim Reports
6- Detailed Interim Reports
1- Short Report
2- Final Reports (to post on TPF website)

**FISCAL YEAR 2024 ACCOMPLISHMENTS**

Status of each task are as follows:
Task 1 – 70% complete. Continued the literature review and survey.
Task 2 – 100% complete.
Task 3 – 100% complete.
Task 4 – 100% complete.
Task 5 – 90% complete. Continued work on Detailed Interim Reports including key parameters from the reinforced tests.
Task 6 – 70% complete. Draft Final Report for unreinforced LCC tests sent to TAC and review comments returned to research team. Continued work on the Draft Final Report for the reinforced LCC tests.
Task 7 – 70% complete.

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

This pooled fund project is nearly complete (~95% completed). The revised estimated project completion date is January 31, 2026.

All laboratory testing associated with this research project is complete and the draft report has been reviewed and discussed by the TAC. The Final Report will be disseminated to the TAC after incorporation of review comments. Upon delivery of the updated Final Report, they will be disseminated to all partner state members (TAC).

**FISCAL YEAR 2026 PROPOSED ACTIVITIES**

All laboratory testing associated with this research project is complete and the draft report has been reviewed and discussed by the TAC in a virtual meeting. The Final Report will be disseminated to the TAC after incorporation of review comments.

**JUSTIFICATION(S) FOR REVISION(S)**

No cost time extension required to complete final report.

**SUMMARY OF THE IMPLEMENTATION RECOMMENDATION**

Project expected completion FY 2026.

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# RESEARCH ADMINISTRATION
# MDOT TRANSPORTATION POOLED FUND STUDY
# ANNUAL REPORT - FISCAL YEAR 2025

STUDY TITLE: Aurora Program (FY20 - FY24)

FUNDING SOURCE: ☒ FHWA ☐ OTHER (*PLEASE EXPLAIN*)

| | | | | |
|---|---|---|---|---|
| TPF NO. | TPF- 5(435) | | MDOT START DATE | 7/17/2019 |
| OR NO. | OR20-212 | | MDOT COMPLETION DATE (Original) | 9/30/2024 |
| | | | COMPLETION DATE (Revised) | 12/31/2026 |
| MDOT TECHNICAL CONTACT | James Roath, 517-230-5361<br>Email: RoathJ1@Michigan.gov | | | |
| LEAD AGENCY | Iowa DOT | | | |
| LEAD STUDY CONTACT | Khyle Clute, 515-239-1646<br>Email: Khyle.Clute@iowadot.us | | | |
| CONTRACTOR | | | | |

**BUDGET STATUS**

| FY 2025 MDOT Budget | | | | MDOT Total Budget | | |
|---|---|---|---|---|---|---|
| FY25 FUNDS | (Original) | $0.00 | | TOTAL BUDGET | (Original) | $125,000.00 |
| | (Revised) | | | | (Revised) | |
| TOTAL FY 2025 EXPENDITURES | | $0.00 | | TOTAL COMMITTED FUNDS AVAILABLE | | $0.00 |

**PARTICIPATING STATES**

AK, AZ, CA, CO, DE, IA, IL, KS, ME, MI, MN, MO, ND, OH, PA, UT, VA, WA, WI

**PURPOSE AND SCOPE**

The Aurora program is a partnership of highway agencies that began in 1996 to collaborate on research, development, and the deployment of Road Weather Information Systems (RWIS) to improve the efficiency, safety, and reliability of surface transportation. It is managed by the Center for Weather Impacts on Mobility and Safety (CWIMS) which is housed under InTrans at Iowa State University.

Aurora's initiatives are funded by member agencies to conduct research that services the needs of its members. The board meets twice each year to set the agenda for RWIS research, keep informed about progress on program initiatives, and discuss solutions for common in the field problems. Newly selected initiatives are led by "champion" member agencies, managed by committees of Aurora members.

Aurora works closely with the Federal Highway Administration (FHWA), having been approved for federal-aid research and development funds without state match using 100% SPR funding. Aurora also has a strong relationship with the American Association of State Highway Transportation Officials (AASHTO) and its Snow and Ice Pooled Fund Cooperative Program (SICOP). In addition, Aurora coordinates with the American Meteorological Society (AMS), the National Severe Storm Laboratory, ITS America, Clear Roads, and the National Center for Atmospheric Research (NCAR). Aurora also works closely with industry as initiated by each participating entity.

**FISCAL YEAR 2020 ACCOMPLISHMENTS**

Administrative:

- Coordinated with states regarding new (or interim) Board representatives.
- Managed Aurora email list. In some cases, states requested multiple individuals be included in Aurora related correspondence.
- Provided program management in terms of projects and program budgets.
- Participated in a planning call (July 10) for the 2020 International Road Weather and Winter Maintenance Conference.
- Prepared presentations about Aurora for members to discuss at the following meetings.
- Coordinated with SICOP.
- FHWA Road Weather Stakeholder Meeting held.
- Updated Aurora website content.

**FISCAL YEAR 2021 ACCOMPLISHMENTS**

Administrative:

- Aurora website updates.
- Ontario membership follow up.
- Manage budget.
- Track new solicitation contributions.
- Update the Aurora Charter, Work Plan and Associate Members.

Project-Specific Activities:

- Tracked project status and prepared a summary for recently completed and active projects.

- Distributed quarterly reports and invoices for project team approval.
- Upon approval, submitted invoices to the Iowa DOT for payment.
- 2020-02 “Roadway Ice/snow Detection using a Novel Infrared Thermography Technology”.
- Distributed quarterly report to project team.
- Project update presentation during the spring meeting.
- 2020-03 Roadway Friction Modeling
- Facilitated sharing of some sensors in support of the project.
- Collaborated in project re-scoping.
- Distributed quarterly reports and invoices.

Meetings and Conferences:
Board member monthly conference calls were held on the following dates.
April 8, 2021
- Financials
- Membership
- Submitted ideas
- Additional solicitation

The May 2021 meeting was held in conjunction with the Aurora Spring meeting.
2021 Aurora Spring Meeting
- Coordinated presentations from FHWA, SICOP and researchers.
- Prepared financial details, including commitment, encumbrances, and available funds.
- Solicited project ideas for the 2021 Aurora Spring Meeting. A total of 14 ideas were received.
- Prepared spreadsheet for project voting.
- Organized and distributed project ideas and voting spreadsheet to Aurora Board.
- Obtained and integrated voting results for discussion during the spring meeting.
- Prepared and distributed questions to the proposers of the five highest rated project ideas.

Conference calls were held with two of the proposers
June 10, 2021
- Project idea update
- Project update
- Other action items – equipment compatibility, data logger use

**FISCAL YEAR 2022 ACCOMPLISHMENTS**

Project- Non-Invasive Sensor Deployment in Aurora Member States
Continue monthly Board meeting calls.
Continue to communicate with new Aurora representatives.
Seek additional project ideas from members.
Gather and distribute project ideas to members.
Continue to hold project-related meetings.
Collaborate and facilitate addressing project needs, relating to scope and/or budget changes, that may arise.

Meetings and Conferences:
Board member monthly conference calls
- Financials
- Membership
- Submitted ideas
- Additional solicitation

May 2022 meeting was held in Portland, OR.
2022 Aurora Spring Meeting
- Coordinated presentations from FHWA, SICOP and researchers.
- Prepared financial details, including commitment, encumbrances, and available funds.
- Solicited project ideas for the 2022 Aurora Spring Meeting. A total of 19 ideas were received.
- Prepared spreadsheet for project voting.
- Organized and distributed project ideas and voting spreadsheet to Aurora Board.
- Obtained and integrated voting results for discussion during the spring meeting.
- Prepared and distributed questions to the proposers of the five highest rated project ideas.

October 2022 Meeting Held in Minneapolis, MN
- Friends of Aurora Presentations
- Final Project decisions
- Projects and Invoices
- State Commitments
- Management and Board Meeting Costs

- Overall Funds Available for Projects
- Discussion regarding 2023 Spring Meeting

**FISCAL YEAR 2023 ACCOMPLISHMENTS**

Automated Extraction of weather Variables from Imagery
Roadway Friction Modeling: Improving the Use of Friction Measurements in State DOTs

Continue monthly Board meeting calls.
Continue to communicate with new Aurora representatives.
Seek additional project ideas from members.
Gather and distribute project ideas to members.
Continue to hold project-related meetings.
Collaborate and facilitate addressing project needs, relating to scope and/or budget changes, that may arise.

Meetings and Conferences:
Board member monthly conference calls
- Financials
- Membership
- Submitted ideas
- Additional solicitation

May 2023 meeting was held in San Diego, CA.
2023 Aurora Spring Meeting
- Coordinated presentations from FHWA, SICOP and researchers.
- Prepared financial details, including commitment, encumbrances, and available funds.
- Solicited project ideas for the 2023 Aurora Spring Meeting.
- Prepared spreadsheet for project voting.
- Organized and distributed project ideas and voting spreadsheet to Aurora Board.
- Obtained and integrated voting results for discussion during the spring meeting.
- Prepared and distributed questions to the proposers of the five highest rated project ideas.

October 2023 Meeting Held in Portland, MA
- Several project kickoff presentations and project final presentations
- Final Project decisions
- Projects and Invoices
- State Commitments
- Management and Board Meeting Costs
- Overall Funds Available for Projects

Discussion regarding 2024 Spring Meeting, looking at scheduling it to be in Colorado.

**FISCAL YEAR 2024 ACCOMPLISHMENTS**

Projects Completed:
Evaluation of Spring Load Restriction Removal Protocols
Road Weather Management using Connected Vehicle Technology
Roadway Ice/Snow Detection using a novel infrared thermography technology
Integration of connected vehicle and RWIS technologies
Assessment of connected vehicle friction measurement data on DOT Winter Maintenance use cases

May 2024 Meeting was held in Boulder, Colorado
- Prepared financial details, including commitment, encumbrances, and available funds.
- Solicited project ideas for the 2024 Aurora Spring Meeting.
- Prepared spreadsheet for project voting.
- Organized and distributed project ideas and voting spreadsheet to Aurora Board.
- Obtained and integrated voting results for discussion during the spring meeting.
- Discussed new Pooled Fund Solicitation

October 2024 Meeting held in Madison, Wisconsin
- Project updates and Invoices
- State Commitments and moving over to new Pooled Fund # after solicitation
- Management and Board Meeting Costs
- Overall Funds Available for Projects

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

FY25 Accomplishments:
Project: Optimal RWIS Sensor Density and Location-Phase 4
Project: Automating Variable Speed Limits Using Weather, Traffic Data Project: Standardized Framework for Winter Weather Road Condition Indices

Project: An Intelligent Human-Centric Communication System for Adverse Weather and Road Conditions
Project: Roadway Friction Forecasting using Stationary and Mobile Friction Data

Project Management Efforts:
Held monthly Board meeting calls.
Continue to communicate with new Aurora representatives.
Seek additional project ideas from members. Gather and distribute project ideas to members.
Continue to hold project-related meetings.
Collaborate and facilitate addressing project needs, relating to scope and/or budget changes, that may arise.

Board member monthly conference calls

- Financials • Membership
- Submitted ideas
- Additional solicitation Spring 2025 Meeting location was Anchorage, Alaska. Fall 2025 Meeting location was Minneapolis, Minnesota and will be a peer exchange between Aurora, Clear Roads, and AASHTO.

**FISCAL YEAR 2026 PROPOSED ACTIVITIES**

Program Administrative Activities:
Lead agency will continue reviewing/updating financial details as work progresses.
Continue holding meetings and conference calls.
Monitor/track project status and timelines.
Projects Management Activities:

- Facilitate and direct project activities as needed.
- Continue to issue and distribute project updates.
- Continue to review invoices for accuracy and completeness.
- Publish Final Reports for completed research projects.

**JUSTIFICATION(S) FOR REVISION(S)**

The project start date was delayed due to budget needs not being met; thus, delaying the contract execution. The delay required moving the project end date back to complete the work.

**SUMMARY OF THE IMPLEMENTATION RECOMMENDATION**

Project expected completion FY 2026.

Michigan Department
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# RESEARCH ADMINISTRATION
# MDOT TRANSPORTATION POOLED FUND STUDY
# ANNUAL REPORT - FISCAL YEAR 2025

STUDY TITLE: Development of Criteria to Assess the Effects of Pack-out Corrosion in Built-up Steel Members

FUNDING SOURCE: ☒ FHWA ☐ OTHER (*PLEASE EXPLAIN*)

| | | | |
|---|---|---|---|
| TPF NO. | TPF-5(436) | MDOT START DATE | 8/05/2019 |
| OR NO. | OR20-201 | MDOT COMPLETION DATE (Original) | 9/30/2022 |
| | | COMPLETION DATE | 8/31/2025 |
| MDOT TECHNICAL CONTACT | Allie Nadjarian, 517-331-6602<br>Email: NadarianA@Michigan.gov | | |
| LEAD AGENCY | Indiana DOT | | |
| LEAD STUDY CONTACT | Tommy Nantung, 765-463-1521 ext. 248<br>Email: tnantung@indot.in.gov | | |
| CONTRACTOR | | | |

**BUDGET STATUS**

| FY 2025 MDOT Budget | | | MDOT Total Budget | | |
|---|---|---|---|---|---|
| FY25 FUNDS | (Original) | $0.00 | TOTAL BUDGET | (Original) | $120,000.00 |
| | (Revised) | | | (Revised) | |
| TOTAL FY 2025 EXPENDITURES | | $0.00 | TOTAL COMMITTED FUNDS AVAILABLE | | $0.00 |

**PARTICIPATING STATES**

IL, KS, MI, MN, PA, TX

**PURPOSE AND SCOPE**

The objectives of the proposed pooled-fund study are as follows:

1. To develop AASHTO ready specifications for the evaluation of the effects of pack-out corrosion in built-up steel tension, compression, and flexural members.
2. Provide guidance on the need for repairs and corrosion rates that can be expected in various environments to assist owners in programming when repairs may need to be made.
3. Identify the most effective methods of repairs and provide suggesting verbiage that could be used when preparing special provisions for repairs.
4. Develop several case-study examples, including calculations that will be used for training users on the methodologies to be developed. It is anticipated that the research team will host several webinars or on-site training sessions to ensure technology transfer and implementation.
5. The impact of this study is obvious considering there is no such quantitative guidance available at present. The results of the work will allow owners to accurately assess the effects of this form of corrosion on various limit states (e.g., strength, fatigue, buckling, etc.) in built-up steel members. Both flexural and truss-type members will be studied. The ability to program repairs based on data-driven models allows for the best possible use of limited maintenance funds and safely extends the life of the existing inventory.

Research Tasks:
To achieve the proposed objectives, the following tasks are proposed:
Task I – Perform a thorough literature review of both domestic and international research on pack-out corrosion, how various owners have addressed this problem, repair strategies, and collect data on corrosion processes and rates.

Task II – Develop a laboratory experimental program that will include large-scale testing of members which contain damage due to pack-out. At present, the research team will explore the use of both simulated pack-out (i.e., newly fabricated components with induced local distortions that simulate pack-out) and “natural” pack-out by obtaining members from various bridge being removed from service. The effects of temperature on the performance of damaged members will also be included in the laboratory testing as the fracture toughness of some older steels is minimal at low temperatures. In this regard, testing of tension and flexural members will be completed at cold temperatures. The benefits of internal redundancy will also be examined. Finally, various mitigation strategies will also be investigated. While there are some anti-corrosion products currently available on the market, it is not clear how to evaluate the effectiveness of these products. Therefore, a portion of the work will focus on the evaluation of such products and to subsequently develop methods to assess the short- and long-term effectives of such products.

Task III – As data become available from Task II, the research team will conduct numerical (FEA) parametric studies to allow a wider range of damage to be evaluated under various geometries and loading conditions which are not possible to include in the laboratory studies. It is noted the research team at Purdue University has gained extensive experience in the laboratory testing and calibrated

non-linear FEA of built-up steel members during the development of the recently published AASHTO Guide Specifications for Internal Redundancy of Mechanically fastened Built-up Steel Members.

Task IV – Based on the results of Tasks I through III, proposed guide specifications for the evaluation of the effects of pack-out corrosion will be developed for consideration by AASHTO COBS. The research team has considerable experience in the development of AASHTO Specifications and has worked very closely with various AASHTO subcommittees to ensure all stakeholders, including FHWA, are involved and have input.

Task V - In addition to developing the Guide Specifications, a methodology to estimate the interval from when “non-critical” pack-out becomes “critical” pack-out corrosion will be developed. This information will be particularly useful to owners when programing funding for future repairs. Finally, guidance on the best practices for the repair of pack-out corrosion, when deemed required, will also be compiled.

Task VI – Develop training materials to ensure the results are disseminated and the research is moved into practice.

Task VII – Summarize the results of the research in a detailed Final Project Report.

**FISCAL YEAR 2020 ACCOMPLISHMENTS**

- Despite the challenges with Purdue being shut down from approximately mid-March through the end of June due to COVID-19, reasonable progress has been made regarding the finite element studies to evaluate the effects of pack-out on the strength of compression members. Analysis have begun to consider the effects of pack-out in flexural members considering fastener pitch, cover plate thickness, flange thickness, and degree of pack-out distortion on the strength of the member. The studies will be used to develop the details associated with the experimental portion of the research.

**FISCAL YEAR 2021 ACCOMPLISHMENTS**

- Prototype testing focusing on the compression flange of a beam was completed. Three tests in total were performed. A W24x68 with top and bottom cover plates was tested to focus on pack-out in a compression flange. Tests included zero distortion of the cover plate as well as various levels of distortion due to simulate pack out. For this test, no section loss was introduced to isolate the effect of the pack-out. The test yielded valuable data regarding the effect of distortion on fastener forces, local stresses, and stiffness. The second test included a girder with simulated section loss and no simulated distortion and a third specimen which included a cover plate having simulated section loss and with simulated pack out distortion. The section loss was simulated by machining material away in a profile like what has been measured from real specimens.
- The data from the two additional prototype tests were used to further calibrated the FEA studies. As with the other tests, excellent agreement between the laboratory measured data and the FEA results have been observed.
- An entire truss has been obtained from INDOT which included members with moderate to severe pack-out that has been taken out of service. Work is underway to develop tests which will utilize these members to evaluate the strength as well as fatigue/fracture performance.

**FISCAL YEAR 2022 ACCOMPLISHMENTS**

- The tests on small portions of members with real pack out corrosion was completed, and data was reviewed and used to calibrated FEA simulations. These specimens were subjected to compression loading to evaluate the effect of section loss and distortion on local buckling. This data will be used along with the data from the compression flange girder tests to begin to develop strategies to evaluate the effects of pack-out on the capacity of compression members.
- The large-scale fatigue specimens have been fabricated and shipped to the lab.
- Continued calibrating FEA models based on experimental data. 3D mapping of the distortion from pack-out and section loss is being incorporated into the girder FEA models to identified regions of amplified local stresses.
- Continue to calibrate FEA models of compression flanges and axial members using the large-and small-scale test date. These data will be used along with the data from the compression flange girder tests to begin to develop strategies to evaluate the effects of pack-out on the capacity of compression members. FEA parametric studies are underway for these compression members.
- Began fatigue testing the large-scale girders. The testing began later than anticipated due to equipment issues. The tests are being run at low stress ranges (7 ksi) to obtain data at stress range levels representative of in-service bridges. Hence, they will take a very long time to complete. There are 4 girders in total that will be fatigue tested.
- Continued calibrating FEA models based on the experimental data.

**FISCAL YEAR 2023 ACCOMPLISHMENTS**

- FEA parametric studies continued on flexural and axial members to evaluate the effect of pack-out corrosion on the strength and fatigue performance of such members.
- Work on parametric studies focused on compression members was intimated for a range of flexural members.
- Conclusions and AASHTO-ready evaluation procedures should be forthcoming.

**FISCAL YEAR 2024 ACCOMPLISHMENTS**

- Continued FEA parametric studies on flexural and axial members to evaluate the effect of pack-out corrosion on the strength and fatigue performance of such members.
- Completed testing of the pull-plate specimens to study ductility in the presence of corrosion. The results are being incorporated into FEA models and are also being evaluated in the context of incorporating the results into the proposed AASHTO-ready guidelines.
- Continued work on parametric studies focused on compression members.
- Results (compression, tension, and fatigue) continue to be synthesized into draft AASHTO ready code and Commentary.

- Created a high-level summary of the portion of the work focused on tension components with results that will be used as the basis for the AASHTO language in preparation.

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

- Completed finite element parametric studies.
- Drafted AASHTO-ready code and commentary for evaluation of members with pack-out corrosion for consideration by AASHTO COBS, S&E and S&M committees.
- Analyzed results from the parametric studies on flexural and axial members to develop simplified “hand” methods to account for the effects of pack-out corrosion on the strength and fatigue performance of such members.
- Finalized equations and the approach for how to address the effects of pack-out corrosion in flexural members, tension members (flanges and truss members), and pack-out corrosion on fatigue.
- The project’s final report is in preparation.

**JUSTIFICATION(S) FOR REVISION(S)**

The project will require a 12-18 month no cost extension. While the official project start date on the TPF website was effectively September 2019, commitments did not arrive until spring of 2020. This was documented in the earlier QPRs from 2019 and 2020. COVID 19 then shut the university down in Spring of 2020 and no work could be performed and no students were hired out of caution. To perform all the long-life fatigue and strength testing, finish all FEA studies, compile all project results, etc. a no-cost extension will be requested through FY 2024.

A 12 month no cost extension was approved to:

- Perform additional parametric studies to enhance the work, as related to tension flanges with pack out and truss compression members with pack-out.
- Prepare the ballot language for AASHTO consideration and present at AASHTO committee meetings.
- Prepare and submit a final project report.

**SUMMARY OF THE IMPLEMENTATION RECOMMENDATION**

The final report is being prepared.

Michigan Department
Of Transportation
5307 (11/17)

# RESEARCH ADMINISTRATION
# MDOT TRANSPORTATION POOLED FUND STUDY
# ANNUAL REPORT - FISCAL YEAR 2025

STUDY TITLE: Technology Transfer Concrete Consortium (FY20-FY24)

FUNDING SOURCE: ☒ FHWA ☐ OTHER (*PLEASE EXPLAIN*)

| | | | | |
|---|---|---|---|---|
| TPF NO. | TPF-5(437) | | MDOT START DATE | 8/05/2019 |
| OR NO. | OR20-207 | | MDOT COMPLETION DATE (Original) | 12/31/2025 |
| | | | COMPLETION DATE (Revised) | 12/31/2027 |
| MDOT TECHNICAL CONTACT | Chris Byrum, 517-285-7085<br>Email: ByrumC@Michigan.gov | | | |
| LEAD AGENCY | Iowa DOT | | | |
| LEAD STUDY CONTACT | Khyle Clute, 515-239-1646<br>Email: Khyle.Clute@iowadot.us | | | |
| CONTRACTOR | Iowa State University | | | |

**BUDGET STATUS**

| FY 2025 MDOT Budget | | | | MDOT Total Budget | | |
|---|---|---|---|---|---|---|
| FY25 FUNDS | (Original) | $0.00 | | TOTAL BUDGET | (Original) | $80,000.00 |
| | (Revised) | | | | (Revised) | $60,000.00 |
| TOTAL FY 2025 EXPENDITURES | | $0.00 | | TOTAL COMMITTED FUNDS AVAILABLE | | $0.00 |

**PARTICIPATING STATES**

AL, AR, CA, CO, FL, GA, IA, ID, IL, IN, KS, KY, MA, MI, MN, MO, MT, NC, ND, NE, NV, NY, OH, OK, OR, PA, SC, SD, TN, TX, UT, VT, WA, WI, WV, WY

**PURPOSE AND SCOPE**

The goals of the Technology Transfer Concrete Consortium (TTCC) are to:
- Identify needed research priorities by region
- Provide a forum for technology exchange between participants
- Develop and fund technology transfer materials
- Provide on-going communication of research needs faced by state agencies to the Federal Highway Administration (FHWA), industry, and the National Concrete Pavement Technology Center (CP Tech Center)
- Provide technical leadership for concrete related national initiatives to advance state-of-the-art construction and material practices

It is anticipated that this consortium would become the national forum for state involvement in the technical exchange needed for collaboration and new initiatives and provide tactical strategies and solutions to issues identified by the member states.

This pooled fund project allows for state representatives to continue the collaborative efforts of TPF-5(313) that originally began in TPF-5(066) Materials and Construction Optimization. The TTCC is open to any state agency desiring to be a part of new developments in concrete. TTCC will meet in conjunction with the National Concrete Consortium (NCC), twice a year. NCC Bylaws and the Executive Committee membership can be found at http://www.cptechcenter.org/ncc/TTCC-NCCMeetings.cfm.

TTCC Project Activities and Deliverables:
- Identify and guide the development and funding of technology transfer materials such as tech brief summaries, web-based courses, and training materials from research activities
- Publish Moving Advancements into Practice (MAP) Briefs on a quarterly basis
- Provide research ideas to funding agencies
- Identify and instigate needed research projects
- Include current activities and deliverables of the pooled fund on the CP Tech Center website
- Maintain the pooled fund project website with current activities and deliverables
- Maintain the TTCC pooled fund listserv; a forum for state reps to post questions to the other state reps and hear how similar problems or situations have been mitigated.
- Track TTCC listserv posted problems and discussions and categorized them for inclusion in a library on the project website
- Develop research problems statements for possible pooled fund projects to address research needs identified by member state reps
- Act as a technology exchange forum for the participating entities
- Contribute to a technology transfer newsletter on concrete pavement research activities every six months
- Submit electronic quarterly reports following lead state guidelines

Pooled fund activities and budgets are discussed at the semi-annual meetings. Proposals for minor research, synthesis studies, and/or training are often presented by partners and then discussed and voted on at the semi-annual meetings. NCC members may propose needed research and/or training, however they may not vote on how to utilize the federal pooled funds. Selection of needed work by partners does not guarantee work can be conducted under this pooled fund project since the Iowa DOT and FHWA must ensure the work will fit within the funding guidelines and scope of the project. Occasionally e-mail discussions and votes are warranted.

**FISCAL YEAR 2020 ACCOMPLISHMENTS**

The spring meeting, which was scheduled for April 2020 in Nashville, TN, was postponed due to COVID-19.
The fall face to face meeting scheduled for Minneapolis, MN was postponed due to COVID-19.
The fall "virtual" meeting was held September 1-3, 2020. The agenda consisted of the following:

- FHWA Alkali-Silica Reactivity (ASR) Update
- Managing ASR for the Future
- Post-treating for ASR
- Lightweight Cellular Concrete
- Performance Engineered Mixture (PEM) Testing Experiences
- Dowel/Tie Bars
- National Transportation Product Evaluation Program (NTPEP) Update
- Pumping Concrete
- National Road Research Alliance (NRRA) Update

**FISCAL YEAR 2021 ACCOMPLISHMENTS**

This pooled fund project, TPF-5-(437), is a continuation/reauthorization of TPF-5(313). The Spring 2021 meeting for TPF-5(437) was tentatively scheduled to be held in Nashville, TN on April 13-15. However, it was, again, switched to a virtual web meeting. The fall 2021 meeting was replaced by registration and attendance at the International Conference on Concrete Pavements. Several MDOT CFS staff attended this weeklong virtual web-based conference, which showcased many very informative topics relative to concrete pavements, presented by experts throughout the world.

**FISCAL YEAR 2022 ACCOMPLISHMENTS**

Held NCC Spring 2022 at the Embassy Suites in Nashville on April 4-6. Attendees included 197 in-person and 75 virtual from 39 states, District of Columbia, Puerto Rico, and Canada. The Fall 2022 meeting was held in Detroit on September 27-29. E-news and MAP Brief were published.

**FISCAL YEAR 2023 ACCOMPLISHMENTS**

Spring (Savannah, Georgia) and Fall (Portland, Oregon) Conferences were held. Information and PowerPoints from the Spring 2023 meeting held April 11-13 are available: https://cptechcenter.org/nc2-meetings. Technology transfer and exchanges remained a major focus. Identified and facilitated research activities. Maintained and updated pooled fund website.

**FISCAL YEAR 2024 ACCOMPLISHMENTS**

Information and PowerPoints from the Fall 2023 meeting held September 12-14 were made available at: https://cptechcenter.org/nc2-meetings/ • E-news and MAP Brief was published in Summer: NC² E-News: Summer 2023• MAP Brief on Revisiting Concrete Scaling: cdn-wordpress.webspec.cloud/intrans.iastate.edu/uploads/2023/07/revisiting_concrete_scaling_summer_2023_MB.pdf• News from the field includes; Illinois Center For Transportation: Performance Evaluation of Stabilized Support Layers for Concrete Pavements, MnDOT: Performance of Concrete Overlays over Full Depth Reclamation, ISU: Impact of Curling and Warping on Concrete Pavement: Phase II. One tech brief was published regarding thin concrete overlay behavior research at the following link; Research Solutions: Geotextiles used in road rehab may help extend pavement life. Spring and Fall Conferences were held. Information and PowerPoints from the Spring 2024 meeting held April 9-11 are available: https://cptechcenter.org/nc2-meetings/ The fall conference was a Big Deal and held concurrent with the 13th International Conference for Concrete Pavements in Minneapolis, MN where a full presentation session was held highlighting project research..

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

This pooled fund study 437 is winding down. Research efforts continue under a new pooled fund study (544).

Funds support the web site, data, and some offered training courses.

FY25 Accomplishments include:

E-News and MAP Briefs publications.
Map Brief, written by Jerod Gross, Snyder & Assoc.
Accelerated Delivery of Concrete Paving Projects
E-News from the field (Winter 2025) includes: • Accelerating Concrete Overlay Construction: A case Study • NCHRP Research Report 1105: Use of Marginal and Unconventional-Source Coal Ashes in Concrete • Developing AI-Assisted In-Situ NDT Method for Air-Void Distribution Testing in Fresh and Hardened Concrete • Early Age Concrete Acceptance • Durability of Concrete Using Low Slag Cement Contents • Toward the Development of Pavement-Specific Structural Synthetic Fibers • Bendable Concrete Utilized on a Bridge Deck (Engineered Cementitious Composite [ECC]) • Development of Cost-Effective Rapid-Setting Concrete for Improved Bridge Joint Performance • Solutions to Mitigate Dowel/Tie Bar Propagated Cracking – Phase 1

**FISCAL YEAR 2026 PROPOSED ACTIVITIES**

- Continue to identify and select workshops for FY 2026.
- Issue RFP for Lab services for cementitious materials & concrete mix consistency. Lab work is anticipated to continue in FY 2026.
- Continue planning and execution of various training workshops.
- E-news and MAP Brief will continue publication during FY 2026.

**JUSTIFICATION(S) FOR REVISION(S)**

None.

**SUMMARY OF THE IMPLEMENTATION RECOMMENDATION**

Project expected completion in FY 2027.

Michigan Department
Of Transportation
5307 (11/17)

# RESEARCH ADMINISTRATION
# MDOT TRANSPORTATION POOLED FUND STUDY
# ANNUAL REPORT - FISCAL YEAR 2025

STUDY TITLE: Smart Work Zone Deployment Initiative

FUNDING SOURCE: ☒ FHWA ☐ OTHER (*PLEASE EXPLAIN*)

| | | | | |
|---|---|---|---|---|
| TPF NO. | TPF-5(438) | | MDOT START DATE | 8/05/2019 |
| OR NO. | OR20-200 | | MDOT COMPLETION DATE (Original) | 12/31/2024 |
| | | | COMPLETION DATE (Revised) | 12/31/2027 |
| MDOT TECHNICAL CONTACT | Chris Brookes, 517-242-6486<br>Email: BrookesC@Michigan.gov | | | |
| LEAD AGENCY | Iowa DOT | | | |
| LEAD STUDY CONTACT | Khyle Clute, 515-239-1646<br>Email: Khyle.Clute@iowadot.us | | | |
| CONTRACTOR | Iowa State University | | | |

**BUDGET STATUS**

| FY 2025 MDOT Budget | | | | MDOT Total Budget | | |
|---|---|---|---|---|---|---|
| FY25 FUNDS | (Original) | $0.00 | | TOTAL BUDGET | (Original) | $125,000.00 |
| | (Revised) | | | | (Revised) | |
| TOTAL FY 2025 EXPENDITURES | | $0.00 | | TOTAL COMMITTED FUNDS AVAILABLE | | $0.00 |

**PARTICIPATING STATES**

IA, IL, KS, MI, MN, MO, NE, TX, WI

**PURPOSE AND SCOPE**

This program represents an on-going effort among cooperating states' Departments of Transportation (DOTs), the Federal Highway Administration (FHWA), universities, and industry to evaluate new products and conduct related research focused on the enhancement of safety and mobility in highway work zones. Over 100 studies and evaluations have been completed since the inception of the Smart Work Zone Deployment Initiative (SWZDI) and final reports are posted in the SWZDI web site at https://swzdi.intrans.iastate.edu/.

Procedures for Project Selection, Award, Implementation

1. Board of Directors (BOD) members solicit and develop problem statements.
2. BOD prioritizes problem statements.
3. Program administrator prepares Request for Proposals (RFPs) and collects proposals from researchers in partnering states.
4. BOD prioritizes proposal topics.
5. BOD reviews, discusses, and prioritizes submitted proposals.
6. Proposal are scored and ordered based on priorities collected in item 5 and weighted values that are based on state partner commitments that year.
7. Annual work plan is prepared by the program administrator who also facilitates contracts between the selected researcher(s) and the Iowa DOT.
8. State DOTs form and lead the individual project Technical Advisory Committees (TACs) for projects awarded to a university or entity in their state (other members can request to serve on the TAC).
9. Projects are tracked quarterly.
10. Draft final reports are reviewed by the home state as well as by the BOD.
11. Final reports are posted to the program webpage and sent to national research report repositories.
12. Implementation and technical transfer opportunities are discussed by the BOD.

Research Implementation and Technology Transfer Benefits: The benefits from the SWZDI pooled fund include a wide variety of products including completed research reports, technical transfer documents, potential presentations and training, safety equipment evaluations, support toward other research, as well as development and/or implementation of research results in areas of mutual interest and benefit to pooled fund members and others in the industry.

**FISCAL YEAR 2020 ACCOMPLISHMENTS**

For the 2020 program, 30 problem statements were developed. The BOD decided that 10 problem statements should be included in the annual RFP, which was distributed to potential researchers at research institutions in contributing states on October 25, 2019.

The three top ranked proposals could be funded and were selected for the 2020 program year and are expected to total $200,000.

List of Approved projects:

1. Temporary Traffic Control Devices at Driveways within a One-Lane, Two-Way Section
2. Using Smart Work Zone Trailer Data to Evaluate and Predict Lane Closure Impacts with a Consideration of Work Intensity
3. Work Zone Activity Data Logging – Phase II

Project 3a is with Michigan State University and is taking place on MDOT project sites. This data collection would have been completed in-house but was able to be performed by MSU instead due to the selection of the project. The voting influence gained by MDOT being an active member played a large role in this project being selected.

**FISCAL YEAR 2021 ACCOMPLISHMENTS**

The Reports completed during the 2021 fiscal year are as follows:

4. Using Smart Work Zone Trailer Data to Evaluate and Predict Lane Closure Impacts with a Consideration of Work Intensity
   This report describes the implementation of machine learning (ML) models to the prediction of work-zone traffic impacts including local speed and traffic volume changes and corridor-level travel time increases. It also summarizes efforts to refine an existing tool that estimates work-zone-related delays and costs by providing consistent estimates of typical travel times that consider variations across days of the week and months of the year.
5. Work Zone Data Management Applications and Opportunities
   This project reviewed various stakeholders' current needs for pre-construction, real-time, and post-construction work zone information and compared these needs to the available work zone data sources and standards. The analysis identified a substantial mismatch between the roadway and lane closure data currently available, and the data required to manage work zone traffic impacts effectively. To address this gap, the project developed a conceptual prototype for a tool that would facilitate self-reporting of closure details by contractors and maintenance crews.

**FISCAL YEAR 2022 ACCOMPLISHMENTS**

The Reports completed during the 2021 fiscal year are as follows:

1. Investigation of Autonomous/Connected Vehicles in Work Zones
   This study is the first research project that examined truck platooning in work zones. A networked or federated simulator was used in which a vehicle driven by a human subject encountered a truck platoon with the lead truck driven by a human driver. The experiment involved 10 scenarios composed of differences in education, truck signage, and number of trucks in the platoon. The results point to the importance of education as the post-education vehicle speeds increased between 8.6% and 12.9% across scenarios, and the distance headway decreased between 28.8% and 30%. The vehicles increased in efficiency while still staying under the work zone speed limit.
2. Effective Signing Strategies and Signal Displays for Work Zone Driveway Assistance Devices (DADs)
   Work zones that include single lane closure on a two-lane, two-way roadway present unique traffic control challenges. In these situations, traffic regulators (i.e., flaggers or temporary traffic signals) are often utilized to regulate traffic such that only a single direction utilizes the open travel lane at any time. Recently, an experimental traffic control treatment, referred to as the driveway assistance device (DAD), was developed to help drivers safely enter a one-lane, bi-directional work zone from a driveway or minor side street by using alternating left and right flashing arrows along with a steady red indication. As the DAD is a relatively new and under-researched treatment, much is still unknown about the optimal designs of the signal display and auxiliary signage to provide the highest comprehension and compliance.

**FISCAL YEAR 2023 ACCOMPLISHMENTS**

The Reports completed during the 2022 fiscal year are as follows:

1. Work Zone Activity Data Logging – Phase II
   In the Work Zone Activity Data Logging Phase I project, state transportation agencies in the SWZDI states and beyond expressed a strong need for better information about the location, extent, and timing of lane closures. More than a dozen use cases for detailed lane closure data were identified and prioritized, such as helping first-responders avoid closures, providing more accurate public information about closure locations and timing, and more efficiently conducing post-construction work zone traffic management effectiveness reviews. Phase I affirmed that most state DOTs currently lack the ability to track lane closures at the level of temporal and spatial detail required for these uses. Among the very few agencies that have the technical ability to record this information, the data lacks reliability. Closures on county and municipal routes were seldom, if ever, tracked.

2. Work Zone Speed Limits and Motorist Compliance:
   This study sought to identify best practices for setting work zone speed limits by state departments of transportation (DOTs) and to evaluate select strategies for improving compliance with work zone speed limits. This was achieved by synthesizing information from a literature review, a state DOT survey, and field evaluations of select speed management strategies.

3. Evaluation of Messaging Techniques to Increase Vehicle Spacing at Work Zones
   Rear-end collisions in work zones, induced primarily by speeding and tailgating, are a predominant concern for roadway safety. Although considerable research has shed light on the dangers and implications of speeding within these zones, there exists a conspicuous research gap in tailgating behaviors.

As of June 30, 2023, work completed was approximately 50%.
Per the TPF website the estimated project completion date is December 31, 2024.

**FISCAL YEAR 2024 ACCOMPLISHMENTS**

Reports completed during the 2024 fiscal year are as follows:

1. *Improving the Effectiveness of Speed Feedback Trailers in Freeway Work Zones*: This study investigated methods for improving the effectiveness of speed feedback trailers (SFTs) when used as a speed management strategy in highway work zones. The research included a literature review, a state department of transportation (DOT) survey, and field evaluations conducted at several freeway work zones. The findings were synthesized to provide recommendations on methods for optimizing the deployment of SFT in freeway work zones.
2. *Mobility and Safety Impacts of Work Zone Lane and Shoulder Widths*: The goal of this project was to quantify the mobility and safety impacts of different combinations of lane width and shy distance to a barrier for a given paved width. The research team developed a device to measure lateral distance and derive speed, vehicle length/type, and headway information under day and night conditions. Data collected at 17 locations in Illinois, Michigan, and Wisconsin were used for the analysis. Lateral distance data of over a quarter of a million vehicles were used for the safety analysis. Extreme value theory (EVT) modeling was conducted to estimate the probabilities of right edge line encroachment and right barrier contact. Wider lanes were found to have decreased edge line encroachment and barrier contact, while wider shy distances were associated with increased edge line encroachment and decreased barrier contact.

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

There are currently 5 on-going projects within this pooled fund. RFPs have been developed for FY26 under TPF-5(545).
1. Evaluation of Expanded Uses of Residential Driveway Temporary Signals (RDTS)
2. Turn Lane Volumes and Storage (Restriction Applies. Review RFP for additional information)
3. Evaluation of Positive Protection in Work Zones (Restriction Applies. Review RFP for additional information)

The following FY25 problem statement RFPs have been sent out:

Subject 1: Best Practices and Evaluation of Automated Seed Enforcement in Work Zones

Subject 2: Traffic Control for Work Zones in Alternative Intersections

Subject 3: Identification and Testing of Crashworthy Temporary Sign Stands

Subject 4: Mobility and Safety Impacts of Work Zone Lane and Shoulder Widths- Part 2
Once all RFPs are submitted, the board will review and determine which ones will be funded for FY 2025.

The following report was completed in 2025:
Development of an Analytical Tool for Work Zone Performance.

Current in-progress research projects are the following:
- The Effect of Nighttime Lighting Systems on Workers' Visibility and Safety (Chun-Hsing Ho, University of Nebraska - Lincoln)
- Mobility and Safety Impacts of Work Zone Lane and Shoulder Widths – Part 2 (Madhav Chitturi, University of Wisconsin - Madison)
- Traffic Control for Work Zones in Alternative Intersections (Henry Brown, University of Missouri – Columbia)
- Improving Work Zone Management and Safety through AI-Powered Connected Vehicle Data Analysis (Anuj Sharma, Iowa State University)
- Accommodation of Vulnerable Road Users (Steven Lavrenz, Wayne State University)

**FISCAL YEAR 2026 PROPOSED ACTIVITIES**

Continue work in progress on active projects.

**JUSTIFICATION(S) FOR REVISION(S)**

None.

**SUMMARY OF THE IMPLEMENTATION RECOMMENDATION**

Project expected completion FY 2027.

Michigan Department
Of Transportation
5307 (11/17)

# RESEARCH ADMINISTRATION
# MDOT TRANSPORTATION POOLED FUND STUDY
# ANNUAL REPORT - FISCAL YEAR 2025

STUDY TITLE: No Boundaries Transportation Maintenance Innovations

FUNDING SOURCE: ☒ FHWA ☐ OTHER (*PLEASE EXPLAIN*)

| | | | | |
|---|---|---|---|---|
| TPF NO. | TPF-5(441) | | MDOT START DATE | 9/17/2019 |
| OR NO. | OR20-208 | | MDOT COMPLETION DATE (Original) | 9/30/2024 |
| | | | COMPLETION DATE (Revised) | 12/30/2025 |
| MDOT TECHNICAL CONTACT | Matt Pratt, 517-643-5372<br>Email: PrattM@Michigan.gov | | | |
| LEAD AGENCY | Colorado DOT | | | |
| LEAD STUDY CONTACT | David Reeves, 303-757-9518<br>Email: david.reeves@state.co.us | | | |
| CONTRACTOR | | | | |

**BUDGET STATUS**

| FY 2025 MDOT Budget | | | | MDOT Total Budget | | |
|---|---|---|---|---|---|---|
| FY25 FUNDS | (Original) | $0.00 | | TOTAL BUDGET | (Original) | $50,000.00 |
| | (Revised) | | | | (Revised) | |
| TOTAL FY 2025 EXPENDITURES | | $0.00 | | TOTAL COMMITTED FUNDS AVAILABLE | | $0.00 |

**PARTICIPATING STATES**

CA, CO, CT, FL, ID, IL, IN, LA, MD, ME, MI, MN, MO, MS, ND, NY, OH, SC, TX, UT, VA, WA, WI

**PURPOSE AND SCOPE**

Through this pooled fund project, the Colorado Department of Transportation (CDOT) will work with other State Departments of Transportation (DOTs) to facilitate the transfer of knowledge of promising non-snow and ice maintenance innovations and technologies. This project provides a forum for State DOTs to share their maintenance innovations with each other, support technology transfer activities and develop marketing and deployment plans for selected innovations through bi-annual 2–3-day peer exchange meetings at various locations selected by participating members. Resources will be provided for the transfer of knowledge and experience of various innovations that include travel, training, and other technology transfer activities.

It is anticipated that this consortium will become the national forum for state involvement in the technical exchange needed for collaboration and new initiatives and be a forum for advancing the application and benefit of research technologies. In addition, the project will create a searchable database or warehouse where innovations and research done relating to highway maintenance can be found and showcased. State participation in this process will be through the pooled fund. FHWA, industry and others will be invited to participate in the project discussions and activities.

Workshops will continue to be provided for the states participating in the pooled fund project. This project will help DOTs to save time and money by not investing in the same research that has already been performed by other state DOTs. Rather than having each DOT identify and conduct research separately, DOTs can work collectively through this pooled fund project.

The Colorado DOT will serve as the lead state for the execution of the pooled fund project described in this proposal. The Colorado DOT will handle all administrative duties associated with the project.

1. Identify promising innovations and technologies ready to be deployed within Maintenance activities, developed by the participating State DOTs, non-participating DOTs, and outside entities.
2. Develop marketing plans for selected ready to deploy innovations and technologies
3. Organize training classes about specific research topics for member State DOTs.
4. Develop a searchable database where innovations and research projects developed across the country can be identified and accessed.
5. Maintain a web site along with content management: http://maintainroads.org
6. (Optional depending on amount and interest level) Creation of synthesis (practice or literature) like reports that will dig deeper into "like issues" facing State DOT operations of maintenance. Topics might include, although not limited to (based on current hot topics):
    a. Employ recruitment & retention including maintenance degree like opportunities.
    b. Asset Management
    c. Emergency and Resiliency Management
    d. Roadside Maintenance such as pollinators
    e. Increased communication opportunities between No-Boundaries and related FHWA-AASHTO-MAC committees/and or groups
    f. New product innovations or best practices specific to operations of maintenance
7. Considering results of #6 above
    a. Develop appropriate workshops
    b. Peer Exchanges and Webinars
    c. Webinars

d. Website enhancements (http://maintainroads.org/)
e. Best practice or manual development

8. Also considering results of #6 - Scope research necessary for funding/management, by others, that will vary dependent upon the nature and scope of the topic.

**FISCAL YEAR 2020 ACCOMPLISHMENTS**

FY 2020 has accomplished establishing the transition to No Boundaries Phase III from Ohio's lead in Phase II. No Boundaries transition team completed the Request for Proposals (RFPs) and consultant selection to manage the pool fund. Setting up the next phase included a series of monthly transition meetings, scope of work development, fund transfers, CDOT contracting process and consultant selection to manage the pool fund. Consultant contract was signed on Sept 1, 2020, and task order 1 signed in late Oct. Pool fund activities should resume with contracts and task order in place.

**FISCAL YEAR 2021 ACCOMPLISHMENTS**

FY 2021 will move forward with the above-mentioned activities using web-based format to replace travel requirements.
Because of COVID-19 pandemic from early 2020 and ongoing, our group has not had a "face to face" meeting since May of 2019 in Denver CO. Also, a factor for 2020 was the expiration of the managing contract for No Boundaries. As of 10/01/2020, Colorado has accepted the role as lead state and CTC & Associates LLC as the managing source with future virtual training session planned but not scheduled as of 10/2020. Update: No Boundaries did have a "face to Face" meeting in Denver on September 14th and 15th. Michigan attended virtually because of the short notice and lack of out-of-state travel approval.

**FISCAL YEAR 2022 ACCOMPLISHMENTS**

No Boundaries is continuing to improve on our on-line database of innovations. The group had its most recent "face to face" meeting in May 2022 at CALTRANS Sacramento CA facility which MDOT attended. Also planned for 2022 is a "face to face" meeting in Indianapolis IN in October of 2022 which will be attended by an MDOT representative. MDOT benefited from the Sacramento CA "face to face by learning of a new QR code process of providing safety and training videos on demand for equipment operations and safety. Process is ongoing and planned to be rolled out in 2023.

**FISCAL YEAR 2023 ACCOMPLISHMENTS**

No Boundaries added entries to the on-line maintenance innovations database, as well as updates to the No Boundaries website. The group held two "face to face" meetings, the first in October 2022 in Indianapolis, IN and the second in Missouri in April 2023. The group also held two TAC teleconferences in March and August 2023. An MDOT representative attended all meetings.

**FISCAL YEAR 2024 ACCOMPLISHMENTS**

No Boundaries continued to add entries to the on-line maintenance innovations database, updated the No Boundaries website and sent weekly news posts to the No Boundaries mailing list. Three in-person meetings were held: October 17-19, 2024, in Virginia, May 10-12, 2024, in Louisiana and September 10-12, 2024, in North Dakota. TAC teleconferences were held on 1/31/24 and 7/31/24. Several syntheses efforts were completed in 2024 on topics including equipment acquisition and management, innovation showcases, and virtual reality for maintenance training. The group drafted the solicitation for phase IV of the pooled fund, which CDOT posted on the TPF website.

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

The pooled fund administration contract has been extended to 12/30/25 to minimize a gap between Phase III of the pooled fund and upcoming phase IV, which should begin sometime in 2025. No Boundaries will continue to add entries to the on-line maintenance innovations database, update the No Boundaries website and send weekly news posts to the No Boundaries mailing list. One in-person meeting will be held, in spring of 2025 in Maine. A fall 2025 in-person meeting and additional activities may happen depending on available funds and which phase the pooled fund is in.

**FISCAL YEAR 2026 PROPOSED ACTIVITIES**

Proposed activities include conducting ongoing management and record keeping, holding the final TAC teleconference on October 30, 2025, continued weekly news emails to the No Boundaries email distribution list, coordinating surveys, continued collection/creation of innovations to add to the innovations database, and updating the No Boundaries website with the latest program information.

**JUSTIFICATION(S) FOR REVISION(S)**

None.

**SUMMARY OF THE IMPLEMENTATION RECOMMENDATION**

Project expected completion FY 2026.

Michigan Department
Of Transportation
5307 (11/17)

# RESEARCH ADMINISTRATION
# MDOT TRANSPORTATION POOLED FUND STUDY
# ANNUAL REPORT - FISCAL YEAR 2025

STUDY TITLE: Traffic Safety Culture - Phase 2

FUNDING SOURCE: ☒ FHWA ☐ OTHER (*PLEASE EXPLAIN*)

| | | | | |
|---|---|---|---|---|
| TPF NO. | TPF-5(444) | | MDOT START DATE | 11/08/2019 |
| OR NO. | OR20-211 | | MDOT COMPLETION DATE (Original) | 9/30/2024 |
| | | | COMPLETION DATE (Revised) | |
| MDOT TECHNICAL CONTACT | Linda Powell (517)331-7880<br>Email: PowellL2@Michigan.gov | | | |
| LEAD AGENCY | Montana DOT | | | |
| LEAD STUDY CONTACT | Rebecca Ridenour, 406-444-7203<br>Email: rridenour@mt.gov | | | |
| CONTRACTOR | Montana State University- Western Transportation Institute/Center for Health and Safety Culture (CHSC) | | | |

**BUDGET STATUS**

| FY 2025 MDOT Budget | | | | MDOT Total Budget | | |
|---|---|---|---|---|---|---|
| FY25 FUNDS | (Original) | $0.00 | | TOTAL BUDGET | (Original) | $50,000.00 |
| | (Revised) | | | | (Revised) | |
| TOTAL FY 2025 EXPENDITURES | | $0.00 | | TOTAL COMMITTED FUNDS AVAILABLE | | $0.00 |

**PARTICIPATING STATES**

CA, CT, GA, IA, ID, IL, IN, KS, KY, LA, MI, MN, MS, MT, NV, TX, UT, VT, WA

**PURPOSE AND SCOPE**

Only through the growth of a positive safety culture can significant and sustainable reductions in crash fatalities and serious injuries be achieved. Towards that end, this pooled fund program will:

1. Conduct research to identify solutions to specific culture-based traffic safety problems, taking advantage of the implementation opportunities to improve traffic safety.
2. Develop resources to enhance understanding and application of traffic safety culture strategies; and
3. Provide technology transfer of best practices in traffic safety culture strategies.

This program will support integrated and multiyear research to guide the transformation of local, state, and national traffic safety culture. Funding partners determine the priority issues each year, and work plans are developed for the selected issues.

Three types of effort are expected in this pooled-fund program:

- Could propose culture-based research directed to specific traffic safety problems. For example, there are common behavioral risk factors amongst most state Strategic Highway Safety Plans (SHSP) such as impaired or distracted driving that can be influenced by culture.
- May generate ideas for general “services and tools” to support the understanding and application of traffic safety culture in the safety plans of project partners. For example, online courses on traffic safety culture for workforce development or a repository of relevant literature and case studies of best practice relevant to addressing the cultural factors of risky behavior could be created.
- It could be used to implement a limited number of demonstration projects to evaluate specific strategies to transform traffic safety culture into select communities, which could then be applied elsewhere.

**FISCAL YEAR 2020 ACCOMPLISHMENTS**

Guidance for Evaluating Traffic Safety Culture Strategies - The completion of this project is key to all future activities for the pooled fund study as it will lay out the basis for how research will be conducted. We have learned to change the culture we need to change people’s beliefs to change their behavior, which in turn will move the safety culture needle. In a safety effort, we need to convince people that a change in bad behavior will have minimal impacts on them.

**FISCAL YEAR 2021 ACCOMPLISHMENTS**

- Guidance on Messaging to Avoid Reactance and Address Moral Disengagement – project is complete with webinar and poster given in addition to final report. In addition, information sheets were developed for aggressive driving and seat belt use.
- Guidance to Promote Workplace Policies and Family Rules to Reduce Cell Phone Use While Driving and Promote Engaged Driving project is complete with webinar and poster given in addition to final report.

**FISCAL YEAR 2022 ACCOMPLISHMENTS**

- A Review of Methods to Change Beliefs – project is completed with the following deliverables: PowerPoint slides, webinar, poster, and the final report
- Resources and Tools to Reduce Multi-Risk Driving Behaviors – Task 1 Literature Review and Task 2 Content Development of Brief Intervention are completed. Expected completion is October 2023.
- Resources and Tools to Improve Pedestrian Safety – Task 1 Literature review is 40% completed. Expected completion is October 2025.

**FISCAL YEAR 2023 ACCOMPLISHMENTS**

- 2023 Annual Meeting held in person in Bozeman, MT on June 6-7th.
- Resources and Tools to Reduce Multi-Risk Driving Behaviors – Task 3: Test Brief Intervention and Task 4: Create Resources and Complete Final Report. Amendment to Task 3 to add more study subjects. Expected completion for Task 3 is December 31, 2023, and Task 4 is June 30, 2024. Final expected September 30, 2024.
- Resources and Tools to Improve Pedestrian Safety – Task 1 report completed (Resources and Tools to Improve Pedestrian Safety) Task 2: Understand the Culture of Pedestrian Safety. Expected completion is October 2025.
- Understanding Aggressive Driving Phase 1 report completed (Understanding Aggressive Driving and Ways to Reduce It – Phase 1).
- Evaluating proposals for Resources and Tools to Improve Occupant Protection and Phase 2 of the Aggressive Driving project currently underway

**FISCAL YEAR 2024 ACCOMPLISHMENTS**

- Resources and Tools to Reduce Multi-Risk Driving Behaviors –Task 4: create resources (PowerPoint presentation, poster and final webinar) and complete Final Report.
- Resources and Tools to Improve Pedestrian Safety – finalized Task 2 report; Task 3 developed a toolkit of tools and resources based on Task 1 and Task 2. Draft Task 3 report and toolkit submitted for review; begin Task 4.
- Understanding Aggressive Driving and Ways to Reduce It – Phase 1 finalized all deliverables and completed final webinar. Project complete.
- Understanding Aggressive Driving and Ways to Reduce It – Phase 2: expanded research of Phase 1 by developing and testing one or more strategies to engage bystanders to discourage aggressive driving and develop and test media messaging to reduce aggressive driving behavior. Research will be conducted from May 2024 to March 2026. Continue work on Task 1, complete interviews by the end of the quarter, and begin work on Task 3 to Develop and Test Media Messages.
- Planning Phase 3 kickoff meeting to be held in the spring of 2025.

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

- Continue to promote Phase 3.
- Completed project Resources and Tools to Reduce Multi-Risk Driving Behaviors (8882-444-20). Vendor began focusing on presenting the results of this project with multiple different partners.
- Understanding Aggressive Driving and Ways to Reduce It – Phase 2 (8882-444-26): Completed transcription cleaning and coded interview data as part of Task 1. Conducted data analysis of a feedback survey from board members, continued to review existent messages, and began developing messages for future testing as part of Task 3.
- Resources and Tools to Improve Pedestrian Safety (8882-444-22): Completed the draft final report and submitted it for review. The board provided comments and CHSC revised the final report and began working on the other final deliverables for this project.

Phase 2 work was completed during FY 2025.

**FISCAL YEAR 2026 PROPOSED ACTIVITIES**

The Center for Health and Safety Culture (CHSC) will begin work to create marketing and communication tools to share results from the study. All remaining deliverables and the closeout accounting spreadsheet for Phase 2 will be completed. Drafting problem statements for Phase 3 will continue. The kickoff meeting for Phase 3 was held in 2025, using unspent funds from Phase 2. Phase 2 closeout will occur in FY 2026.

**JUSTIFICATION(S) FOR REVISION(S)**

None.

**SUMMARY OF THE IMPLEMENTATION RECOMMENDATION**

Pending receipt of the final report.

Michigan Department
Of Transportation
5307 (11/17)

# RESEARCH ADMINISTRATION
# MDOT TRANSPORTATION POOLED FUND STUDY
# ANNUAL REPORT - FISCAL YEAR 2025

STUDY TITLE: High Performance Computational Fluid Dynamics (CFD) Modeling Services for Highway Hydraulics

FUNDING SOURCE: ☒ FHWA ☐ OTHER (*PLEASE EXPLAIN*)

| | | | |
|---|---|---|---|
| TPF NO. | TPF-5(446) | MDOT START DATE | 1/28/2020 |
| OR NO. | OR23-208 | COMPLETION DATE (Original) | 9/30/2025 |
| | | COMPLETION DATE (Revised) | |
| MDOT TECHNICAL CONTACT | Erik Calson, 517-230-8180<br>Email: CarlsonE2@michigan.gov | | |
| LEAD AGENCY | FHWA | | |
| LEAD STUDY CONTACT | Kornel Kerenyi, 202-493-3142<br>Email: kornel.kerenyi@dot.gov | | |
| CONTRACTOR | Argonne National Laboratory | | |

## BUDGET STATUS

| FY 2025 MDOT Budget | | | MDOT Total Budget | | |
|---|---|---|---|---|---|
| FY25 FUNDS | (Original) | $0.00 | TOTAL BUDGET | (Original) | $80,000.00 |
| | (Revised) | | | (Revised) | |
| TOTAL FY 2025 EXPENDITURES | | $0.00 | TOTAL COMMITTED FUNDS AVAILABLE | | $0.00 |

## PARTICIPATING STATES

MI, OH, SC, TX

## PURPOSE AND SCOPE

The objective of these pooled funds is to provide research and analysis for a variety of highway hydraulics projects managed or coordinated by State DOTs; to provide and maintain a high-performance Computational Fluid Dynamics (CFD) computing environment for application to highway hydraulics infrastructure and related projects; and to support and seek to broaden the use of CFD among State Department of Transportation employees.

Task 1: Computational Mechanics Research on a Variety of Projects: The TRACC scientific staff in the computational mechanics focus area will perform research, analysis, and parametric computations as required for projects managed or coordinated by State DOTs. Task 2: Computational Mechanics Research Support: The TRACC support team consisting of highly qualified engineers in the CFD focus areas will provide guidance to users of CFD software on an as needed or periodic basis determined by the State DOTs. Task 3: Computing Support: The TRACC team will use the TRACC clusters for work done on projects; The TRACC system administrator will maintain the clusters and work closely with the Argonne system administrator's community; The TRACC system administrator will also install the latest versions of the STAR-CCM+ and OpenFOAM CFD software and other software that may be required for accomplishing projects.

## FISCAL YEAR 2023 ACCOMPLISHMENTS

Initial CFD modeling of a C type grate for on-grade and sump locations have been started. The initial modeling assumed the following variables:

- Gutter Manning's n of 0.016
- Longitudinal slopes of 0.5% to 5%
- Gutter cross sectional slopes of 2 and 4%
- Discharge (Q) from 0 – 2.5 cfs
- Impacts of debris clogging on inlet capture efficiency

## FISCAL YEAR 2024 ACCOMPLISHMENTS

Continued computational mechanics research on a variety of projects.
CFD modeling for DI 36x36, DI 112, DI 125, CB 9, and CB 18 Roadway Drainage Inlets.

The final report, "Computational Analysis of Hydraulic Efficiency of Michigan DOT Cover C" was published.
(https://www.anl.gov/argonne-scientific-publications/pub/189529)

The researcher provided capture efficiency curves that can be implemented in a spreadsheet, and we are working to find ways to incorporate in the ORD Drainage and Utilities.

## FISCAL YEAR 2025 ACCOMPLISHMENTS

The final report is complete and has been published here: https://www.anl.gov/argonne-scientific-publications/pub/189529

| JUSTIFICATION(S) FOR REVISION(S) |
| --- |
| None. |
| **SUMMARY OF THE IMPLEMENTATION RECOMMENDATION** |
| Inlet capture efficiencies can be imported into ORD Drainage and Utilities for performing spread calculations. We're also working with our PMC Consultant to develop a spreadsheet that can also utilize these capture efficiencies. |

Michigan Department
Of Transportation
5307 (11/17)

# RESEARCH ADMINISTRATION
# MDOT TRANSPORTATION POOLED FUND STUDY
# ANNUAL REPORT - FISCAL YEAR 2025

STUDY TITLE: Traffic Control Device (TCD) Consortium (3)

FUNDING SOURCE: ☒ FHWA ☐ OTHER (*PLEASE EXPLAIN*)

| | | | | |
|---|---|---|---|---|
| TPF NO. | TPF-5(447) | | MDOT START DATE | 6/02/2022 |
| OR NO. | OR21-207 | | MDOT COMPLETION DATE (Original) | 2/12/2025 |
| | | | COMPLETION DATE (Revised) | |
| MDOT TECHNICAL CONTACT | Jon Re, 517-898-5779<br>Email: ReJ@Michigan.gov | | | |
| LEAD AGENCY | FHWA | | | |
| LEAD STUDY CONTACT | Laura Mero, 202-493-3377<br>Email: Laura.Mero@got.gov | | | |
| CONTRACTOR | | | | |

**BUDGET STATUS**

| FY 2025 MDOT Budget | | | | MDOT Total Budget | | |
|---|---|---|---|---|---|---|
| FY25 FUNDS | (Original) | $20,000.00 | | TOTAL BUDGET | (Original) | $100,000.00 |
| | (Revised) | | | | (Revised) | |
| TOTAL FY 2025 EXPENDITURES | | $20,000.00 | | TOTAL COMMITTED FUNDS AVAILABLE | | $0.00 |

**PARTICIPATING STATES**

American Traffic Safety Services Association, AL, AZ, CO, CT, DE, FHWA, FL, GA, IA, ID, IL, KS, KY, MA, MD, MI, MN, MO, MS, MT, NC, NE, NH, NJ, NM, NY, OK, OR, PA, SC, TN, TX, WI

**PURPOSE AND SCOPE**

This project is being created to re-new the contract for Pooled Fund Project TPF-5(316). All new Funding Commitments will need to be made on the Pooled Fund Website to this new project and all new funds will be transferred to the Lead State/Agency by the partners. The Lead State/Agency will have the responsibility for Receiving, Obligating, Expending, and Balancing the funding for this project.

To assemble a consortium composed of regional, State, local entities, appropriate organizations and the FHWA to 1) establish a systematic procedure to select, test, and evaluate approaches to novel TCD concepts as well as incorporation of results into the MUTCD; 2) select novel TCD approaches to test and evaluate; 3) determine methods of evaluation for novel TCD approaches; 4) initiate and monitor projects intended to address evaluation of the novel TCDs; 5) disseminate results; and 6) assist MUTCD incorporation and implementation of results.

The TCD Consortium will focus on systematic evaluation of novel TCDs, employing a consistent process that addresses human factors and operations issues for each TCD idea. Providing local and state agencies responses to their needs and to new technologies with the right assessment skills and tools will enable consistent TCD idea identification and evaluation. TCD Consortium efforts will address TCD issues identified by local and state jurisdictions, industry, and organizations and aid in compliance with the MUTCD rule-making process and incorporation of novel TCDs into the MUTCD.

**FISCAL YEAR 2021 ACCOMPLISHMENTS**

Work continues in FY 2021 on the following topics.

- Evaluation of Additional Alternatives of and Arrow Sizes for Overhead Arrow per Lane Guide Signs
- Enhancing Conspicuity for Standard Signs and retro reflectivity Strips on Posts
- Sign Guidance for Zipper Merge

While no products have been delivered to date the outcomes will shape the standards and guidance in the Manual on Uniform Traffic Control Devices and thus impact MDOT operating practices for each of these areas.

**FISCAL YEAR 2022 ACCOMPLISHMENTS**

Held the Annual meeting in person in August in San Diego

Progress has been made on the following:

- Advisory Speed Signs on Ramps: 1) Had kick-off meeting; 2) Currently processing information from most participating states; 3) A work-plan will be presented in October 2022.
- Sign Guidance for Zipper Merge: 1) The research team completed data collection in New Hampshire and most of the data collection in North Carolina and Maryland. 2) In addition, the team has analyzed data collected from the three locations. 3) They are looking to finalize the research and host a final meeting.
- Enhancing Conspicuity for Standard Signs and retro reflectivity Strips on Posts: The research team has provided edits to the FHWA publications team, and the final version has been developed for publication.

- Evaluation of Additional Alternatives of and Arrow Sizes for Overhead Arrow-per-Lane Guide Signs: 1) Finished data collection, 2) Began data analysis.
- Comprehension and Legibility of Selected Symbol Signs Phase Ⅳ
- Countdown Pedestrian Signals (CPS) Legibility and Comprehension without Flashing Hand: Phase I and II Final Report
- Signing, in Combination with Lane Markings, in Advance of Lane-Reduction Transitions

**FISCAL YEAR 2023 ACCOMPLISHMENTS**

- Completed publication FHWA-HRT-23-070: Evaluation of Lane Reduction and Late Merge Signing (formerly called Zipper Merge).
- Advisory Speed Signs on Ramps: 1) Field Review of selected sites and 2) Analysis data from field review.
- Completed Evaluation of Additional Alternatives of and Arrow Sizes for Overhead Arrow-per-Lane (OAPL) Guide Signs
- Pedestrian Signing at Unsignalized Crossings - preparation for computer-based testing has been completed and is now searching for on road field locations.
- 2023 Annual meeting held in person in Albuquerque, NM on September 13-15th. Call for proposals was held. Voting held on top priorities.

**FISCAL YEAR 2024 ACCOMPLISHMENTS**

- Several projects were initiated and are in various phases of progress/completion. They include evaluations of Pedestrian Signing at Unsignalized Crosswalks, Advisory Exit and Ramp Speed Signs, and Comprehension of Legibility of Selected Symbol Signs Phase IV and V.
- Final deliverable received for Advisory Exit and Ramp Speed Signs.

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

- Pooled Fund Study (PFS) Traffic Control Device (TCD) Consortium (3) is a consortium composed of State DOTs and other local agencies that combine funds to study new or novel traffic control devices, disseminate results, and facilitate information sharing among members. The third study TPF-5(447) ended in February 2025 and the fourth study TPF-5(554) began in April 2025.
- Near the end of TPF-5(447), Evaluation of Advisory Exit and Ramp Speed Signs (FHWA-HRT-24-138) was published in July 2024. The study evaluated different sign combinations for freeway ramp exits in both a laboratory setting with participants and field installation with speed data collected. The findings provided optimized sign combinations and placement on freeway ramps.
- In TPF-5(447), Pedestrian Signing at Unsignalized Crossings study is waiting for final publication and the TCD Consortium continued work on studies for Comprehension and Legibility of Selected Symbol Signs Phase V and Evaluation of Pavement Markings in Merge Areas that will be completed in TPF-5(554).
- The members met in Arlington VA in September 2024 to discuss and vote on future research topics and most of the members have continued onto TPF-5(554). Michigan DOT has provided comments on most deliverables and Michigan members have put forth new research topics. Overall, Michigan DOT members are satisfied with research outcomes in TPF-5(447) and look forward to participating in TPF-5(554).

**JUSTIFICATION(S) FOR REVISION(S)**

None.

**SUMMARY OF THE IMPLEMENTATION RECOMMENDATION**

- Results from the Traffic Control Devices Pooled Fund Study will be reviewed and considered by FHWA for inclusion in a subsequent Manual on Uniform Traffic Control Devices
- Finishing FHWA project for Pedestrian Signing at Unsignalized Crossings
  The study reviewed various existing warning and regulatory signs that are allowed at unsignalized crossings and tested new experimental regulatory signs. The full finished report is being reviewed before final publication and results will be presented at this year's TRB meeting.
- Finishing Symbol Signs Phase V
  This is the fifth iteration of an ongoing study to test the legibility and comprehension of new or experimental traffic signs. There were 22 signs test in total and findings will be proved to NCUTCD for future consideration in the MUTCD. The final report is being reviewed before final publication.
- Ongoing Studies
  There is a study to review pavement markings at interchange on-ramp gore areas. The lab study portion is finishing, and the field implementation phase will begin next year. Another study is beginning this year that will review spacing for temporary traffic control signs. The work plan is almost complete, and the researchers will be surveying agencies for current practices.
- Annual Meeting – September 2025
  Three potential research topics were selected to generate problem statements and members are currently voting on them to select the future research study.

Michigan Department
Of Transportation
5307 (11/17)

# RESEARCH ADMINISTRATION
# MDOT TRANSPORTATION POOLED FUND STUDY
# ANNUAL REPORT - FISCAL YEAR 2025

STUDY TITLE: Automated Vehicle Pooled Fund Study

FUNDING SOURCE: ☒ FHWA ☐ OTHER (*PLEASE EXPLAIN*)

| | | | |
|---|---|---|---|
| TPF NO. | TPF-5(453) | MDOT START DATE | 6/30/2020 |
| OR NO. | OR21-203 | MDOT COMPLETION DATE (Original) | 9/30/2025 |
| | | COMPLETION DATE (Revised) | 7/31/2026 |
| MDOT TECHNICAL CONTACT | Jason Bodell, 989-370-1526<br>Email: BodellJ@Michigan.gov | | |
| LEAD AGENCY | Ohio DOT | | |
| LEAD STUDY CONTACT | Michelle Lucas, 614-644-8135<br>Email: michelle.lucas@dot.ohio.gov | | |
| CONTRACTOR | | | |

**BUDGET STATUS**

| FY 2025 MDOT Budget | | | MDOT Total Budget | | |
|---|---|---|---|---|---|
| FY25 FUNDS | (Original) | $50,000.00 | TOTAL BUDGET | (Original) | $250,000.00 |
| | (Revised) | | | (Revised) | |
| TOTAL FY 2025 EXPENDITURES | | $50,000.00 | TOTAL COMMITTED FUNDS AVAILABLE | | $0.00 |

**PARTICIPATING STATES**

CO, CT, MD, MI, MN, OH, PA, TX, VA, WA

**PURPOSE AND SCOPE**

Through this pooled fund, the Ohio Department of Transportation (ODOT) will work with federal and state departments of transportation to establish multiple projects to research vehicle-roadway interaction including data failures and mitigation methods, identify and define standards, and encourage interoperability across state borders.

The pooled fund study will focus on the following:
- Independently research and address issues that will affect the deployment of Automated Vehicle systems by state transportation agencies.
- Support AASHTO's Strategic and Deployment Plans.
- Support USDOT's Automated Vehicle Policy.

**FISCAL YEAR 2021 ACCOMPLISHMENTS**

Worked with PFS members to decide on initial projects and study scope.
Selected consultant and started project entitled Infrastructure Owner Operator Strategic Roadmap for Accelerated Adoption of Automated Vehicles

**FISCAL YEAR 2022 ACCOMPLISHMENTS**

- Completed Infrastructure Owner Operator Strategic Roadmap project.
- Select consultant and begin research on Automated vehicle industry forum project.

**FISCAL YEAR 2023 ACCOMPLISHMENTS**

Pooled fund study overall
Monthly meetings
Third project RFP has been posted, Guidance for Sustainable Integration of Automated Transportation Technologies to focus on researching best practices for successfully integrating and sustaining AV technologies into the transportation infrastructure. The goal of this project is to determine what infrastructure modifications should be performed to adapt to the integration of AV transportation technologies.
The second project developed a Stakeholder engagement plan and website to promote collaboration between academic, industry and government partners around AV development and deployment. This is still supported throughout the life of the AV PFS.
Launched the AV Industry Forum and published an AV Pooled Fund Forum - Final Report, dated June 2023.

**FISCAL YEAR 2024 ACCOMPLISHMENTS**

IOO Strategic Roadmap (Project 1) is being utilized to develop concepts for future RFPs.

AV Industry Forum currently has 104 active users, and the Board plan is to incorporate continued use of the forum for future projects.

**Overall study activities:**
Monthly meetings
An RFP (Project 1) was posted. Study Title: **Guidance for Sustainable Integration of Automated Transportation Technologies.**
The objective is to focus on researching best practices for successfully integrating and sustaining AV technologies into the

transportation infrastructure. The goal of this project is to determine what infrastructure modifications should be performed to adapt to the integration of AV transportation technologies.
Project 2 developed a Stakeholder engagement plan and website to promote collaboration between academic, industry and government partners around the area of AV development and deployment. This will be supported throughout the life of the AV PFS.

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

FY 2025 had us establish a coordinated framework for developing consistent standards and practices that support safe AV integration into public roadways. In addition, the TPF has produced a series of technical reports, quarterly updates, and data analyses that guide infrastructure design, AV testing, and deployment policies.

**FISCAL YEAR 2026 PROPOSED ACTIVITIES**

1. Continue to hold monthly meetings.
2. Projects 3 and 4 will remain active in FY 2026.
3. Posting RFP- Defining Safety of AVs.
4. Complete development and post RFP- Remote Operations of AVs.

**JUSTIFICATION(S) FOR REVISION(S)**

None.

**SUMMARY OF THE IMPLEMENTATION RECOMMENDATION**

Project expected completion FY 2026.

Michigan Department
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5307 (11/17)

# RESEARCH ADMINISTRATION
# MDOT TRANSPORTATION POOLED FUND STUDY
# ANNUAL REPORT - FISCAL YEAR 2025

STUDY TITLE: Flood-Frequency Analysis in the Midwest: Addressing Potential Nonstationary Annual Peak-Flow Records

FUNDING SOURCE: ☒ FHWA ☐ OTHER (*PLEASE EXPLAIN*)

| | | | | |
|---|---|---|---|---|
| TPF NO. | TPF-5(460) | | MDOT START DATE | 9/17/2020 |
| OR NO. | OR22-208 | | MDOT COMPLETION DATE (Original) | 9/30/2025 |
| | | | COMPLETION DATE (Revised) | |
| MDOT TECHNICAL CONTACT | Erik Carlson, 517-230-8180<br>Email: CarlsonE2@Michigan.gov | | | |
| LEAD AGENCY | South Dakota DOT | | | |
| LEAD STUDY CONTACT | David Huft, 605-773-3358<br>Email: dave.huft@state.sd.us | | | |
| CONTRACTOR | | | | |

## BUDGET STATUS

| FY 2025 MDOT Budget | | | | MDOT Total Budget | | |
|---|---|---|---|---|---|---|
| FY25 FUNDS | (Original) | $55,600.00 | | TOTAL BUDGET | (Original) | $166,800.00 |
| | (Revised) | | | | (Revised) | $222,400.00 |
| TOTAL FY 2025 EXPENDITURES | | $55,600.00 | | TOTAL COMMITTED FUNDS AVAILABLE | | $0.00 |

## PARTICIPATING STATES

IA, IL, MI, MN, MO, Montana DNRC, SD, WI

## PURPOSE AND SCOPE

The overall goal of this study is to evaluate the combined effects of multidecadal climatic persistence (including hydroclimatic shifts), gradual climate change, and land-use change on peak-flow frequency analyses in the multi-state region in the Midwest. This study is intended to provide a framework for addressing potential nonstationary issues in statewide flood-frequency updates that are commonly conducted by the United States Geological Survey (USGS) in cooperation with state DOTs throughout the nation on an ongoing basis. This will be achieved through the following primary objectives: 1. Define spatial and temporal characteristics of climatic persistence/change affecting annual peak flows in the multi-state region. 2. Develop and apply a statistical methodology for estimating changes in peak-flow frequency distributions in the multi-state region in relation to climatic persistence/change and urbanization; the effects of rural and land-use change will only be investigated in an exploratory manner. 3. Investigate methods for addressing regional climatic persistence/change and land-use change in peak-flow frequency analysis. To the extent possible, estimates of trend-adjusted flood magnitudes for various exceedance levels (such as the 10-percent or 1-percent annual exceedance probability) will be provided for comparison to previously published estimates.

The results of the proposed investigation will be presented in two peer reviewed USGS Data Releases, two Scientific Investigations Reports (SIR; online only), two journal articles and a USGS Fact Sheet. Tasks include efforts to: (1) Publicly release watershed-based climate data (metrics of precipitation and temperature) on a monthly time scale and summed to annual seasonal and annual total values. These data will also contain trend results for trends in climate metrics in annual peak streamflow and climate variables (Years 1 and 2); (2) Characterize the effects of natural hydroclimatic shifts and potential climate change on annual peak flows in Midwest: Illinois, Iowa, Minnesota, North Dakota and South Dakota (Years 1 and 2); (3) Analyze the seasonality of flood peaks in the region and their trends and implications for trend attribution (Years 1 and 2); (4) Evaluate the effect of urbanization on flood-peaks in major metropolitan areas in the study region (Years 2 and 3); (5) Publicly release data that compares adjustment methods at individual sites, such as multiple flood-frequency analysis results (Years 3 and 4); (6) Summarize methods for addressing regional hydroclimatic shifts, climate change, and land-use change in peak-flow frequency analyses in the Midwest (Years 3 and 4); (7) Succinctly summarize the above work in a short fact sheet that provides links to project products to make it easy to find data and results. This summarization is intended to be handed out at future meetings, sent to managers for an overview, etc. (Year 4).

## FISCAL YEAR 2022 ACCOMPLISHMENTS

USGS is wrapping up Tasks 1, 2, and 3, as noted above. They have provided preliminary findings in climate trends of gages, including seasonality of peak flow values, for participating Midwest states at quarterly Teams meetings.

## FISCAL YEAR 2023 ACCOMPLISHMENTS

Finalized Tasks 1, 2, and 3 and transitioning to Tasks 4, 5, and 6, as noted above.

## FISCAL YEAR 2024 ACCOMPLISHMENTS

Worked on Tasks 4, 5 and 6 and starting to summarize work, as noted in Task 7, as noted above.

Published “Peak Streamflow Trends in Michigan and Their Relation to Changes in Climate, Water Years 1921-2020.” The document has been shared with Michigan’s Department of Environment, Great Lakes, and Energy’s (EGLE’s) Hydrologic Studies Unit.

Peak streamflow trends in Michigan and their relation to changes in climate, water years 1921–2020 (usgs.gov)

| FISCAL YEAR 2025 ACCOMPLISHMENTS |
| --- |
| FY25 saw the wrap-up of the project, with several publications that are relevant to Michigan, including peak discharge trends and relation to climate, suggested regression analysis as it relates to climate trends, the effects of urbanization, and impacts of tile drainage on peaks.<br><br>Nonstationary flood frequency analysis using regression in the north-central United States<br><br>Regional Analysis of the Dependence of Peak-Flow Quantiles on Climate with Application to Adjustment to Climate Trends<br><br>Data for Regional Analysis of the Dependence of Peak-Flow Quantiles on Climate with Application to Adjustment to Climate Trends<br><br>Peak streamflow trends and their relation to changes in climate in Illinois, Iowa, Michigan, Minnesota, Missouri, Montana, North Dakota, South Dakota, and Wisconsin<br><br>Peak Streamflow Data, Climate Data, and Results from Investigating Hydroclimatic Trends and Climate Change Effects on Peak Streamflow in the Central United States, 1921–2020 - ScienceBase-Catalog<br><br>The joint effect of changes in urbanization and climate on trends in floods: A comparison of panel and single-station quantile regression approaches - ScienceDirect<br><br>A framework for understanding the effects of subsurface agricultural drainage on downstream flows |
| **JUSTIFICATION(S) FOR REVISION(S)** |
| None. |
| **SUMMARY OF THE IMPLEMENTATION RECOMMENDATION** |
| Publications have been shared with EGLE and Michigan Technological University researchers looking to update peak discharge regression equations for the state of Michigan. May look to expand on this study by partnering with USGS for future research. |

Michigan Department
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5307 (11/17)

# RESEARCH ADMINISTRATION
# MDOT TRANSPORTATION POOLED FUND STUDY
# ANNUAL REPORT - FISCAL YEAR 2025

STUDY TITLE: Consortium for Asphalt Pavement Research and Implementation (CAPRI)

FUNDING SOURCE: ☒ FHWA ☐ OTHER (*PLEASE EXPLAIN*)

| | | | | |
|---|---|---|---|---|
| TPF NO. | TPF-5(465) | | MDOT START DATE | 10/15/2020 |
| OR NO. | OR23-205 | | MDOT COMPLETION DATE (Original) | 9/30/2025 |
| | | | COMPLETION DATE (Estimate Revised Date) | 12/31/2027 |
| MDOT TECHNICAL CONTACT | Michelle Miller, 517-256-6799<br>Email: MillerM81@Michigan.gov | | | |
| LEAD AGENCY | Alabama DOT | | | |
| LEAD STUDY CONTACT | Kidada Dixon, 334-353-6940<br>Email: dixonk@dot.state.al.us | | | |
| CONTRACTOR | | | | |

**BUDGET STATUS**

| FY 2025 MDOT Budget | | | | MDOT Total Budget | | |
|---|---|---|---|---|---|---|
| FY25 FUNDS | (Original) | $10,000.00 | | TOTAL BUDGET | (Original) | $30,000.00 |
| | (Revised) | | | | (Revised) | |
| TOTAL FY 2025 EXPENDITURES | | $10,000.00 | | TOTAL COMMITTED FUNDS AVAILABLE | | $0.00 |

**PARTICIPATING STATES**

AL, CO, FHWA, FL, GA, HI, ID, IN, KY, MA, ME, MI, MO, MS, NC, ND, NE, NM, NY, OH, OK, PA, PR, SC, TN, TX, VA, VIDPW, WA, WI

**PURPOSE AND SCOPE**

The goals of CAPRI are to: • Provide technical guidance on current and evolving specifications for asphalt materials. • Develop asphalt pavement research needs. • Conduct small-scale studies to address knowledge gaps or explore new topics. • Foster the implementation of practical research findings to help improve the performance, sustainability, value, and safety of asphalt pavements. As a consortium of all asphalt pavement stakeholders, CAPRI will be a key resource to the AASHTO Committee on Materials and Pavements, state DOTs, FHWA, and industry.

Activities related to the above goals will be developed through semi-annual meetings rotated among participating organizations. CAPRI meetings will serve as a forum to facilitate knowledge sharing among participants. Outcomes of CAPRI meetings will include technical guidance articles on high profile issues, and research need statements (RNSs) organized into a new National Asphalt Research Roadmap (NARR) that will be made public through a website managed and maintained by NCAT. Recognizing the existence of specialized topics within asphalt pavement engineering and the range of expertise that CAPRI participants will bring to the forum, CAPRI meetings will be organized into topics led by committees that focus on asphalt binders, asphalt mixtures, pavement design, construction, maintenance/rehabilitation, pavement-vehicle interaction, and other committees as the need arises in the future. More details about the CAPRI operation are provided in the full announcement. The activities and deliverables of CAPRI are as follows: • Organize semi-annual meetings that include presentations on research of national significance, discussions on implementation and technology transfer, and activities organized by the committees. • Identify issues with current asphalt-related standards and share potential solutions to help move standards forward to ultimately improve pavement performance. • Identify short-term and long-term research needs and strategically prioritize the needs so the most urgent and impactful opportunities are addressed first. • Develop research need statements (RNSs) and identify the appropriate source(s) of funding for each project. Organized RNS into the National Asphalt Research Roadmap and publish it on the website. • Select and prioritize small-scale, exploratory, kick-off studies that can be funded directly by CAPRI to address gaps in the path to implementation, gather additional information to assess the magnitude of perceived problems, and/or explore new technologies. • Assist in the deployment of research findings by selecting and prioritizing activities such as conducting workshops, refining and shepherding of standards, demonstration project assistance, which can be funded through CAPRI or from other sources. • Publish progress reports that document the results of the entire project

**FISCAL YEAR 2023 ACCOMPLISHMENTS**

The CAPRI Executive Director continued to recruit additional member organizations to join the consortium. CAPRI subcommittees and task forces continued to work on their respective roles and initiated work to fill gaps in research of high priority need, advocated for funding for other priority needs in other research funding programs, and supported the development of tech transfer for proven technologies. A Fall meeting is scheduled.

**FISCAL YEAR 2024 ACCOMPLISHMENTS**

Spring and Fall meetings were held. Provide technical guidance on current and evolving specifications for asphalt materials. Develop asphalt pavement research needs. Conducted a lag and dwell time study. Developed implementation resources for Balance Mix Design, Density and Longitudinal Joint Density to help improve the performance, sustainability, value, and safety of asphalt pavements.

| FISCAL YEAR 2025 ACCOMPLISHMENTS |
| --- |
| Spring and Fall meetings were held. RFP for Validation of Short and Long-Term Oven Aging Lab Procedures has been advertised. Request for Quotes: Examining Specimen Fabrication Variabilities of Balanced Mix Design. More organizations are continuing to join in the Pooled Fund. The Subcommittees continue to meet and work to identify and fill gaps in high priority research.<br><br>CAPRI is continuing through 2027 as CAPRI 2. Continued participation is recommended and being pursued. |
| **FISCAL YEAR 2026 PROPOSED ACTIVITIES** |
| The Fall 2025 CAPRI meeting scheduled for Oct. 21-22 at the FHWA facility in Lakewood, CO.<br>Continue work activities on the five (5) CAPRI projects.<br>Technology Transfer Subcommittee will update the CAPRI website.<br>A 3-part webinar series on the future ban of trichloroethylene (TCE) is planned for November and December 2025.<br>Executive team will continue monthly meetings to discuss organizational and financial matters, research and implementation needs, and plan for bi-annual meetings. |
| **JUSTIFICATION(S) FOR REVISION(S)** |
| None. |
| **SUMMARY OF THE IMPLEMENTATION RECOMMENDATION** |
| Project expected completion FY 2027. |

Michigan Department
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5307 (11/17)

# RESEARCH ADMINISTRATION
# MDOT TRANSPORTATION POOLED FUND STUDY
# ANNUAL REPORT - FISCAL YEAR 2025

STUDY TITLE: National Road Research Alliance - NRRA (Phase-II)

FUNDING SOURCE: ☒ FHWA ☐ OTHER (*PLEASE EXPLAIN*)

| | | | |
|---|---|---|---|
| TPF NO. | TPF-5(466) | MDOT START DATE | 12/17/2020 |
| OR NO. | OR21-209 | MDOT COMPLETION DATE (Original) | 1/31/2026 |
| | | COMPLETION DATE (Revised) | |
| MDOT TECHNICAL CONTACT | Kevin Kennedy, 517-749-9067<br>Email: KennedyK@Michigan.gov | | |
| LEAD AGENCY | Minnesota DOT | | |
| LEAD STUDY CONTACT | Ben Worel, 763-381-2130<br>Email: ben.worel@state.ms.us | | |
| CONTRACTOR | | | |

**BUDGET STATUS**

| *** FY 2025 MDOT Budget** | | | **MDOT Total Budget** | | |
|---|---|---|---|---|---|
| FY25 FUNDS | (Original) | $150,000.00 | TOTAL BUDGET | (Original) | $750,000.00 |
| | (Revised) | $374,856.00 | | (Revised) | $974,856.00 |
| TOTAL FY 2025 EXPENDITURES | | $524,856.00 | TOTAL COMMITTED FUNDS AVAILABLE | | $0.00 |

*** Overpayment:** $150,000.00 will be assigned to Sol 1641 (NRRA Phase III) in FY26.

**PARTICIPATING STATES**

CA, FHWA, GA, IA, ID, IL, Local Road Research Board (LRRB), MI, MN, MO, MS, MT, ND, NE, NY, WI

**PURPOSE AND SCOPE**

Primary objectives of the National Road Research Alliance (NRRA Phase-II) are:

- Implementation and technology transfer of NRRA Phase-I research efforts and other common interests.
- Continue to fund and support research and implementation efforts of common interest.
- Continue communication with both its government agencies along with its associate members (industry, associations, consultants, academia).
- Continued utilization of MNROAD to conduct structured construction, field testing and evaluation of pavement materials, equipment, and methods under real-world conditions.
- Establish industry standards and develop performance measures for improving pavement performance.
- Develop and/or revise specifications and recommendations.
- Studying and promoting innovative techniques and technologies that will save agencies money, improve safety, and increase efficiency.
- Supporting technology transfer by developing practical field guides, best practices, and training curriculum to promote the results of research projects.
- Conduct cost-benefit analysis to ensure that new technologies, materials, or methods contribute to operational efficiencies.
- Support the exchange of information and ideas through collaborative research efforts that provide opportunities for public agencies to share experiences.
- Identify and prioritize common road related research needs to address regional and national issues that are built on existing efforts such as FHWA's PCC and HMA Roadmaps as well as the Foundation for Pavement Preservation Roadmap.
- Fund high priority, readily implementable research projects though research contracts and university partnerships.
- Leverage knowledge, skills, and resources from participating partners to advances pavement research and implementation efforts while developing the workforce of the future.
- Support technology transfer that highlights the implementation of research results and the associated benefits.

The scope of work for this pooled fund project is:

- Members provide the prioritized research needs, project development and design by way of the research project teams.
- Members provide funding for high priority, readily implementable research projects.
- Members receive timely results on NRRA research projects through communication products that emphasize lessons learned and implementation.
- Assistance in putting research results into practice through technology transfer events.
- NRRA members support committees that meet periodically throughout the year to determine priorities, develop strategies to address the priorities, and execute action plans.

**FISCAL YEAR 2021 ACCOMPLISHMENTS**

To date ten (10) government agencies and over fifty-five (65+) industry, associations, consultants, and academic institutions have become NRRA members to share their expertise and are learning about new tools and methods to improve and expand upon transportation systems nationally.

**Phase-I Projects:**
- Tech Transfer - 100% of the 13/13 projects complete.
- 2017 Long Term Research – 50% of the 4/8 projects complete.
- 2019 Long Term Research – 8% of the 1/11 projects complete.
- 2019 Call for Innovation Research – 0% of the 0/5 projects complete.
- 2020 Call for Innovation Research – 0% of the 0/7 projects complete.

**Phase-2 Projects:**
- 2021 Long Term Research – 0% of the 0/13 projects complete.

**General:**
- NRRA members/Teams have met monthly again this quarter which also acts as TAP meetings for each team's short and long-term research efforts also focusing on development of 2021 projects with inputs on MnROAD 2022 construction.
- Executive Committee meetings: Two meetings held this quarter, and one expected in the next quarter to help establish Phase-II efforts in February 2021.
- Call for Construction sent out and ideas are being submitted – one formal idea so far and other potential ideas – Construction in 2022.
- Monthly Research pays off webinars have been completed and a plan for end of 2021 topics are developed.

**FISCAL YEAR 2022 ACCOMPLISHMENTS**

Working on two RFPs fall/winter of 2022. NRRA members/Teams have met monthly again this year which also acts as TAP meetings for each team's short and long-term research efforts also focusing on development of 2021 projects with inputs on MnROAD 2022 construction/sensors. Monthly Research pays off webinars have been completed and a plan for 2022 topics are developed. See the NRRA website for details on all updated activities. Technical teams TAPS developing construction designs, layers, sensor requirements, and ICT related construction activities to include in the 2022 MnROAD construction. Completed partnerships with FHWA for veta and carboncure related research efforts. Finalizing partnerships with a local HMA plant to furnish HMA surface mix for the reflective cracking group study. Finalizing partnerships with a local PCC plant to furnish PCC mix need for the 2022 construction. Finalized partnerships with Missouri and the funding received for reflective cracking challenge. Successful 2022 Minnesota Transportation Conference & Expo in St. Paul, Minnesota on May 17-19 and the NRRA tracks for each technical team.

**FISCAL YEAR 2023 ACCOMPLISHMENTS**

NRRA members/teams continued to meet monthly, which also acts as TAP meetings for each team's short and long-term research efforts. Monthly research pays off webinars continued. Technology transfer has remained a focus of the pooled fund. Continued to plan and schedule conferences. Call for innovation added approximately $1.8 million of new research to program. NRRA had a technical track at the Minnesota Transportation Conference and Expo on May 15-17, 2023.

**FISCAL YEAR 2024 ACCOMPLISHMENTS**

Various technologies transfers and long-term research needs were completed and/or placed under contract. The project progress/final products were posted on the NRRA website. The conference was held in the spring. NRRA paid for travel to the International Concrete Conference and the International Society for Intelligent Construction Conference. NRRA Technical Teams have met every month which also acts as TAP meetings for each team's short and long-term research efforts. Monthly Research Pays Off webinars have been completed and a plan for 2025 topics is under development.

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

Government collaboration efforts include 14 government agencies and over 85 industry, associations, consultants, and academic institutions have joined NRRA as members to share expertise and learn new tools and methods to improve and expand transportation systems nationally.

Phase-2 Efforts:
- 2021 Long Term Research
- 14% of projects were completed.
- Missouri contract for reflective cracking pending.
- 2 RFP pending contracted – 1.) perpetual pavements; 2.) recycled binder availability.
- 2023 Call for Innovation- 0% projects completed.
- 2024 Contracting - 0% completed.
- 2025 Contracting - 0% of the contracted
- 4 amendments in process.
- 3 low carbon concrete projects discussed amongst members.

NOTES:
1. NRRA annual meeting held in Minnesota April 22-23, 2025. Details/Agenda on the NRRA webpage.
2. NRRA Technical Teams have met every month, including this quarter, which also acts as TAP meetings for each team's short and long-term research efforts.
3. Refer to the NRRA website for details on all updated activities.
4. Monthly Research pays off webinars have been completed and a plan for 2024 topics are developed.
5. NRRA budget for Phase-I and Phase-II completed.

6. Added a “working group” for agencies/members to work on low carbon materials and what coordination is possibly needed with the funding each state has received. This could develop into a team depending on what is needed.
7. Final contract completed for Missouri reflective cracking/NCAT additive study that Missouri DOT is funding with SPR dollars to include these test sections with NRRA (reflective cracking) and MnROAD NCAT efforts (additive study).

**FISCAL YEAR 2026 PROPOSED ACTIVITIES**

Finalize Phase-1 Pooled Fund Close Out
Finalize Phase-2 Pooled Fund with MnDOT finance.
Continued task activities on Phase-2 PFS.
Prepare for Phase-3 PFS.

- MnDOT plan updates to financial system for tracking and preparing financial closeout of NRRA Phase-2.

Phase-2 Closeout.

**JUSTIFICATION(S) FOR REVISION(S)**

Supplemental work was added 5/1/2025 to determine the proper placement, planning, construction, and data from sensor instrumentation is necessary to assess early life performance of jointed plain concrete pavement test sections. (FY25 MDOT overpayment, along with $224,856 for future US-23 instrumentation, will be assigned to Sol 1641 (NRRA Phase III) in FY26.)

**SUMMARY OF THE IMPLEMENTATION RECOMMENDATION**

Project expected completion FY 2026.

Michigan Department
Of Transportation
5307 (11/17)

# RESEARCH ADMINISTRATION
# MDOT TRANSPORTATION POOLED FUND STUDY
# ANNUAL REPORT - FISCAL YEAR 2025

STUDY TITLE: Structural Behavior of Ultra-High Performance Concrete

FUNDING SOURCE: ☒ FHWA ☐ OTHER (*PLEASE EXPLAIN*)

| | | | |
|---|---|---|---|
| TPF NO. | TPF-5(468) | MDOT START DATE | 2/01/2021 |
| OR NO. | OR20-214 | MDOT COMPLETION DATE (Original) | 9/30/2025 |
| | | COMPLETION DATE (Revised) | 12/31/2025 |
| MDOT TECHNICAL CONTACT | Brad Wagner, 517-256-6451<br>Email: WagnerB@michigan.gov | | |
| LEAD AGENCY | FHWA | | |
| LEAD STUDY CONTACT | Benjamin Graybeal, 202-493-3122<br>Email: Benjamin.graybeal@dot.gov | | |
| CONTRACTOR | | | |

## BUDGET STATUS

| FY 2025 MDOT Budget | | | MDOT Total Budget | | |
|---|---|---|---|---|---|
| FY25 FUNDS | (Original) | $0.00 | TOTAL BUDGET | (Original) | $50,000.00 |
| | (Revised) | | | (Revised) | |
| TOTAL FY 2025 EXPENDITURES | | $0.00 | TOTAL COMMITTED FUNDS AVAILABLE | | $0.00 |

## PARTICIPATING STATES

FL, GA, MI, MN, MS, NJ, NY, PA, TX

## PURPOSE AND SCOPE

The objective of the proposed project is to develop knowledge pertinent to the structural performance of ultra-high-performance concrete (UHPC). This knowledge will be of significant value as the AASHTO Committee on Bridges and Structures considers the use of UHPC-class materials in highway bridges and structures.

The proposed project is focused on the design, fabrication, performance, and analysis of UHPC components. It is anticipated that various UHPC components will be designed, fabricated, and tested. The test results will be analyzed and used to inform proposed structural design guidance for UHPC components. Results will also be used to support the usage of UHPC by interested departments of transportation. It is anticipated that bridge superstructure components (e.g., pretensioned girders) will be a significant part of this study, with behaviors related to flexure, shear, and end zones being investigated. Other components may be investigated based on available resources and the interest of participating partners.

## FISCAL YEAR 2021 ACCOMPLISHMENTS

This Pooled Fund Study held its project kicked off meeting in February of 2021.

The Principal Investigator discussed with each partner representative present their respective input on priorities regarding UHPC. Two (2) initial priorities identified were:

- Development of guidelines for the design of UHPC. A draft “AASHTO LRFD Guide Specifications for Structural Design with UHPC” was developed and reviewed by the pooled fund members. Members’ comments were provided.
- Develop design examples for UHPC members. This initiative is just now getting underway and will be further developed/delivered in FY 2022.

## FISCAL YEAR 2022 ACCOMPLISHMENTS

- Worked on finalization of LRFD Guide Specifications
- Developed two UHPC Design Examples and submitted to AASHTO for review
- MDOT selected a UHPC beam end repair project in Grand Region and will be let and constructed FY23
- Developed visual aids to support testing methods for UHPC.
- Published AASHTO T397 “Standard Method of Test for Uniaxial Tensile Response of Ultra-High-Performance Concrete”.
- Initiated a task for full scale testing of UHCP girders.

## FISCAL YEAR 2023 ACCOMPLISHMENTS

- The guide specification was published. The research team is developing a “Materials Conformance Guidance” that parallels this guide spec.
- Fabricated girders for full scale testing.
- Tensile testing was completed.
- Fatigue testing is in progress on large scale UHPC girders.
- Testing performed to determine development length for prestressed strands in UHPC beams
- Work 50% completed as of Sept 30, 2023.

**FISCAL YEAR 2024 ACCOMPLISHMENTS**

- Continued to support AASHTO Committee on Bridges and Structures (CBS) subcommittee T-10 on Structural Concrete to evaluate FHWA proposed draft UHPC Materials Conformance Guidance that has been requested by T-10.
- Continued work on a journal paper draft detailing the results of the experimental investigation utilizing servo-hydraulic and non-servo hydraulic loading frames in performing direct tension tests of UHPC specimens in accordance with AASHTO T 397.
- Published FHWA report on UHPC design recommendations and examples highlighting the analysis of a rectangular mild steel reinforced UHPC beam and a pretensioned UHPC I-Beam with a conventional concrete deck.
- Continue work on the UHPC tensile fatigue behavior project: continue cycling second girder.
- Continue testing of 12 pretensioned beams that were designed to investigate the development length of prestressing strands.

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

- Made good progress in efforts to draft and deliver a material conformance guide specification to AASHTO COBS for their review/balloting/publication.
- Developed a QC test for UHPC tensile properties for use in precast plants, thus removing one of the hurdles that various folks have pointed out in the past. AASHTO COMP will be balloting the test method soon. Also ongoing are 1) UHPC interface shear tests (i.e., composite connection between a UHPC beam and a conventional concrete deck), and 2) UHPC post-tensioning anchorage tests. The team also continued work on a Guide Specification for Conformance of UHPC, and continued evaluation on fatigue behavior.

**FISCAL YEAR 2026 PROPOSED ACTIVITIES**

- Continue to support AASHTO Committee on Bridges and Structures (CBS) Concrete Structures Committee as they evaluate the FHWA proposed draft UHPC Materials Conformance Guidance. The Concrete Structures Committee chairman intends to prepare this guidance for vote by the full CBS committee in June 2026; therefore, the current draft needs to be brought to near finalization by the end of the reporting period. Multiple technical and coordination meetings are anticipated, along with the requisite revisions and updates to the document.
- Compile and analyze results from the three UHPC girder fatigue tests that have been completed.
- Draft document containing the results of 12 pretensioned beams that were designed to investigate the development length of prestressing strands. Document will also contain results from pullout block tests on untensioned strands.
- Draft peer reviewed journal paper focusing on the end zone behavior of pretensioned elements. Include experimental data on end zone cracking and strand transfer length that has been obtained from specimens cast for testing at TFHRC during the past 7 years.
- Continue executing tests of the girder-to-deck interface shear behavior project
- Continue executing tests for the Flexural Behavior of Heavily Reinforced UHPC project.

**JUSTIFICATION(S) FOR REVISION(S)**

This is a rather loosely structured Pooled Fund with high level initiatives that are continually developing.

**SUMMARY OF THE IMPLEMENTATION RECOMMENDATION**

Project expected completion FY 2026.

Michigan Department
Of Transportation
5307 (11/17)

# RESEARCH ADMINISTRATION
# MDOT TRANSPORTATION POOLED FUND STUDY
# ANNUAL REPORT - FISCAL YEAR 2025

STUDY TITLE: Clear Roads Winter Highway Operations Pooled Fund – Phase III

FUNDING SOURCE: ☒ FHWA ☐ OTHER (*PLEASE EXPLAIN*)

| | | | | |
|---|---|---|---|---|
| TPF NO. | TPF-5(479) | | MDOT START DATE | 6/10/2021 |
| OR NO. | OR22-206 | | MDOT COMPLETION DATE (Est. Original) | 6/30/2026 |
| | | | COMPLETION DATE (Revised) | |
| MDOT TECHNICAL CONTACT | Carl Fedders, 517-897-6730<br>Email: FeddersC@Michigan.gov | | | |
| LEAD AGENCY | Minnesota Department of Transportation | | | |
| LEAD STUDY CONTACT | Tom Peters, 651-366-3578<br>Email: tom.peters@state.mn.us | | | |
| CONTRACTOR | | | | |

**BUDGET STATUS**

| FY 2025 MDOT Budget | | | | MDOT Total Budget | | |
|---|---|---|---|---|---|---|
| FY25 FUNDS | (Original) | $25,000.00 | | TOTAL BUDGET | (Original) | $125,000.00 |
| | (Revised) | | | | (Revised) | |
| TOTAL FY 2025 EXPENDITURES | | $25,000.00 | | TOTAL COMMITTED FUNDS AVAILABLE | | $25,000.00 |

**PARTICIPATING STATES**

AK, AZ, CA, CO, CT, DE, IA, ID, IL, IN, KS, KY, MA, MD, ME, MI, MN, MO, MT, ND, NE, NH, NJ, NV, NY, OH, OK, OR, PA, RI, SD, TX, UT, VA, VT, WA, WI, WV, WY

**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 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 2021 ACCOMPLISHMENTS**

The Clear Roads pooled fund study plans to commence and continue several projects during the 2021 FY. These projects are listed below.

- 21-01 Grip Sensor Technology and Salt Application
- 21-02 Update to CR 13-04 Best Practices for Protecting DOT Equipment from Corrosive Effect of Chemical Deicers
- 21-03 The Efficacy and Environmental Impact of Non-Chloride Deicers
- 21-04 Training Module Development for CR 18-03 Evaluation of SSI/WSI Variables
- 21-05 Synthesis Evaluation of Electric Vehicle Technologies and Alternate Fuels for Winter Operations

- 21-06 Calculated Plow Cycle Times from AVL Data
- 21-07 Determining the Migration of Chloride-based Deicers through Different Soil Types Adjacent to Chloride-treated Roadways
- 20-06 Salt Shed Design Template
- 20-05 Using GIS to Highlight Highway Segments Sensitive to Deicing Materials
- 20-04 Expanded Use of AVL/GPS Technology
- 20-03 Evaluation of Indoor Automated Stockpile Measurement Systems
- 20-02 Understanding the NaCl Phase Diagram
- 20-01 Entry-Level Driver Training (CDL) for Maintenance Equipment Operators
- 19-04 Synthesis of Technical Requirements and Considerations for an Automated Snowplow Route Optimization RFP Template
- 19-03 Measuring the Efficiencies of Tow Plows and Wing Plows
- 19-01 Expanding Application Rate Guidance for Salt Brine Blends for Direct Liquid Application and Anti-icing
- 18-06 Standard Test Procedures for Ice Melting Capacity of Deicers
- 18-02 High Performance Blade Evaluation

**FISCAL YEAR 2022 ACCOMPLISHMENTS**

Project selected for FY 2022:

- *22-01 Comprehensive Guide to Prewet* [A comprehensive guide that will provide optimal application rates for meeting pre-wetting goals and will quantify the benefits of different rates, speeds, and other delivery factors. The guide will also present the findings of using two to four salt spreader configurations and delivery systems (e.g., auger, Monroe hopper, zero-velocity spreader). The evaluation will include a discussion of the advantages and disadvantages of each in meeting pre-wetting goals.]
- *22-02 Liquid Chloride Storage and Pump System Best Management Practices* [This project will develop a guidance manual that explores the issues transportation agencies should consider when choosing or replacing deicing liquid storage systems. There are several areas of interest associated with operating a reliable system including safety, environment, and cost-effectiveness. A review of the systems different agencies uses, including system benefits and challenges, will help agencies better understand their options when procuring a new system or updating an existing one.]
- *22-03 Effects of Additives in Lowering the Freezing Point* [While manufacturers of deicing salt products claim that additives enhance product performance, there is no definitive evidence to substantiate these claims. Evaluating these products in the lab and in the field will establish the effectiveness of additives to lower eutectic temperatures and will indicate whether additives increase the performance of deicing salts. Research recommendations can be used to inform the decision-making of state departments of transportation (DOTs), municipalities and other winter maintenance practitioners when choosing a deicing salt for winter maintenance operations.]
- *22-04 Evaluation of DLA of Salt Brine vs Granular Salt as Measured through Various Performance and Safety Metrics* [Many of the studies conducted to date focus on cost savings and environmental impacts of the DLA of salt brine while not addressing the efficacy and safety impacts of its use. Without performance comparison data to support DLA practices, the traveling public may conclude that while the advantages of DLA in cost savings and environmental impacts are clear, granular salt treatments are still the more effective way to treat winter roadways. This study aims to provide DOTs with the information they need to defend the use of DLA treatments where appropriate.]
- *22-05 Synthesis: Use of Dashboards for Winter Operations* [Advances in information technology offer agencies the capability to capture and track data obtained from winter maintenance equipment. A review of which agencies are using dashboards in winter maintenance operations, including necessary resources and best practices for developing and implementing this tool, will give Clear Roads an understanding of how this data is obtained and displayed through these dashboards. Then, how is the information displayed used to gain efficiencies related to Level of Service, material use, resource allocation, and the cost of winter maintenance operations.]
- *22-S1 Synthesis: Corrosion and Connectors Don't Mix* [The goal of this synthesis is to identify the various setups / connectors used by Clear Roads members. Determine if anyone is experiencing success in keeping the lights operating for an entire winter season. Identify a setup / connector that is most likely to operate for an entire snow season.] Project completed in FY 2022
- *19-02 Recruitment and Retention of Highway Maintenance Workers* [This project developed a concise guide of innovative but practical ways for DOTs to recruit and retain a highly proficient, productive, versatile, and committed roadway maintenance workforce. The final report includes case studies in several categories, including recruitment programs, retention strategies, recruitment and retention for underserved communities, recruitment, and retention of the next generation, and capturing information to inform program improvements.]
- *20-07 AWSSI Enhancements, Phase 2* [This project continued the process of improving the tool developed by the MRCC. This iteration added additional locations to the AWSSI tool; updated the average AWSSI seasonal total map through the 2019-2020 season; added the ability to download the daily seasonal data for any given station during the current season; and provided the user with the ability to add up to five specific historical seasons to be included in any station's current year chart.]
- *20-01: Entry-Level Driver Training (CDL) for Maintenance Equipment Operators* [This project developed the following materials: (1) complete curriculum to meet the FMCSA requirements for the instructor-led classroom and behind-the-wheel components of the entry-level driver training rule, focusing on obtaining an initial Class B CDL, upgrading from a Class B CDL to a Class A CDL, and obtaining the hazardous materials endorsement for the first time; (2) all training materials and resources necessary for states to execute the training program; (3) train-the-trainer materials to assist agencies in implementing the training program; and (4) fact sheet and timeline to help agencies ensure that all of their training locations are added to the TPR before February 7, 2022. To date, there have been 750 requests for this material from agencies all over the U.S.]

- *19-04 Synthesis of Technical Requirements and Considerations for Automated Snowplow Route Optimization* [Through a survey and follow-up interviews with agencies and vendors, this project captured the technical requirements and considerations involved in selecting an automated snowplow route optimization program. The project produced two complementary documents as appendices to the final report: 1) Decision Support Guidance: An accessible and in-depth discussion of the technical requirements for route optimization and the key decisions DOTs should consider when developing the project scope and managing a provider. 2) Contracting Language Template: A flexible template to assist DOTs with developing a scope of work for an RFP for automated snowplow route optimization services. The language in the template is intended to ensure that DOTs and service providers have a shared understanding of the scope of work that the DOT requires and to maximize the likelihood that the project will result in safe, feasible, implementation-ready routes.]
- *19-01 Expanding Application Rate Guidance for Salt Brine Blends for Direct Liquid Application and Anti-icing* [Through a survey of practice and subsequent field testing, researchers gathered a robust set of data on how agencies apply various liquid deicers across a broad range of field conditions, particularly at lower temperatures. The test results, along with the survey results and information gathered through a literature review, were used to create a set of application rate tables for brine and brine blend usage for DLA and anti-icing.]
- *19-03 Measuring the Efficiencies of Tow Plows and Wing Plows* [Through a practitioner survey, testing/simulation, and analysis, this project created a spreadsheet-based Decision Support Tool to help agencies more accurately assess the efficiencies, costs of ownership, and return on investment for tow plows and wing plows and determine the best locations to deploy it. A companion Best Practices Guide will help agencies understand the considerations for purchasing, deploying, and operating specific plow types.]
- *20-02 Understanding the NaCl Phase Diagram* [Project deliverables include the development of training materials (a fact sheet and a video) to help provide winter maintenance practitioners with a better understanding of the phase diagram for sodium chloride and how to apply it to yield the best results in roadway deicing. This knowledge will help winter maintenance agencies apply salt and salt brine effectively for the best performance on winter roadways.]

**Ongoing Projects**

- 18-02 High Performance Blade Evaluation
- 18-06 Standard Test Procedures for Ice Melting Capacity of Deicers
- 20-03 Evaluation of Indoor Automated Stockpile Measurement Systems
- 20-04 Expanded Use of AVL/GPS Technology
- 20-05 Using GIS to Highlight Highway Segments Sensitive to Deicing Materials
- 20-06 Salt Shed Design Template
- 21-01 Grip Sensor Technology and Salt Applications
- 21-02 Update to CR 13-04: Best Practices for Protecting DOT Equipment from the Corrosion Effect of Chemical Deicers
- 21-03 Efficacy, Cost, and Impacts of Non-Chloride Deicers
- 21-04 Training Module Development for Evaluation of Storm Severity Index and Winter Severity Index Variables
- 21-05 Evaluation of Electric Vehicle Technologies and Alternative Fuels for Winter Operations
- 21-06 Calculating Plow Cycle Times from AVL Data
- 21-07 Determining the Migration of Chloride-based Deicers through Different Soil Types

**FISCAL YEAR 2023 ACCOMPLISHMENTS**

**Completed Projects**

- 22-S1 Corrosion and Connectors Don't Mix

**Funded Projects**

- 23-01 Development of a Public Service Announcement Library
- 23-02 Quantifying the Economic Value of Snow and Ice Operational Success
- 23-03 Updating the Impact of Capital Projects Decision Support Tool
- 23-04 Solar Radiation Benefits / Chloride Reduction Potential Associated with the Use of Vegetation Management Practices Near Roads

**Ongoing Projects**

- Comprehensive Guide to Pre-wetting Application Rates and Methods (CR 22-01)
- Best Management Practices for Liquid Chloride Storage and Pumping Systems (CR 22-02)
- Effects of Additives in Deicing Salts at Lower Temperatures (CR 22-03)
- Evaluation of Direct Liquid Application of Salt Brine Versus Granular Salt as Measured Through Various Performance and Safety Metrics (CR 22-04)
- Use of Dashboards for Winter Operations (CR 22-05)
- pH Waiver for Deicing Products and the Qualified Products List (CR 22-06)

**In-Person Meetings**

- 2022 Fall Meeting (Indianapolis, IN)
- 2023 Spring Meeting (Austin, TX)
- 2023 Fall Meeting (Salt Lake City, UT)

**Feature Articles**

- The August issue of APWA Reporter covers the project, Entry-Level Driver Training (CDL) for Maintenance Equipment Operators.
- The Winter issue (October) of APWA Reporter addressed recently completed Clear Roads projects that advance winter maintenance decision-making / efficiency. Those projects include:
  - Measuring the Efficiencies of Tow Plows and Wing Plows.
  - Synthesis of Technical Requirements and Considerations for Automated Snowplow Route Optimization.
  - Training Module Development for Evaluation of Storm Severity Index and Winter Severity Index Variables.

**State Winter Maintenance Data Survey**

Published the 2021-2022 survey results.

**Qualified Products List**

Upgraded the vendor submission form and back- end management system / database.

**Research Implementation Survey**

Completed the 2023 edition of the Clear Roads Research Implementation Survey.

**FISCAL YEAR 2024 ACCOMPLISHMENTS**

**Completed Projects**

- Calculating Plow Cycle Times from AVL Data (CR 21-06)
- Using GIS to Highlight Highway Segments Sensitive to Deicing Materials (CR 20-05)
- Standard Test Procedures for Ice Melting Capacity of Deicers (CR 18-06)
- Training Module Development for Evaluation of Storm Severity Index and Winter Severity Index Variables (CR 21-04)
- Update to CR 13-04: Best Practices for Protecting DOT Equipment from the Corrosion Effect of Chemical Deicers (CR 21-02)

**Funded Projects**

- Toxicity Standards for the QPL (CR 24-01)
- Effective Pretreatment Methods for Events Beginning as Rain (CR 24-02)
- Salt Management Training for Non-DOT End Users (CR 24-03)
- Synthesis: Predictive Methods to Update the Road Report (CR 24-s1)
- Synthesis: Snow & Ice, 2030 - Be Ready for Change with the Snow & Ice Fighting Industry (CR 24-s2)
- Synthesis: Update of the Status of AVL / GPS for Winter Operations (CR 24-s3)
- Synthesis: Best Practices for Research Implementation (CR 24-s4)

**Ongoing Projects**

- pH Waiver for Deicing Products and the QPL (CR 22-06)
- Development of Public Service Announcement Library (CR 23-01)
- Quantifying the Economic Value of Snow and Ice Operations Success (CR 23-02)
- Updating the Capital Projects Decision Support Tool (CR 23-03)
- Using Vegetation Management Practices Near Roads to Leverage the Benefits of Solar Radiation (CR2 23-04)
- Synthesis: Management of Video Recordings and Images Taken from Truck-Mounted Cameras (CR 23-s1)
- Synthesis: Brine-Making Practices (CR 23-s2)
- Synthesis: UAV Uses for Winter Maintenance (CR 23-s3)

**In-Person Meetings**

- 2024 Spring Meeting (Annapolis, MD)
- 2024 Fall Meeting (Kalispell, MT)

**Feature Articles**

- October 2023: Taking the Guesswork Out of Deicer Selection
- October 2024: Tools to Make Better Winter Maintenance Decisions

**Other**

- Published the 2022-2023 State Winter Maintenance Data and Statistics database
- Continued to populate the Clear Roads Equipment Online Database
- Continued to manage the Clear Roads Qualified Products List

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

**Funded the following projects during the spring 2025 meeting:**

- Developing a Road Condition Standard Legend (CR 25-01)
- A Benefit-Cost Analysis of Implementing and Operating AVL/GPS Technology Systems (CR 25-02)
- Updated Techniques in Clearing Different Interchange Configurations and Other Geometric Layouts(CR 25-03)

- Materials and Guidance to Maximize the Value of a Weather Services Contract(CR 25-04)
- Snowplow Truck Washing Facility Designs and RFP Templates(CR 25-05)
- Comprehensive Guide to Pre-Wetting Application Rates and Methods(CR 25-06)
- pH Waiver for Deicing Products and the Qualified Products List(CR 25-07)
- Synthesis: Best Practices for Usage of AVL and Other Vehicle Monitoring Technologies in Employee Relations (CR 25-s1)

**Commenced work on the following projects:**
- Toxicity Standards for the Qualified Products List (CR 24-01)
- Effective Pretreatment for Events Beginning as Rain (CR 24-02)
- Salt Management Training for Non-DOT End Users (CR 24-03)
- Synthesis: Predictive Methods to Update Road Condition Reporting (CR 24-s1)
- Synthesis: Snow and Ice, 2030 (CR2 24-s2)
- Synthesis: Update on the Status of AVL/GPS for Winter Operations (CR 24-s3)
- Synthesis: Best Practices for Research Implementation (CR 23-s4)

**Completed work on the following projects:**
- Salt Shed Design Template (CR 20-06)
- Grip Sensor Technology and Salt Applications (CR 21-01)
- Best Management Practices for Liquid Chloride Storage and Pumping Systems (CR 22-02)
- Effects of Additives in Deicing Salts at Lower Temperatures (CR 22-03)
- Use of Dashboards for Winter Operations (CR 22-05)
- Synthesis: Management of Video Recordings and Images Taken from Truck-Mounted Cameras (CR 23-s1)
- Synthesis: Brine-Making Practices (CR 23-s2)
- Synthesis: UAV Uses for Winter Maintenance (CR 23-s3)

**Conducted the following in-person meetings:**
- 2025 Spring Meeting (Richmond, VA)
- 2025 Fall Meeting (Bloomington, MN)

**Publishing the following article in the APWA Reporter:**
- October 2025: It Began with a Martini Shaker

**Published the 2023-2024 State Winter Maintenance Data and Statistics database.**

**Continued to populate the Clear Roads Equipment Online Database.**

**Continued to manage the Clear Roads Qualified Products List.**

**FISCAL YEAR 2026 PROPOSED ACTIVITIES**

- Hold Fall 2026 meeting in Portland, Maine.
- Facilitate responses related to 2025 RFP solicitations.
- Post the 2024-2025 Annual Survey of State Winter Maintenance Data.
- Publish findings from synthesis projects
- Webinars and Research Briefs.
- Update Clear Roads website.

**JUSTIFICATION(S) FOR REVISION(S)**

This continuation project, formerly TPF-5(353), will maintain its focus on advancing winter highway operations nationally through practical, practice-ready research related to materials, equipment, and methods. State departments of transportation are aggressively pursuing new technologies, practices, tools, and programs to improve winter highway operations and safety while maintaining fiscal responsibility.

**SUMMARY OF THE IMPLEMENTATION RECOMMENDATION**

Project expected completion FY 2026.

Michigan Department
Of Transportation
5307 (11/17)

# RESEARCH ADMINISTRATION
# MDOT TRANSPORTATION POOLED FUND STUDY
# ANNUAL REPORT - FISCAL YEAR 2025

STUDY TITLE: Building Information Modeling (BIM) for Infrastructure

FUNDING SOURCE: ☒ FHWA ☐ OTHER (*PLEASE EXPLAIN*)

| | | | | |
|---|---|---|---|---|
| TPF NO. | TPF-5(480) | | MDOT START DATE | 6/30/2021 |
| OR NO. | OR21-210 | | MDOT COMPLETION DATE (Original) | 9/30/2025 |
| | | | COMPLETION DATE (Revised) | 12/31/2027 |
| MDOT TECHNICAL CONTACT | Luke Arnold, 517-243-8313<br>Email: ArnoldL1@Michigan.gov | | | |
| LEAD AGENCY | Iowa DOT | | | |
| LEAD STUDY CONTACT | Khyle Clute, 515-239-1646<br>Email: Khyle.Clute@iowadot.us | | | |
| CONTRACTOR | | | | |

**BUDGET STATUS**

| FY 2025 MDOT Budget | | | | MDOT Total Budget | | |
|---|---|---|---|---|---|---|
| FY25 FUNDS | (Original) | $30,000.00 | | TOTAL BUDGET | (Original) | $150,000.00 |
| | (Revised) | | | | (Revised) | |
| TOTAL FY 2025 EXPENDITURES | | $30,000.00 | | TOTAL COMMITTED FUNDS AVAILABLE | | $0.00 |

**PARTICIPATING STATES**

AZ, CA, CT, FL, GA, IA, IL, IN, KY, MI, MN, MO, MS, MT, NC, NE, NY, OH, OK, PA, SC, TX, UT, WI

**PURPOSE AND SCOPE**

The pooled fund serves as the mechanism for stakeholders to work collaboratively to advance BIM for Infrastructure. This will involve building off the foundational work that was charted out in the BIM National Strategic Work Plan, with emphasis on increasing coordination and awareness of BIM technologies and activities. Activities that advance the short- and medium-term goals of the BIM National Strategic Work Plan will be prioritized and carried out by the pooled fund participants. Meetings will serve as a forum to facilitate knowledge sharing among participants. Proposed activities include:

- Develop BIM foundational use cases and workflows. Highlight more effective digital exchange of information (e.g., survey to design, design to construction, construction to asset management, etc.). This kind of exchange will increase collaboration and automation, reduce duplication of effort, and avoid errors.
- Establish BIM Processes (e.g., Develop contract model language to guide BIM procurements.)
- Identify and Execute Capacity-Building Activities (e.g., Establish project selection criteria for BIM implementation; Identify project types and use cases for early pilot projects phase).
- Enhance Skills and Collaboration (e.g., Establish a workforce training curriculum to set expectations about required BIM qualifications. Understand organizational roles and responsibilities to connect data silos).
- Deploy Standards-Based Data Management Tools and Techniques (e.g., Develop catalog of information model requirements to define what data should be created and why. Develop standard information delivery specifications for data exchange between systems).
- Lessons Learned - Identify issues with current implementation efforts and share potential solutions to help move toward greater BIM maturity.
- Research Priorities - Identify short-term and long-term research needs and strategically prioritize the needs so the most urgent and impactful opportunities are addressed first.
- Information Exchange - Establish a forum/expert hub for practitioners in the highway industry to understand the various tools and technologies being used, promote the common modeling formats, and share experiences.

**FISCAL YEAR 2021 ACCOMPLISHMENTS**

What products or services were delivered from study activities performed in 2021? The project was approved by FHWA and assigned federal project number TPF-5(480) in August 2021. The lead agency's current activities include identifying participants to serve on the Technical Advisory Committee (TAC).

**FISCAL YEAR 2022 ACCOMPLISHMENTS**

The TAC met virtually several times throughout FY 2022 to discuss the key objectives of TPF-5(480), along with drafting and finalizing the RFP for this project. The RPF was posted in September 2022 with proposals due on November 1, 2022.
Current activities underway include scheduling of the first TAC meeting in 2022.

**FISCAL YEAR 2023 ACCOMPLISHMENTS**

Summary:
Proposals due: Tuesday, November 1, 2022.
Notification of virtual interview: Friday, November 11, 2022
Virtual interviews: Friday, November 18, 2022
Notification of proposal selection: Tuesday, November 22, 2022
Virtual kick-off meeting to discuss Year 1 Scope of Work: Friday, December 16, 2022
Year 1 Scope of Work approval and contract negotiation: End of January
Project start date: February 1, 2023.

In addition, the TAC intends on meeting in-person for two days per year on the project.

Accomplishments:
Provided detailed 5-year plan for this project.
Created “Digital Workflow Graphic” to describe the data flow through road projects.
Developed best practice document for signing and sealing models.
Developed best practice document for “Model as a Legal Document”.
Started working on a digital clearinghouse website to create a searchable database for BIM topics / research.
Documented “state of the practice” for BIM at the DOT level.

**FISCAL YEAR 2024 ACCOMPLISHMENTS**

Creation of a “BIM Guidebook” for states to leverage. This will include short guides and best practices for all state DOT’s and how they can leverage BIM in their state. This guidebook will be evaluated and updated every year.

Started work to create a data dictionary for road objects and their attributes or property sets.
Documented a process for how to create an information delivery manual for roads.
Conducted survey to Identify field tools (software) and resources that state DOTs are currently using.

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

Determined scope of Information Delivery Manual
Design to Construction Information
Digital As-Built Information
Created draft data dictionaries for infrastructure elements within the scope of the IDM
Developed detailed process models for Design to Construction and Construction to Operations exchanges
Developed template BIM Execution Plan with information requirements
Developed draft information delivery manual

**FISCAL YEAR 2026 PROPOSED ACTIVITIES**

Continue development on the draft for the first round of videos and flyers
Initiation and Plan IDM Development
IDM Development and Integration
IDM Testing, Finalization, and Documentation

**JUSTIFICATION(S) FOR REVISION(S)**

None.

**SUMMARY OF THE IMPLEMENTATION RECOMMENDATION**

Project expected completion FY 2027.

Michigan Department
Of Transportation
5307 (11/17)

# RESEARCH ADMINISTRATION
# MDOT TRANSPORTATION POOLED FUND STUDY
# ANNUAL REPORT - FISCAL YEAR 2025

STUDY TITLE: Center for the Aging Infrastructure: Steel Bridge Research, Inspection, Training and Education Engineering Center - SBRITE (Continuation)

FUNDING SOURCE: ☒ FHWA ☐ OTHER (*PLEASE EXPLAIN*)

| | | | | |
|---|---|---|---|---|
| TPF NO. | TPF-5(486) | | MDOT START DATE | 11/16/2021 |
| OR NO. | OR22-205 | | MDOT COMPLETION DATE (Original) | 9/30/2026 |
| | | | COMPLETION DATE (Revised) | |
| MDOT TECHNICAL CONTACT | Mike Halloran, 269-930-0786<br>Email: HalloranM@Michigan.gov | | | |
| LEAD AGENCY | Indiana DOT | | | |
| LEAD STUDY CONTACT | Anne Rearick, 317-232-5152<br>Email: arearick@indot.in.gov | | | |
| CONTRACTOR | | | | |

**BUDGET STATUS**

| *FY 2025 MDOT Budget | | | | MDOT Total Budget | | |
|---|---|---|---|---|---|---|
| FY25 FUNDS | (Original) | $75,000.00 | | TOTAL BUDGET | (Original) | $60,000.00 |
| | (Revised) | | | | (Revised) | $235,000.00 |
| TOTAL FY 2025 EXPENDITURES | | $75,000.00 | | TOTAL COMMITTED FUNDS AVAILABLE | | $50,000.00 |

*MDOT increased its pledge commitment to $75,000 in FY25 and $50,000 in FY26.

**PARTICIPATING STATES**

AK, AR, CA, FHWA, IA, ID, IL, IN, KS, MD, MI, MN, MO, MT, NC, NJ, NM, NY, PA, SD, TN, TX, UT, WI, WV

**PURPOSE AND SCOPE**

This is a continuation of SPR-5(281) for the Steel Bridge Research, Inspection, Training, and Education (S-BRITE) Engineering Center focused on existing steel highway bridges. Initially proposed in 2013, this has become a national center leading education, training, research, and engineering that benefits the existing aging steel bridge and structure inventory. Over the life of the project, ten states, the US Army Corps, and FHWA have provided support. Current funding is very strong, and partner states continue to be added. Although the Center has been focused on highway bridges, it will also support stakeholders of steel railroad bridges and steel ancillary structures, such as lighting towers and sign supports. As a result, in-kind support from the railway industry has been strong as well. The Center has contributed to improved asset management decisions for DOTs, FHWA, and other partners relative to existing steel bridge inventory.

The long-term goal of the S-BRITE Center has been to create the next generation of bridge engineers and inspectors who are properly educated to be effective stewards of the existing aging steel bridge inventory. At the university level, the development of a new “minor” or certificate within Civil Engineering is proposed that will prepare engineering students for a career in transportation structures. At the professional level, high-quality, specialized short courses will be developed targeting individuals currently responsible for the existing infrastructure. The courses will go beyond the current National Highway Institute (NHI) course level. Although training, education, and research are the overall focus of the Center, the cornerstone will be a multi-acre Bridge Component Gallery that will include full-scale bridge structures, portions of complete structures, and individual components with a host of common and uncommon details used in steel bridges. The gallery has provided a unique hands-on experience for the education of individuals of all levels regarding steel fabrication, deterioration, inspection techniques, etc. An S-BRITE flyover video highlighting the scale of the bridge component gallery can be found at: https://engineering.purdue.edu/CAI/SBRITE/Facilities. Since the bridge components are not actually in service and are in more accessible conditions, costly traffic control and extensive fall-protection will not be required during training. Conveniently, they have been situated so that real-world conditions exist to truly simulate in-situ inspection conditions. The S-BRITE “living laboratory” has become incredibly useful for research tools being developed for inspection, durability modeling, and performance testing of inspectors. To help fill the technical voids found at most DOTs, a unique team of experts have been assembled through the S-BRITE Center to create a Distributed Expertise Network (DEN). Some of these individuals are local to Purdue at the Center while others are located at their respective institutions. The DEN serves the role that no longer exists in many individual state DOTs today, specifically the existence of a group of highly specialized technical experts that are “on-call” to assist as issues arise. These experts have been able to travel to the participant’s location if required as funding levels provide. There is no need for special subcontracts between the individual state and the expert since the agreements are already in place as participants of the Center. As states have different needs and resources, three different levels or “tiers” of contributions were developed with each tier receiving defined benefits. Participants will be stakeholders in the direction of the Center, research program directions, and coursework development. Tier 1A and Tier 1B come at a cost of $30,000 per year for two years, making the total commitment $60,000. This level provides support for the administration and policy development for center operations and strategic plan along with course development, traditional research and gallery development and maintenance. Specific deliverables will include one training course at the stakeholders’ facility for up to 30 people and one training course for up to two people, including travel to Purdue University for specialized training.

**FISCAL YEAR 2022 ACCOMPLISHMENTS**

- MDOT 125869 CAH S13 Beam E Pier 2 Pin Hole Corrective Action Stress Analysis & Repair Plan - Provided some guidance on this issue. The outcome was replacement.
- Parish Road's span bridge with damaged flanges that were weld repaired. Girders lifted off supports. Provided FEA analysis on estimated locked in stresses due to the many CJP welds added to the flanges. provided in put on heat straightening etc. should the contract elect to go that route
- M-55 Colley Bridge over Pine Creek (Cooley Bridge) plug weld questions. Provided suggested strategies moving forward and retrofit suggestions.

**FISCAL YEAR 2023 ACCOMPLISHMENTS**

- 35022-B01: Dr. Connor provided recommendations for analyzing link plates with out of plane distortion due to pack rust.
- B01-11101: US-12 over St. Joseph River
- Dr. Connor provided recommendations regarding plug weld removals using hand drilling adjacent to the defects.
- B03-51021: M-55 over Pine River (Cooley Bridge)
- Dr. Connor provided recommendations regarding plug weld removals identified in the North Truss U8'-U9' tension chord.
- B01-41027-4: I-196 WB over Grand River
- S-BRITE provided recommendations regarding analyzing web distortion of the beams and the load rating analysis.
- STR 2134: Route 537 over Ford River (Delta County)
- Dr. Connor provided recommendations regarding pin and hangers with welded washers.
- MDOT hosted S-BRITE to teach the following classes:
- Inspector Awareness (October 6 and Oct 27)
- Inspecting Steel Bridges for Fatigue (Nov 2-3)
- SBRITE provided feedback on a structural steel detail at B05-2 of 25132 (I-475/Flint River). It is a highly skewed bridge with long spans, and SBRITE was asked to comment on the proposed cross frame details and connections to the bottom flange of the girder.
- SBRITE provided CIF detail risk assessment guidance to help us assess whether we needed to retrofit existing structures.
- US-2 over Cut River – they provided guidance for instrumenting the hold down link plates to assess the remaining fatigue life. They gave us a diagram for where to instrument and gave us recommendations for how to set a threshold and how to pare down the strain data and gave a path forward in terms of how to use the data to assess fatigue life.
- S05 of 63103 – They gave us guidance for how to assess and retrofit a bridge that has experienced cracks in the juncture between the longitudinal beams and a transverse steel box girder.

**FISCAL YEAR 2024 ACCOMPLISHMENTS**

- Technical assistance and instrumentation of Cut River for determination of fatigue life for hold down plates
- Technical Review and evaluation of cracks on M-14 over the Huron River
- Continued support for I-696 over I-75 project for evaluation of the retrofit holes in the web of the cross girder that were placed to arrest potential fractures that could pop in where the longitudinal girder flange passes through the web of the cross girder

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

- MDOT continues to find great value in this pooled fund project with S-BRITE. In May, a hands-on class for retrofitting steel bridges for fatigue was conducted by the S-BRITE team at an MDOT facility. This was a two-day class where employees learned retrofit strategies for fatigue and fracture retrofits.
- Dr. Connor also met with the International Bridge Authority (IBA) several times to provide recommendations on instrumenting rocker links and gave recommendations as to how to analyze remaining fatigue life on certain components of a specific MDOT bridge project.

**FISCAL YEAR 2026 PROPOSED ACTIVITIES**

- Training will be offered to S-BRITE partners.
- Continued work with FHWA to obtain approval for S-BRITE equivalent NSTM training.
- Work on the PIN inspection sub-task will continue.
- A stake holder meeting will be held to review the progress on the RBI methodology being developed.
- Continued work on updating the S-BRITE website.
- It is anticipated that a request will be sent to partner states requesting S-BRITE continue for another five years.

**JUSTIFICATION(S) FOR REVISION(S)**

MDOT increased its pledge commitment to $75,000 in FY25 and $50,000 in FY26 for a revised total commitment of $235,000.00.

**SUMMARY OF THE IMPLEMENTATION RECOMMENDATION**

Project expected completion FY 2026.

Michigan Department
Of Transportation
5307 (11/17)

# RESEARCH ADMINISTRATION
# MDOT TRANSPORTATION POOLED FUND STUDY
# ANNUAL REPORT - FISCAL YEAR 2025

STUDY TITLE: Transportation Management Centers Pooled Fund Study Phase II

FUNDING SOURCE: ☒ FHWA ☐ OTHER (*PLEASE EXPLAIN*)

| | | | | |
|---|---|---|---|---|
| TPF NO. | TPF-5(487) | | MDOT START DATE | 11/09/2021 |
| OR NO. | OR22-211 | | MDOT COMPLETION DATE (Original) | 4/16/2027 |
| | | | COMPLETION DATE (Revised) | |
| MDOT TECHNICAL CONTACT | Suzette Peplinski, 616-451-3091<br>Email: PeplinskiS@Michigan.gov | | | |
| LEAD AGENCY | FHWA | | | |
| LEAD STUDY CONTACT | Chip Millard, 202-366-4415<br>Email: chip.millard@dot.gov | | | |
| CONTRACTOR | | | | |

**BUDGET STATUS**

| FY 2025 MDOT Budget | | | | MDOT Total Budget | | |
|---|---|---|---|---|---|---|
| FY25 FUNDS | (Original) | $25,000.00 | | TOTAL BUDGET | (Original) | $125,000.00 |
| | (Revised) | | | | (Revised) | |
| TOTAL FY 2025 EXPENDITURES | | $25,000.00 | | TOTAL COMMITTED FUNDS AVAILABLE | | $25,000.00 |

**PARTICIPATING STATES**

AL, AZ, CA, DE, FL, GA, IA, IL, IN, KS, LA, MD, MI, MN, MO, NJ, NV, NY, OH, PA, TN, TX, UT, VA, WA, WI, WV

**PURPOSE AND SCOPE**

The objectives of the Traffic Management Centers (TMC) Pooled Fund Study (PFS) is to assemble regional, state, and local transportation management agencies and FHWA to: (1) identify key issues and challenges agencies are facing with their traffic management systems (TMSs) or centers (TMCs); (2) suggest approaches to addressing identified issues; (3) initiate and monitor projects intended to address identified issues; (4) develop technical resources and disseminate results; (5) provide leadership and coordinate with others on TMC interests; and (6) promote and facilitate sharing information on TMC issues nationally.

The TMC Pooled PFS involves a group of public agencies and organizations who voluntarily pool funds each year to address the key challenges and issues they are facing in support of improving performance, capabilities, and how they manage and operate their TMSs. TMC PFS members collaborate by using funds they contribute for the pursuit of projects they agree to pursue and develop technical resources and advance activities to address the key challenges and issues they are collectively facing. This project is being created to establish a new number (Phase II of TPF-5(319)) and allow for 5 additional years (April 17, 2022, to April 16, 2027) beyond the existing study (TPF-5(319)). Agencies can join and add their commitments to the TMC PFS at any time during each year the TMC PFS, which is approved through April 16, 2027.

The Chair of the TMC Pooled Fund Study is Alex Wassman from the Missouri Department of Transportation. The Co-chairs are Josh Brown from the Tennessee Department of Transportation and Ryan McNary from the Pennsylvania Department of Transportation.
The TMC PFS is a group of public agencies and organizations who voluntarily pool funds each year to address the key challenges and issues they are facing in support of improving the performance, capabilities, and how they manage and operate their TMSs. TMC PFS members collaborate by using funds they contribute for the pursuit of projects they agree to pursue and develop technical resources and advance activities to address the key challenges and issues they are collectively facing. FHWA provides the staff and resources (e.g., administrative, technical, project management) to facilitate all the activities and develop the technical resources for each initiated project.

TMC PFS members have identified the need to develop resources to assist with evaluating and benchmarking the capabilities, and desired levels of performance for the existing and the next generation of their TMS. The need for technical resources was also identified to assist with planning, designing, procuring, developing, implementing, testing, operating, and evaluating possible improvements to these systems. TMC PFS members have identified over 15 ideas for possible future projects to pursue within the following four technical areas identified where work needs to be pursued over the next five years: 1) assessing and reporting on TMS capabilities and performance; 2) planning, designing, and procuring TMSs; 3) managing and operating TMSs; and 4) staffing, support resources, and capacity building.

This PFS Phase 2 is active and running concurrently with TPF-5(319) Phase 1.

**FISCAL YEAR 2023 ACCOMPLISHMENTS**

Completed reports include the Analysis of TMC Staff and Staffing Contracts, TMS Asset Management Planning for TMSs and LCCA, Inventorying, Documenting, and Configuring TMS Assets and Resources.
The annual meeting was held in May 2023 to select new projects, provide presentations on current projects, hear member state initiatives, and tour the Tennessee DOT facilities.
Multiple webinars and virtual technical exchanges were held for all TMC PFS members.
Webinars are usually hosted by NOCOE and are available to the national transportation community.

**FISCAL YEAR 2024 ACCOMPLISHMENTS**

The annual meeting and tour were held in May 2024 to review progress on current projects and select new projects and to tour the Kansas City SCOUT facilities. Additionally, four webinars were completed for TMS Emerging Topics. The Webinars were opened and hosted by NOCOE.

Quarterly virtual technical exchange meetings were held with member states.

Completed Reports:
1. Managing TMS Assets
2. Assessing and Reporting on TMS Capabilities and Performance
3. Predictive Analytics for TMS
4. Aligning TMC Staffing Capabilities for the Future of Systems Operations
5. Performance Measures and Health Index of Intelligent Transportation Systems Assets

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

The objectives of the Traffic Management Centers (TMC) Pooled Fund Study (PFS) is to assemble regional, state, and local transportation management agencies and FHWA to: (1) identify key issues and challenges agencies are facing with their traffic management systems (TMSs) or centers (TMCs); (2) suggest approaches to addressing identified issues; (3) initiate and monitor projects intended to address identified issues; (4) develop technical resources and disseminate results; (5) provide leadership and coordinate with others on TMC interests; and (6) promote and facilitate sharing information on TMC issues nationally. The TMC Pooled PFS involves a group of public agencies and organizations who voluntarily pool funds each year to address the key challenges and issues they are facing in support of improving performance, capabilities, and how they manage and operate their TMSs. TMC PFS members collaborate by using funds they contribute for the pursuit of projects they agree to pursue and develop technical resources and advance activities to address the key challenges and issues they are collectively facing. This project has created a new number for Phase II of TPF-5(319) to allow for 5 additional years (April 17, 2022, to April 16, 2027) beyond the existing study TPF-5(319). Agencies can join and add their commitments to the TMC PFS at any time during each year of the TMC PFS, which is approved through April 16, 2027.

The Chair of the TMC Pooled Fund Study is Juan Hernandez from the Nevada Department of Transportation. The Co-chairs are David Gaffney from the Pennsylvania Department of Transportation and Suzette Peplinski from MDOT. The TMC PFS is a group of public agencies and organizations who voluntarily pool funds each year to address the key challenges and issues they are facing in support of improving the performance, capabilities, and how they manage and operate their TMSs. TMC PFS members collaborate by using funds they contribute for the pursuit of projects they agree to pursue and develop technical resources and advance activities to address the key challenges and issues they are collectively facing. FHWA provides the staff and resources (e.g., administrative, technical, project management) to facilitate all the activities and develop the technical resources for each initiated project. TMC PFS members have identified the need to develop resources to assist with evaluating and benchmarking the capabilities, and desired levels of performance for the existing and the next generation of their TMS. The need for technical resources was also identified to assist with planning, designing, procuring, developing, implementing, testing, operating, and evaluating possible improvements to these systems. TMC PFS members have identified over 15 ideas for possible future projects to pursue within the following four technical areas identified where work needs to be pursued over the next five years: 1) assessing and reporting on TMS capabilities and performance; 2) planning, designing, and procuring TMSs; 3) managing and operating TMSs; and 4) staffing, support resources, and capacity building.

Projects completed in FY25 include:
- Using Information from Social Media to Improve the Operation of TMS.
- Two technical webinars were held, and three-member virtual technical exchanges.
- Annual meeting was held in September 2025.

Progress made on ongoing projects:
- Sharing and Using Different Types of Data in TMS.
- Planning to Frame TMS' Strategic Direction and Future Investments.
- Using Information from Social Media to Improve the Operation of TMS.
- Methods to Identify Staffing Needs and Developing or Updating Staffing Plans for TMS.
- Sharing and Using Open-Source or Agency Owned Software and APIs.
- Classifying, Measuring, Collecting, and Using Information on Conditions of TMS Assets.
- Locating and Placing TMS Field Devices.

| FISCAL YEAR 2026 PROPOSED ACTIVITIES |
| --- |
| TMC PFS Virtual Technical Exchange. Next exchange scheduled for November 5, 2025.<br>Review progress on current and planned TMC PFS projects. Meeting scheduled for December 3, 2025 |
| **JUSTIFICATION(S) FOR REVISION(S)** |
| None. |
| **SUMMARY OF THE IMPLEMENTATION RECOMMENDATION** |
| Project expected completion FY 2027. |

Michigan Department
Of Transportation
5307 (11/17)

# RESEARCH ADMINISTRATION
# MDOT TRANSPORTATION POOLED FUND STUDY
# ANNUAL REPORT - FISCAL YEAR 2025

STUDY TITLE: Safety Service Patrol Standardization and Management Practices

FUNDING SOURCE: ☒ FHWA ☐ OTHER (*PLEASE EXPLAIN*)

| | | | | |
|---|---|---|---|---|
| TPF NO. | TPF-5(489) | | MDOT START DATE | 12/07/2021 |
| OR NO. | OR22-209 | | MDOT COMPLETION DATE (Original) | 9/30/2025 |
| | | | COMPLETION DATE (Revised) | 9/30/2026 |
| MDOT TECHNICAL CONTACT | Sarah Gill, 248-867-6841<br>Email: GillS@Michigan.gov | | | |
| LEAD AGENCY | FHWA | | | |
| LEAD STUDY CONTACT | Jim Austrich, 202-366-0731<br>Email: james.austrich@dot.gov | | | |
| CONTRACTOR | Volpe | | | |

**BUDGET STATUS**

| FY 2025 MDOT Budget | | | | MDOT Total Budget | | |
|---|---|---|---|---|---|---|
| FY25 FUNDS | (Original) | $25,000.00 | | TOTAL BUDGET | (Original) | $100,000.00 |
| | (Revised) | | | | (Revised) | |
| TOTAL FY 2025 EXPENDITURES | | $25,000.00 | | TOTAL COMMITTED FUNDS AVAILABLE | | $0.00 |

**PARTICIPATING STATES**

AL, CA, FHWA, FL, GA, IN, LA, Louisiana Transportation Research Center (LRTC), MD, MI, MN, MO, NC, NJ, NY, PA, TN, TX, UT, WA

**PURPOSE AND SCOPE**

The primary objective of this PFS study will be to gain technical information related to SSP program management, standards associated with SSP response protocol and the implementation of traffic control, and references and guidance related to staffing, training, and resource allocations within SSP programs. The goals include: 1. Assemble best practices and lessons learned from existing programs 2. Develop guidance documents based on lessons learned from existing programs 3. Reference or create tools that will help agencies make informed program decisions such as route selection, staffing levels, and resource allocation.

The work plan is described in three primary phases. Phase 1 will cover the best practices research effort on the deployment of emergency traffic control (ETC) and potential SSP vehicle configurations used by agencies across the country. Phase 2 is focused on the staffing resources with a research effort focused on Staffing strategies, training programs, and the use of associated certifications. Phase 3 includes a focus on the strategic level of managing an SSP program and will focus on funding strategies and budgets, and resource management (route selection, number and type of vehicles, lengths of patrol routes, time of day, etc.) Phase 1 Best Practices in ETC and Vehicle Configurations (est. $250,000) Phase 1 includes an assessment in standards for both SSP vehicle and emergency traffic control implementation. SSP programs can range widely in the types of services provided to the motorists and it is paramount that responders can safely manage the on-scene response. This requires the appropriate type of vehicle, communications, technology, and resources to be contained within a single vehicle. This phase will look at emergency traffic control layouts that optimize the safety of all responders and the public and balance with the available storage capacity of an SSP vehicle. This will include the color and visibility of the vehicles, traffic control devices and placement, lighting systems and other emerging technologies (beacons, tethered drones, etc.) that add value to the response and safety. In addition, it will look at additional technologies and equipment contained on an SSP vehicle and the effectiveness of those tools in supporting a response. Tasks: 1. Multi-state Program and Literature Review 2. Focused research and outreach to agencies on ETC layouts, vehicle equipment, and use of emerging technologies 3. Technical guide for best practices in ETC implementation, including device requirements and schematics of actual layout 4. Technical guide for potential vehicle configurations (chassis, 4x4 etc.), equipment needs, and emerging technology applications Phase 2 Staffing, Training, and Certification ($275,000) Phase 2 is focused on how agencies are staffing their SSP program. Programs can use in-house, contracted staff, or even a hybrid structure to provide the necessary staffing levels and oversight of the day-to-day operations. Additionally, SSP staff are required to perform independently every day and must have a broad technical skill set to respond to a variety of issues while on duty. This phase will include research on the structure and content of existing training programs as well as identifying lessons learned or the future direction of established programs. This research also should capture the integration of certification within agencies' training curriculum and how that certification is used to support the staffing, hiring, and promotion structure. Tasks: 1. Multi-state Program and Literature Review 2. Focused research and outreach to agencies on staffing structure including policies or legislation that may steer the decisions around the staffing structure 3. Focused research and outreach to agencies on training and certification programs and how they are integrated into the resource management and staffing strategy 4. Technical guide for best practices in staffing structures including job descriptions, qualifications job postings, policies, and legislation that drive staffing decisions 5. Technical guide for developing, implementing, and maintaining a training and certification program Phase 3 Program Management ($225,000) Phase 3 is focused on an assessment of existing programs and their program management strategies. This includes a look at tools used for route selection, asset management, staffing levels, and budgeting purposes. All public agencies are required to commit to a budget and that is no exception for an SSP. This research will focus on how SSP programs are determining and managing budgets.

**FISCAL YEAR 2022 ACCOMPLISHMENTS**

We have formed our technical group and meet regularly. Share information and have started to collect and compare documentation.

**FISCAL YEAR 2023 ACCOMPLISHMENTS**

We held our first in person SSP Pooled Fund Study meeting in North Carolina in May. The SSP Pooled Fund study has focused on Phase 1 – Information gathering and classifying information to document all service patrol nationally and classify them based on the size and responsibility of the program. Documentation and information were provided on a SharePoint site. A master excel file was updated with the information to compare programs. Interviews were held to get the remaining information.

**FISCAL YEAR 2024 ACCOMPLISHMENTS**

The second annual meeting took place in Cambridge, MA on May 1st and 2nd with Tim Schneider in attendance. The meeting was held at the USDOT Volpe Center and MassDOT. The pooled fund has developed a draft for the synthesis report, *Safety Service Patrol (SSP) Overview: A Synthesis Report*, which will be the deliverable for Phase 1 of the initial PFS research project. In Fiscal Year 2024 the team completed drafts of Chapters 1, 2, and 4 were circulated and updated with comments and feedback, Chapter 3 Draft is complete, Revised State Profile Drafts, draft white paper on sponsorship delivered, members continued to upload files to the filesharing structure to inform the research, and Phase 2 is in the planning stages.

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

Produced Phase 1 report documenting status of Safety Service Patrol programs nationally. Work on Phase 2 and PFS Challenges with EVs. The next SSP PFS Annual Meeting was scheduled for April 8-9, 2025, in New Orleans but was canceled due to travel restraints. Multiple interviews with each state that is involved were conducted. Quarterly half day workshops have been participated in.

Implementation Efforts:

Review of the Phase 1 Report to ensure that it is incorporating all four contracts in Michigan along with the new innovations that are included in some of the current contracts.
Demonstrating Michigan's Safety Service Patrol program and things that make it unique, including some assist and repair types, transporting motorists, drones, cameras, trailers, debris clear trucks and vendor software.

**FISCAL YEAR 2026 PROPOSED ACTIVITIES**

Will be demonstrating Michigan's Safety Service Patrol program and things that make it unique including some assist and repair types, transporting motorists, drones, cameras, trailers, debris clear trucks and vendor software.

Phase 2 interview materials will be finalized.
Phase 2 analysis will start.
Finalize and distribute EV whitepaper.

**JUSTIFICATION(S) FOR REVISION(S)**

None.

**SUMMARY OF THE IMPLEMENTATION RECOMMENDATION**

Project expected completion FY 2026.

Michigan Department
Of Transportation
5307 (11/17)

# RESEARCH ADMINISTRATION
# MDOT TRANSPORTATION POOLED FUND STUDY
# ANNUAL REPORT - FISCAL YEAR 2025

STUDY TITLE: Evaluating New Technologies for Roads Program Initiatives in Safety and Efficiency (ENTERPRISE- Phase III)

FUNDING SOURCE: ☒ FHWA ☐ OTHER (*PLEASE EXPLAIN*)

| | | | |
|---|---|---|---|
| TPF SOLICITATION NO. | TPF-5(490) | MDOT START DATE | 1/19/2022 |
| OR NO. | OR22-204 | MDOT COMPLETION DATE (Original) | 09/30/2027 |
| | | COMPLETION DATE (Estimated Revised) | 10/21/2028 |
| MDOT TECHNICAL/LEAD STUDY CONTACT | Marlon Spinks, 586-634-3952<br>Email: SpinksM@Michigan.gov | | |
| LEAD AGENCY | Michigan Department of Transportation | | |
| | | | |
| CONTRACTOR | | | |

**BUDGET STATUS**

| FY 2025 MDOT Budget | | | MDOT Total Budget | | |
|---|---|---|---|---|---|
| FY25 FUNDS | (Original) | $35,000.00 | SPR Budget | (Original) | $175,000.00 |
| | (Revised) | | Non-SPR Budget | (Original) | $240,980.00 |
| **TOTAL FY 2025 EXPENDITURES** | | $35,000.00 | **TOTAL FUNDS AVAILABLE** | | $415,980.00 |

| Year | Total MDOT Contributions | Project Total Expenditures |
|---|---|---|
| 2022 | $ 35,000.00 | *$ 15,352.95 |
| 2023 | $ 70,000.00 | $175,563.39 |
| 2024 | $105,000.00 | $238,402.04 |
| 2025 | $140,000.00 | $205,993.03 |
| **Total Pooled Fund Expenditures** | | $619,958.46 |

*CTC and Associates expenditure for assistance with Phase III preparation and transition from Phase II

**PARTICIPATING STATES**

IA, IL, KS, MI, MN, TX, WI

**PURPOSE AND SCOPE**

This study is a continuation of TPF-5(359) Phase II to enhance innovation in highway operations and Intelligent Transportation Systems (ITS) through research and technology transfer. Another purpose of this study is to continue the assessment of transformational technologies and their impact on the transportation industry.

**FISCAL YEAR 2021 ACCOMPLISHMENTS**

This proposed study was approved for solicitation by FHWA Michigan Division and is included on the FY 2021 annual work plan. Current state partners pledge commitments total is $450,000.00.

**FISCAL YEAR 2022 ACCOMPLISHMENTS**

Full waiver was approved; MDOT obtained FHWA final approval of the proposed study, and a federal project number was assigned. MDOT requested all state partners transfer their FY 2022 pledge commitment amounts.

**FISCAL YEAR 2023 ACCOMPLISHMENTS**

Secured state partner's fund transfers for FY 2022 and 2023.

Project 1: State of the Art Roadway Sensors – Phase 1

- Task 1: Literature Search, Survey, and/or Interviews – Completed Task 1 by compiling and organizing findings from the literature search and survey.
- Task 2: Roadway Sensor Analysis – Conducted a webinar with interested ENTERPRISE Board members to prioritize use case areas and specific sensors to focus in-depth analysis on items of interest for Task 2 and 3 activities.
- Task 3: Use Cases – Began documenting use cases that were identified in Tasks 1 and 2.
- Task 4: Draft Final Report – Began development of the report based on findings from Tasks 1 and 2.

Project 2: New Methods of Traffic Data Collection

- Task 1: Literature Search, Survey, and or/Interviews – Continued online search to identify traditional and emerging data collection methodologies. Began to analyze survey results that focused on identifying state DOTs that have used or are using emerging methodologies for collecting traffic data.

- Task 2: Industry Scan – Continued online search of vendors that provide data collection methodologies.

Project 3: Potential Approaches for Wrong Way Driving Applications – Phase 2
- Task 1: Synthesis of Current WWD In-Vehicle or Mobile Applications – Completed Task 1 by completing the online search to identify WWD in-vehicle and mobile applications and prepared the draft synthesis. Presented a project update at the September ENTERPRISE Board meeting.
- Task 2: Industry Outreach - Automobile Manufacturers and Application Providers – Began discussing an outreach strategy.
- Task 3: Industry Outreach – Enhance Phase 1 White Paper – Completed engagement with USDOT/FHWA, received input and insights to continue to pursue inclusion of WWD events in national data exchanges.

Project 4: Procurement Specification for Physical Security of ITS
- Task 1: Investigate Best Practices for Security of ITS Field Devices – Completed the literature review. Created a one- page project summary document. Defined “ITS cabinets, shelters/huts, and boxes” for the purpose of this project. Recruited agencies to participate in interviews through outreach to the AASHTO Committee on Transportation System Operations (CTSO). Developed an interview guide. Completed 6 interviews with State DOTs to gather physical security practices and specifications. Began creating interview summaries. Presented a project update at the September ENTERPRISE Board Meeting.
- Task 2: Best Practices Checklist: Began reviewing practices noted by State DOTs, for consideration for inclusion in the best practices checklist.

Project 5: Novel Uses of Unmanned Aerial Systems (UAS) in ITS
- Task 1: Literature Search, Survey, and/or Interviews – Completed the literature search. Began developing survey questions. Provided a project update at the September ENTERPRISE Board meeting.
- Task 2: Use Cases and Applications: Began compiling UAS use cases from literature.

Project 6: State of the Art of Roadway Sensors – Phase 2
- Conducted project kickoff during September ENTERPRISE Board meeting.

**FISCAL YEAR 2024 ACCOMPLISHMENTS**

The following Phase III research secondary projects were initiated in FY 2024:
Project 7: Administration of Communications – Phase 1
Project 8: Something Old, Something New – New Applications of Old Technologies
Project 9: Uncontrolled Pedestrian Crossing ITS Countermeasures
Project 10: Communication Future – Phase 1
Project 11: Quick Connect DMS Replacement
Project 12: Administration of Communications – Phase 2
Project 13: Analysis and Benefits of Connected Street Lighting

Planned/Scheduled the next in-person Board Meeting to be held in Detroit, MI on October 23rd and 24th.

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

Enterprise for FY2025 performed work on following list of specific projects proposed by the Enterprise TPF Member States (status of project included):

Project 7: Administration of Communications - Project completed, final report available
Project 8: ITS Simple Innovations - Project completed, final report available
Project 9: Uncontrolled Pedestrian Crossing ITS Countermeasures - Project completed, Final Report available
Project 10: Defining and Advancing Digital Infrastructure - Drafting Final Report
Project 11: Role of AI in ITS - Project completed, Final Report available
Project 12: Alternate Methods of Traffic Data Analysis - Currently identifying and documenting use cases.
Project 13: Truck Parking Technologies - Project completed, Final Report available.
Project 14: Documenting Current Road Weather Information System (RWIS) Technologies Related to ITS and Operations- Project completed, Final Report available.
Project 15: ITS Simple Solutions – Phase 2- Prepared for Project Kickoff
Project 16: Information Technology Support Models for ITS - Prepared for Project Kickoff
Project 17: Evaluation Process for ITS Systems - Prepared for Project Kickoff
Project 18: Deterrents for Rodents Chewing in Fiber and Cabinets - Prepared for Project Kickoff

**FISCAL YEAR 2026 PROPOSED ACTIVITIES**

Administrative Contract:
CTC & Associates will continue updating the website with current information. (http://enterprise.prog.org).
CTC & Associates will continue to monitor research project's schedules and obtain TAC approval of the researcher's invoices.
CTC & Associates will coordinate scheduling and facilitate Board meetings for FY 2026.
Athey Creek, Inc.:
Project 2: New Methods of Traffic Data Collection
Project 3: Potential Approaches for Wrong-Way Driving Applications – Phase 2
Project 4: Procurement Specification for Physical Security of ITS

Project 5: Novel Uses of Unmanned Aerial Systems (UAS) in ITS
Project 6: State of the Art of Roadway Sensors – Phase 2
Commence research activities on the following secondary projects:
Project 7: ITS Simple Innovations
Project 8: Defining and Advancing Digital Infrastructure
Project 9: Uncontrolled Pedestrian Crossing ITS Countermeasures
Project 10: Role of AI in ITS
Project 11: Alternate Methods of Traffic Data Analysis

**JUSTIFICATION(S) FOR REVISION(S)**

A no cost time extension was granted to CTC and Associates under the administrative contract to allow additional time for their assistance with transition into Phase III of this pooled fund project.

**SUMMARY OF THE IMPLEMENTATION RECOMMENDATION**

Project expected completion FY 2028.

Michigan Department
Of Transportation
5307 (11/17)

# RESEARCH ADMINISTRATION
# MDOT TRANSPORTATION POOLED FUND STUDY
# ANNUAL REPORT - FISCAL YEAR 2025

STUDY TITLE: Roadside Safety Pooled Fund – Phase 3

FUNDING SOURCE: ☒ FHWA ☐ OTHER (*PLEASE EXPLAIN*)

| | | | |
|---|---|---|---|
| TPF NO. | TPF-5(501) | MDOT START DATE | 9/09/2022 |
| OR NO. | OR23-204 | MDOT COMPLETION DATE (Original) | 9/30/2025 |
| | | COMPLETION DATE (Revised) | 12/31/2027 |
| MDOT TECHNICAL CONTACT | Carlos Torres, 517-335-2852<br>Email: TorresC@Michigan.gov | | |
| LEAD AGENCY | Washington State DOT | | |
| LEAD STUDY CONTACT | Mustafa Mohamedali, 360-704-6307<br>Email: Mustafa.Mohamedali@wsdot.wa.gov | | |
| CONTRACTOR | | | |

## BUDGET STATUS

| FY 2025 MDOT Budget | | | MDOT Total Budget | | |
|---|---|---|---|---|---|
| FY25 FUNDS | (Original) | $65,000.00 | TOTAL BUDGET | (Original) | $195,000.00 |
| | (Revised) | | | (Revised) | $325,000.00 |
| TOTAL FY 2025 EXPENDITURES | | $65,000.00 | TOTAL COMMITTED FUNDS AVAILABLE | | $130,000.00 |

## PARTICIPATING STATES

AK, AL, CA, CO, CT, DE, FL, IA, ID, IL, LA, MA, MD, MI, MN, MO, NM, OH, Ontario MOT, OR, PA, TN, TX, UT, WA, WI, WV

## PURPOSE AND SCOPE

The objective of this Pooled Fund is to assist transportation agencies in achieving their Roadway Departure (RwD) related to all state Strategic Highway Safety Plans (SHSPs) goals through development, evaluation and deployment of life-saving roadside safety devices and countermeasures in accordance with AASHTO and Federal Highway Administration (FHWA) adopted standards such as the Manual for Assessing Safety Hardware (MASH). It will also support continuation of MASH implementation in roadside hardware categories that have lagged in achieving MASH compliance (special barrier applications, sign supports, work zone traffic control devices, luminaire poles, etc.) due to various design and performance challenges and other related factors. These activities will directly support and impact state efforts to achieve Target Zero by helping reduce the frequency and severity of roadway departure crashes.

TPF-5(501) is intended to replace the current Roadside Safety Research for MASH Implementation pooled fund study, TPF-5(343), which expires in December 2023.

Given their common interest in SHSP implementation, all states would benefit from participation in this Pooled Fund program. However, the FHWA Roadway Departure Focus States may particularly benefit from the roadside safety research, collaboration, and information sharing that will constitute the framework of the program.

Representatives of participating states will be convened as a technical committee to identify common research needs, select and prioritize projects for funding, and oversee research and testing. Specific activities include the design, analysis, testing, and evaluation of crashworthy roadside safety devices, and the development of guidelines for the use, selection, and placement of these devices. Devices to be considered for research include bridge rails, guardrails, transitions, median barriers, portable concrete barriers, end treatments, crash cushions, culverts, breakaway support structures (e.g., sign supports, luminaire supports, mailboxes), and work zone traffic control devices. Research will also address the influence of roadside features such as driveways, slopes, ditches, shoulders, medians, and curbs on vehicle collision performance. Computer simulation, full-scale crash testing, analysis of real-world crash data, and cost effectiveness analysis are the primary tools that will be employed in these investigations. The identification, description, selection, and prioritization of research issues will be made by the technical committee on an annual basis, unless emerging issues require committee decisions in the interim.

## FISCAL YEAR 2023 ACCOMPLISHMENTS

This is a new pooled fund group that officially started on 9/9/22. Once sufficient funds were obligated to the pooled fund by member states, beginning in May 2023, the lead agency was able to start executing task orders to initiate some of the priorities member states had identified at the fall 2022 annual meeting.

After a significant deal of work, collaboration and negotiations between all parties and legal counsel, the master agreement with the research institution (Texas Transportation Institute) was finally concluded. This led to TTI being able to submit proposals for individual tasks and projects that had been identified at the 2022 annual meeting.

The following projects and tasks were initiated between 4/1/23 and 6/30/23:

1. T1969-AA: 2023 Program Development & Coordination Effort
2. T1969-AB: Optimized Guardrail Blockouts
3. T1969-AC: W-Beam Guardrail in Front of Retaining Wall or Rip Rap
4. T1969-AD: Barrier Deflections at Lower Impact Severities
5. T1969-AE: Phase II Thrie Beam Retrofit – Application of New Design without a Curb for MASH TL-3 and Performance and Improvements for MASH TL-4
6. T1969-AF: MASH TL-3 Evaluation of Sign Posts with Flashing Beacon Equipment
7. T1969-AG: MASH TL-3 Transition Design with a Storm Drain Inlet: Phase II

**FISCAL YEAR 2024 ACCOMPLISHMENTS**

**Completed Projects**

1. T1969-AG: MASH TL-3 Transition Design with a Storm Drain Inlet: Phase II

**Ongoing Projects**

2. T1969-AA: 2023 Program Development & Coordination Effort
3. T1969-AB: Optimized Guardrail Blockouts
4. T1969-AC: W-Beam Guardrail in Front of Retaining Wall or Rip Rap
5. T1969-AD: Barrier Deflections at Lower Impact Severities
6. T1969-AE: Phase II Thrie Beam Retrofit – Application of New Design without a Curb for MASH TL-3 and Performance and Improvements for MASH TL-4
7. T1969-AF: MASH TL-3 Evaluation of Signposts with Flashing Beacon Equipment
8. T1969-AH: 2023 Travel and Meeting Assistance
9. T1969-AI: Design and MASH Full-Scale Crash Testing and Evaluation of the Merritt Parkway Guiderail
10. T1969-AJ: Engineering Support Services and Recommendations for Roadside Safety Issues/Problems for Member States
11. T1969-AL: Guidelines for Overlapping Precast Portable Barriers
12. T1969-AM: MASH TL-5 Concrete Median Barrier with Shallowest Embedment or Footing in Asphalt
13. T1969-AN: MASH TL-3 Enhancement of Short Radius Guardrail System (SRGS) in Front of 2:1 Slope, Phase I
14. T1969-AO: MASH TL-3 Design, Testing, and Evaluation of a Flared Guardrail System, Phase II
15. T1969-AP: Evaluation of Multi-Post Large Sign Supports with Slip Base and Slip Hinge
16. T1969-AQ: Bridge Rail End Treatments Guidance for constrained Sites
17. T1969-AR: MASH Evaluation of Square Tubing Slip Base Sign Support Systems
18. T1969-AS: Simulation Modeling Improvements and Updates

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

**New Projects:**

1. T1969-A6: 2024 Website and MASH Database Update Support
2. T1969-A7: Engineering Support services and Recommendations for Roadside Safety Issues for Member States
3. T1969-A8: MASH Test 3-21 of Free-Standing to Anchored PCB System on Asphalt
4. T1969-A9: An Exploration into Variation in Approach Guardrail Transition (AGT) to Rigid Barriers – Phase 2
5. T1969-B1: Design Variations of Short Radius Guardrail System
6. T1969-B2: Develop Guidance for MASH TL-3 Breakaway Sign Support Systems on Slopes
7. T1969-B3: Bridging Gaps in Concrete Barriers – Phase 1
8. T1969-B4: Placement of Underground Obstructions Adjacent to Guardrail Posts

**Ongoing Projects:**

1. T1969-A5: Washington State I-90 Snoqualmie Pass Scupper Barrier Full-Scale Crash Testing – Phase 3
2. T1969-AB: Optimized Guardrail Blockouts
3. T1969-AD: Barrier Deflections at Lower Impact Severities
4. T1969-AI: Design and MASH Full-Scale Crash Testing and Evaluation of the Merritt Parkway Guiderail
5. T1969-AL: Guidelines for Overlapping Precast Concrete Portable Barriers
6. T1969-AN: MASH TL-3 Enhancement of Short Radius Guardrail System (SRGS) in Front of 2:1 Slope, Phase I
7. T1969-AO: MASH TL-3 Design, Testing, and Evaluation of a Flared Guardrail System, Phase II
8. T1969-AP: Evaluation of Multi-Post Large Sign Supports with Slip Base and Slip Hinge
9. T1969-AQ: Bridge Rail End Treatments Guidance for constrained Sites
10. T1969-AR: MASH Evaluation of Square Tubing Slip Base Sign Support Systems
11. T1969-AS: Simulation Modeling Improvements and Updates
12. T1969-A2: 2024 Program Administration & Development
13. T1969-A3: Determine MASH TL-3 and/or TL-2 Compliance of the Midwest Guardrail System (MGS) with Reduced Post Spacing Near Curbs
14. T1969-A4: Determine MASH TL-3 and/or TL-2 Compliance of the Midwest Guardrail System (MGS) with Reduced Post Spacing Near Slopes
15. T1969-A5: Washington State I-90 Snoqualmie Pass Scupper Barrier Full-Scale Crash Testing – Phase 3
16. T1969-A4: Determine MASH TL-3 and/or TL-2 Compliance of the Midwest Guardrail System (MGS) with Reduced Post Spacing Near Slopes

**Completed Projects:**

1. T1969-AA: 2023 Program Development & Coordination Effort
2. T1969-AJ: Engineering Support Services and Recommendations for Roadside Safety Issues for Member States
3. T1969-AK: 2023 Administrative Support
4. T1969-AM: MASH TL-5 Concrete Median Barrier with Shallowest Embedment or Footing in Asphalt
5. T1969-A1: 2024 Travel and Meeting Assistance

New projects were selected by the group at the 2025 annual meeting held in September.

**FISCAL YEAR 2026 PROPOSED ACTIVITIES**

Continue work on active task orders. Commence work on approved new task orders. As the study funds continue to increase, lead agency will execute task orders for all remaining priorities. Total estimated cost up to $1.6M.

**JUSTIFICATION(S) FOR REVISION(S)**

None.

**SUMMARY OF THE IMPLEMENTATION RECOMMENDATION**

Expected project completion FY 2027.

Michigan Department
Of Transportation
5307 (11/17)

# RESEARCH ADMINISTRATION
# MDOT TRANSPORTATION POOLED FUND STUDY
# ANNUAL REPORT - FISCAL YEAR 2025

STUDY TITLE: Concrete Bridge Engineering Institute (CBEI)

FUNDING SOURCE: ☒ FHWA ☐ OTHER (*PLEASE EXPLAIN*)

| | | | | |
|---|---|---|---|---|
| TPF NO. | TPF-5(508) | | MDOT START DATE | 3/20/2023 |
| OR NO. | OR23-206 | | MDOT COMPLETION DATE (Original) | 9/30/2026 |
| | | | COMPLETION DATE (Revised) | 5/31/2027 |
| MDOT TECHNICAL CONTACT | Brad Wagner, 517-256-6451<br>Email: WagnerB@Michigan.gov | | | |
| LEAD AGENCY | Texas DOT | | | |
| LEAD STUDY CONTACT | Tom Schwerdt, 512-466-4186<br>Email: tom.schwerdt@txdot.gov | | | |
| CONTRACTOR | | | | |

**BUDGET STATUS**

| FY 2025 MDOT Budget | | | | MDOT Total Budget | | |
|---|---|---|---|---|---|---|
| FY25 FUNDS | (Original) | $50,000.00 | | TOTAL BUDGET | (Original) | $200,000.00 |
| | (Revised) | | | | (Revised) | |
| TOTAL FY 2025 EXPENDITURES | | $50,000.00 | | TOTAL COMMITTED FUNDS AVAILABLE | | $50,000.00 |

**PARTICIPATING STATES**

AL, CA, CO, FHWA, FL, GA, IA, ME, MI, MN, NE, PA, TN, TX, UT, WI

**PURPOSE AND SCOPE**

The overall objective of this pooled fund is to implement specific programs within the Concrete Bridge Engineering Institute (CBEI) that address national workforce training needs through research, development, and technology transfer activities.

The specific objectives are to develop and implement the following programs with coordinated input of members of the pooled fund: Three initial specific training programs, a Concrete Solutions Center, and a Bridge Component Collection. The scope of each is further defined below.

Technology transfer through training programs will draw on the latest technologies and provide an innovative approach by utilizing a hands-on intensive curriculum. The training programs will draw from the best, and most current, state of the art methods. CBEI will serve to continually gather emerging or underutilized technologies such as those above, and provide research, development, and technology transfer activities in partnership with the originators of the technology. This will result in training curricula and technology transfer documents for the concrete bridge workforce. Non-destructive Evaluation (NDE) techniques will be an overarching component included in each of the programs.
This solicitation will create a consortium of states that fund the Concrete Bridge Engineering Institute (CBEI). The scope within this pooled fund includes the resources to create and operate the components of CBEI and member benefits listed below:

- Training Seats:
  - Deck Construction Inspection Program to meet the need of ensuring proper initial construction of concrete bridge decks utilizing full-scale hands-on components. Bridge deck construction techniques utilizing precast deck panels and associated technologies will be included in this program.
  - Concrete Materials for Bridges Program to provide guidance on the proper selection and use of constituent materials to improve the service life of concrete bridges, sustainability of concrete construction, and provide hands-on examples of what happens when these are not considered.
  - Post-tensioning (PT) Laboratory (aka PT Academy) to provide hands-on training for inspectors and field installers as well as test and evaluate promising post-tensioning technologies.
- Concrete Solutions Center: Members are provided with support through the CBEI Concrete Solutions Center, including direct technical support, webinars, and custom workshops. Identified emerging technologies will be further evaluated through this program and new training programs and draft documentation developed to foster successful implementation.
- Bridge Component Collection: Member support will help fund the growth and development of the full-scale Bridge Component Collection. The Concrete Bridge Component Collection at CBEI contains full scale specimens from decommissioned bridges as well as from previous research projects. The components include segmental bridge components, precast girders, bent caps, and specimens exhibiting concrete deficiencies such as alkali-silica reaction (ASR). This resource will be used for training and technology testing and can serve specific needs of a member with consensus of the Technical Advisory Committee.
- CBEI will engage partners such as industry groups and will seek to complement existing training and resources. CBEI will draw on existing resources at the University, such as other Centers and departments and will also engage other subject matter experts and resources outside of the University.

**FISCAL YEAR 2023 ACCOMPLISHMENTS**

The project agreement for this pooled fund was issued on June 21, 2023, and the kickoff meeting was held with the TAC on 6/22/23. An overview of the pooled fund was described. Most of the pooled fund efforts officially begin in January of 2024. However, technical support capacity is now available, and MDOT has utilized this for several current issues as noted below:

- Assessment of beam end flange cracking on several new structures. CBEI has met with us, proposed a plan, and will perform analysis.
- Assessment of beam end web cracking – CBEI met with us, gave recommendations, and shared research information.
- Assessment of fabrication issues on an active construction project – Had a call with the PI and received recommendations for how to proceed.

**FISCAL YEAR 2024 ACCOMPLISHMENTS**

Major development on the project began in earnest in January 2024. Accomplishments included development of a Concrete Bridge Materials Course and significant development for Bride Deck Construction Inspection course, something MDOT Subject Matter Experts are integrally supporting. The Concrete Solutions Center officially launched, and MDOT asked and received guidance on several topics including:

- Guidance on concrete bearing arrangements and national best practices.
- Guidance on equipment for measuring cracks in concrete
- Guidance on reasonable hold down forces for harped strands
- Guidance on Structural Health Monitoring for Pot Bearings

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

The pooled fund completed and delivered both the concrete materials and concrete bridge construction inspection training. MDOT was an integral participant in the development of the construction inspection training. MDOT sent two staff to a CBEI class, one attended the Concrete Bridge Materials Course in April 2025, and one attended the bridge construction inspection course in May. The concrete bridge solutions also provided a significant amount of technical support to MDOT, and input was crucial in our response to the M-30 bridge issues this year.

**FISCAL YEAR 2026 PROPOSED ACTIVITIES**

- Continue project management.
- Continue to advance site preparation construction activities, component collection modifications, and work on design of site support components.
- Ongoing maintenance and continuous improvements for the bridge deck specimen area and concrete materials course demo areas.
- Develop post-tensioning laboratory area.

**JUSTIFICATION(S) FOR REVISION(S)**

None.

**SUMMARY OF THE IMPLEMENTATION RECOMMENDATION**

Project expected completion FY 2027.

Michigan Department
Of Transportation
5307 (11/17)

# RESEARCH ADMINISTRATION
# MDOT TRANSPORTATION POOLED FUND STUDY
# ANNUAL REPORT - FISCAL YEAR 2025

STUDY TITLE: Work Zone Analytics

FUNDING SOURCE: ☒ FHWA ☐ OTHER (*PLEASE EXPLAIN*)

| | | | | |
|---|---|---|---|---|
| TPF NO. | TPF-5(514) | | MDOT START DATE | 5/04/2023 |
| OR NO. | OR24-208 | | MDOT COMPLETION DATE (Original) | 6/30/2026 |
| | | | COMPLETION DATE (Revised) | |
| MDOT TECHNICAL CONTACT | Chris Brookes, 517-242-6486<br>Email: BrookesC@Michigan.gov | | | |
| LEAD AGENCY | Indiana Department of Transportation | | | |
| LEAD STUDY CONTACT | Tommy Nantung, 765-463-1521 ext. 248<br>Email: tnantung@indot.in.gov | | | |
| CONTRACTOR | | | | |

## BUDGET STATUS

| FY 2025 MDOT Budget | | | | MDOT Total Budget | | |
|---|---|---|---|---|---|---|
| FY25 FUNDS | (Original) | $30,000.00 | | TOTAL BUDGET | (Original) | $90,000.00 |
| | (Revised) | | | | (Revised) | |
| TOTAL FY 2025 EXPENDITURES | | $30,000.00 | | TOTAL COMMITTED FUNDS AVAILABLE | | $30,000.00 |

## PARTICIPATING STATES

DE, FHWA, IL, MD, MI, PA, TX, UT, WI

## PURPOSE AND SCOPE

Over a three-year period, Purdue University and the Indiana Department of transportation have been monitoring congestion and hard braking data across all 2,600 miles of Indiana Interstates using connected vehicle data. Reports from this data monitoring can provide insights into the impact of construction activities on congestion and have evolved over the three-year period. Indiana recognized there is a need to develop a multi-state consensus on the most effective reports.

This study will provide a framework to formalize reporting models, data reduction processes, and the decision making process so these techniques can be scaled to other states to assist them in proactively identifying emerging safety concerns in their work zones, conduct effective after action reviews of past work zones, and ultimately identify best practices for future work zones that minimize congestion, hard braking and ultimately crashes.

## FISCAL YEAR 2024 ACCOMPLISHMENTS

A webinar was held on February 15, 2024. The research team shared examples of weekly heatmaps using Omnitracs connected truck data. Partner states were asked to submit interstate work zones of interest for their states, with SharePoint sites set up for each state to receive heatmaps, which were provided weekly.

The Purdue Research team presented “Work Zone Analytics” at the Midwest Work Zone Roundtable on May 9, 2024, to share pooled fund activities with a broader audience. A webinar was held on May 10, 2024, for partner states to review weekly heatmaps for selected case studies for work zones of interest as previously submitted. Weekly heatmaps were generated on all interstates for each TPF partner state, along with heatmaps specific to work zones (43 total) previously submitted by the states, which are updated every Monday in a shared one-drive folder. A heatmap monograph entitled “Measuring and Visualizing Freeway Traffic Conditions: Using Connected Vehicle Data” that demonstrates approximately 50 use cases was published.

Beginning in July, the weekly heatmap distribution to partner states included commentary that identified the top two or three noteworthy changes from the week before for each state. Another webinar was held on August 9, 2024, to review the weekly heatmaps for the partner states and select case studies for work zones of interest from those previously submitted by states. Dialogue on available data sources to monitor work zones included the more affordable truck data, but in some cases passenger car data provides better coverage of work zones. Potential application of hard braking data to monitor work zones was also included, along with the use of Vizzion truck dash cam images to monitor work zones conditions. Tactical webinars with individual states provided opportunities to discuss their work zones of interest in more detail and review associated heatmaps and noteworthy changes from previous weeks. These state specific webinars included: Wisconsin (July 29, 2024), Illinois (July 31, 2024), Texas (Aug. 2, 2024), and Illinois (Sept. 13, 2024).

## FISCAL YEAR 2025 ACCOMPLISHMENTS

Presented pooled fund information at the Ohio Traffic Engineering Conference on October 9, 2024, and explored opportunities for Ohio DOT to join the Pooled Fund Study. Presented research at the virtual National Work Zone Management Conference on October 22, 2024. Continue to prepare and distribute weekly heatmaps for the partner states with a high-level summary and key changes from the previous week for quick access and reference. Continue outreach activities to share findings with a broader audience and solicit

participation in the 167 study. Continue to develop and strengthen private sector partnerships for collecting and analyzing connected vehicle data for work zone analysis activities. Prepared recommendations for the October 30, 2024, panel meeting.

**FISCAL YEAR 2026 PROPOSED ACTIVITIES**

- Webinar with TPF-5(514) partners is scheduled for October 1, 2025.
- Virtual drives of work zones from Vizzion images will be distributed via YouTube unlisted playlists for each state on a weekly basis.
- States may request virtual drives for specific work zones and time periods as needed
- Planning is underway for an in-person panel meeting during the first quarter of 2026.
- One-on-one calls with states can be scheduled to review their respective work zones and reports.

**JUSTIFICATION(S) FOR REVISION(S)**

None.

**SUMMARY OF THE IMPLEMENTATION RECOMMENDATION**

Project expected completion FY 2026.

Michigan Department
Of Transportation
5307 (11/17)

# RESEARCH ADMINISTRATION
# MDOT TRANSPORTATION POOLED FUND STUDY
# ANNUAL REPORT - FISCAL YEAR 2025

STUDY TITLE: Evaluation of Low-Cost Safety Improvements (ELCSI-PFS)

FUNDING SOURCE: ☒ FHWA ☐ OTHER (*PLEASE EXPLAIN*)

| | | | | |
|---|---|---|---|---|
| TPF NO. | TPF-5(515) | | MDOT START DATE | 5/08/2023 |
| PROJECT NO. | OR24-207 | | MDOT COMPLETION DATE (Original) | 9/30/2028 |
| | | | COMPLETION DATE (Revised) | |
| MDOT TECHNICAL CONTACT | Garrett Dawe, 989-289-2388<br>Email: DaweG@Michigan.gov | | | |
| LEAD AGENCY | FHWA | | | |
| LEAD STUDY CONTACT | Kim Woon, 202-493-3383<br>Email: woon.kim@dot.gov | | | |
| CONTRACTOR | | | | |

**BUDGET STATUS**

| FY 2025 MDOT Budget | | | | MDOT Total Budget | | |
|---|---|---|---|---|---|---|
| FY25 FUNDS | (Original) | $15,000.00 | | TOTAL BUDGET | (Original) | $75,000.00 |
| | (Revised) | | | | (Revised) | |
| TOTAL FY 2025 EXPENDITURES | | $15,000.00 | | TOTAL COMMITTED FUNDS AVAILABLE | | $45,000.00 |

**PARTICIPATING STATES**

AR, CO, FHWA, KS, KY, MD, ME, MI, MO, MT, NE, NH, NM, PA, SD, TX, UT, VA

**PURPOSE AND SCOPE**

The goal of this research is to develop reliable estimates of the effectiveness of the safety improvements identified as strategies, including but not limited to, those in the National Cooperative Highway Research Program (NCHRP) Report 500 Guidebooks. These estimates will be determined by conducting scientifically rigorous before-and-after evaluations at sites in the United States where these strategies are being implemented. This work will support efforts towards Vision Zero and the Safe Systems Approach.

**FISCAL YEAR 2024 ACCOMPLISHMENTS**

Held Annual Meeting in Oklahoma City in June. Top safety needs were discussed, in addition to CMF development ideas and SLCI evaluation suggestions. The meeting also included topics on micromobility, motorcycles, MIRE data elements, and emerging topics.

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

Conducted a stakeholder panel meeting in February for new studies on Curb Extensions, Narrow Width Rumble Strips, and Wide Width Pavement markings. Began the gap analyses for all three studies based on literature review and inputs from the stakeholder panel meeting.

**FISCAL YEAR 2026 PROPOSED ACTIVITIES**

- Continue working on data collections for all three studies.
- Conduct a quarterly meeting.
- Draft technical memorandums for data collection plan and feasibility study.
- Begin planning 2026 TAC meeting.

**JUSTIFICATION(S) FOR REVISION(S)**

None.

**SUMMARY OF THE IMPLEMENTATION RECOMMENDATION**

Project expected completion FY 2028.

Michigan Department
Of Transportation
5307 (11/17)

# RESEARCH ADMINISTRATION
# MDOT TRANSPORTATION POOLED FUND STUDY
# ANNUAL REPORT - FISCAL YEAR 2025

STUDY TITLE: Highway Safety Manual 2nd Edition (HSM2) Implementation

FUNDING SOURCE: ☒ FHWA ☐ OTHER (*PLEASE EXPLAIN*)

| | | | | |
|---|---|---|---|---|
| TPF NO. | TPF-5(516) | | MDOT START DATE | 5/02/2023 |
| OR NO. | OR23-203 | | COMPLETION DATE (Original) | 9/30/2027 |
| | | | COMPLETION DATE (Revised) | |
| MDOT TECHNICAL CONTACT | Daniel Garcia, 586-634-7671<br>Email: GarciaD1@Michigan.gov | | | |
| LEAD AGENCY | FHWA | | | |
| LEAD STUDY CONTACT | Sarah Pascual, 202-366-0087<br>Email: sarah.pascual@dot.gov | | | |
| CONTRACTOR | | | | |

**BUDGET STATUS**

| FY 2025 MDOT Budget | | | | MDOT Total Budget | | |
|---|---|---|---|---|---|---|
| FY25 FUNDS | (Original) | $16,000.00 | | TOTAL BUDGET | (Original) | $80,000.00 |
| | (Revised) | | | | (Revised) | |
| TOTAL FY 2025 EXPENDITURES | | $16,000.00 | | TOTAL COMMITTED FUNDS AVAILABLE | | $32,000.00 |

**PARTICIPATING STATES**

AR, CA, FL, IA, ID, KS, KY, LA, MA, MI, MO, MS, NV, NY, OH, PA, TX, UT, VA, WA, WI

**PURPOSE AND SCOPE**

Accelerate implementation of HSM2 and related analytical tools to assess current and future safety performance of existing roadways and alternative designs, and help practitioners make more informed decisions, better target investments, and reduce fatalities and serious injuries on the nation's roadways. This includes activities before and after publication of HSM2 (anticipated 2025).

This study will conduct research and develop products to enable States to accelerate their implementation of HSM2. A Technical Working Group consisting of one representative from each participating agency will help identify and prioritize the specific tasks and products.

**FISCAL YEAR 2023 ACCOMPLISHMENTS**

The solicitation for the HSM2 pooled fund has cleared and the process to transfer funds completed. Planning started for 2024 Peer Exchange in support of HSM 2nd Edition implementation. Activities being coordinated with Highway Safety Manual Implementation TPF-5(255)

**FISCAL YEAR 2024 ACCOMPLISHMENTS**

The fund will have a peer exchange in Louisiana for 2024 during the balloting period of the Second Edition of the Highway Safety Manual. This will allow pooled fund study members to discuss changes and identify implementation needs prior to the final publication of the manual. Each PFS member state could send up to 2 participants. The length will be 3 total days.

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

Holding periodic meetings to provide status updates on the project. The last update meeting was held in August 2025, where various states shared information. A new SharePoint website was created for the group to share information with each other.

**FISCAL YEAR 2026 PROPOSED ACTIVITIES**

- A bi-monthly meeting is scheduled for November 18 (w/Concurrent PFS TPF-5(255)).
- Work will continue on the remaining main tasks on the Advancing Application of DDSA project.
- Lead agency will continue to solicit partner states to add fund commitments to the HSM2 Implementation PFS.

**JUSTIFICATION(S) FOR REVISION(S)**

None.

**SUMMARY OF THE IMPLEMENTATION RECOMMENDATION**

Project expected completion FY 2027.

Michigan Department
Of Transportation
5307 (11/17)

# RESEARCH ADMINISTRATION
# MDOT TRANSPORTATION POOLED FUND STUDY
# ANNUAL REPORT - FISCAL YEAR 2025

STUDY TITLE: Performance Centered Concrete Construction

FUNDING SOURCE: ☒ FHWA ☐ OTHER (*PLEASE EXPLAIN*)

| | | | | |
|---|---|---|---|---|
| TPF NO. | TPF-5(517) | | MDOT START DATE | 5/30/2023 |
| OR NO. | OR23-207 | | COMPLETION DATE (Original) | 9/30/2027 |
| | | | COMPLETION DATE (Est. Revised End Date) | 12/31/2029 |
| MDOT TECHNICAL CONTACT | Chris Byrum, 517-285-7085<br>Email: ByrumC@Michigan.gov | | | |
| LEAD AGENCY | Iowa DOT | | | |
| LEAD STUDY CONTACT | Khyle Clute, 515-239-1646<br>Email: Khyle.Clute@iowadot.us | | | |
| CONTRACTOR | | | | |

**BUDGET STATUS**

| *FY 2025 MDOT Budget | | | | MDOT Total Budget | | |
|---|---|---|---|---|---|---|
| FY25 FUNDS | (Original) | $20,000.00 | | TOTAL BUDGET | (Original) | $100,000.00 |
| | (Revised) | | | | (Revised) | |
| TOTAL FY 25 EXPENDITURES | | $20,000.00 | | TOTAL COMMITTED FUNDS AVAILABLE | | $40,000.00 |

**PARTICIPATING STATES**

CO, IA, ID, KS, MI, MN, MO, ND, NM, OK, PA, WI

**PURPOSE AND SCOPE**

Surveys conducted for the past 5 years indicate that several states have changed or are in the process of changing their specifications in response to the PEM initiative. It is time to consider “what’s next?” The intent of this proposed work is to answer that question.

The fundamental philosophy is unchanged; the ability to specify, measure, and deliver concrete paving mixtures that perform as intended for their design lifetime and beyond. Having the capability to consistently prepare reliable, high-performing mixtures at the batch plant naturally leads to the need to evaluate what happens to the concrete through the stages of transportation, placement, finishing and sawing. Actions between the batch plant and the grade that potentially influence the longevity of a mixture include:

Transport
Handling
Water / admixture addition
Vibration
Finishing / texturing
Curing
Sawing
Opening to traffic
Properties that may be affected by these actions include:

Uniformity
Consolidation
Air void system stability
Durability and strength
Segregation
Smoothness
Cracking
It is intended to follow the previous PEM model to:

Establish a sound understanding of these properties and how they are affected by workmanship
Develop / select appropriate test methods for evaluation at or behind the paver
Select pass / fail criteria
Provide tools for contractors to ensure that compliance is practical
Provide documentation and training resources to encourage agencies and contractors to adopt performance-based specifications reflecting PEM and related construction practices.
The first action will be a brainstorming session with stakeholders, including those engaged in construction and inspection on the grade. The objective will be to review what actions can be taken on the grade that affects sustainable pavement performance, and what data is needed to guide these actions. Tools needed to provide a feedback loop between the batch plant and the paver operator will be

discussed, along with tools that can be used to ensure that the finished concrete will perform satisfactorily with a focus on sustainability, for the design life of the pavement. The work plan will be refined following the brainstorming session.

**FISCAL YEAR 2023 ACCOMPLISHMENTS**

The kickoff meeting was held on August 14, 2023. The meeting started with a review of the previous PEM study. Then an open discussion was held with all members of the study.

Based on this discussion and the survey results, the group identified five primary priorities and one secondary priority for P3C:

- Primary
  - o Curing
  - o Consolidation
  - o Finishing
  - o W/cm
  - o Air
- Secondary
  - o Smoothness

If any and/or all these goals are met/improved it would increase the ride quality, durability, and life of MDOT's concrete pavements. Thus, improving MDOT's transportation system.

**FISCAL YEAR 2024 ACCOMPLISHMENTS**

The lead researcher developed a scope and budget for the pooled fund study. After the review by TAC, the team submitted the scope and budget to Iowa DOT (pooled fund lead state) to get the project under contract. The items listed in the fiscal year 2023 were also detailed out in the scope. The Project was cleared by Federal Highway. Two additional DOTs joined the Pooled Fund study. There was a meeting to detail what the proposed project was going to include for the two additional DOTs.

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

This pooled fund study is an extension of our previous pooled fund study and takes over the new research activities. Funding for the two studies overlap. Work continues on searching for appropriate test methods and researchers knowledgeable in the topics of interest. It is planned to wrap up the literature review and detailed work plan soon. The TAC was not available during the last quarter for a meeting so a new time in the next quarter will be sought. A student has been appointment and is starting on the literature review, focusing on finding tools to measure Curing, Workability, Consolidation, Air void system, and Finishing timing.

**FISCAL YEAR 2026 PROPOSED ACTIVITIES**

Complete work on the literature review.
Initiate lab testing and subcontracts for the selected technologies.

**JUSTIFICATION(S) FOR REVISION(S)**

None.

**SUMMARY OF THE IMPLEMENTATION RECOMMENDATION**

Project expected completion FY 2030.

Michigan Department
Of Transportation
5307 (11/17)

# RESEARCH ADMINISTRATION
# MDOT TRANSPORTATION POOLED FUND STUDY
# ANNUAL REPORT - FISCAL YEAR 2025

STUDY TITLE: Implementation of Structural Data from Traffic Speed Deflection Devices (Continuation)

FUNDING SOURCE: ☒ FHWA ☐ OTHER (*PLEASE EXPLAIN*)

| | | | | |
|---|---|---|---|---|
| TPF NO. | TPF-5(518) | | MDOT START DATE | 5/17/2023 |
| OR NO. | OR24-204 | | MDOT COMPLETION DATE (Original) | 9/30/2027 |
| | | | COMPLETION DATE (Revised) | 9/30/2028 |
| MDOT TECHNICAL CONTACT | Paul Shapter, 517-243-7739<br>Email: Shapterp@Michigan.gov | | | |
| LEAD AGENCY | Virginia DOT | | | |
| LEAD STUDY CONTACT | Brian Diefenderfer, 434-293-1944<br>Email: Brian.Diefenderfer@VDOT.Virginia.gov | | | |
| CONTRACTOR | | | | |

**BUDGET STATUS**

| FY 2025 MDOT Budget | | | | MDOT Total Budget | | |
|---|---|---|---|---|---|---|
| FY25 FUNDS | (Original) | $55,000.00 | | TOTAL BUDGET | (Original) | $220,000.00 |
| | (Revised) | | | | (Revised) | |
| TOTAL FY 2025 EXPENDITURES | | $55,000.00 | | TOTAL COMMITTED FUNDS AVAILABLE | | $110,000.00 |

**PARTICIPATING STATES**

AR, CA, ID, IL, KS, KY, ME, MI, MN, MO, MS, MT, NC, ND, NM, NV, NY, OK, PA, SC, SD, TN, TX, VA, VT, WI, WY

**PURPOSE AND SCOPE**

The objectives of this follow-on pooled fund study include continuation of an existing research consortium that focuses on providing participating agencies guidance on how to specify and implement TSDD data within their respective pavement management systems and processes. Specific tasks within this multi-year program will be developed in cooperation with the partner agencies.

The work plan will be developed based on the priorities indicated by the pooled fund study partner agencies during the kick-off meeting. It is anticipated that the details and scope of the study will be further defined by the partner agencies throughout the life of the study. It is proposed that the project will initially include the following tasks: 1) Develop case studies that document how partner agencies have incorporated pavement structural data into their pavement management processes; 2) Develop analysis procedures to evaluate concrete-surfaced and composite pavements; 3) Develop or summarize ongoing efforts related to TSDD device calibration; 4) Investigate the effect of structural condition on the rate of pavement deterioration; 5) Provide targeted technical assistance to participating agencies for effective use of TSDD data within their specific pavement management system and processes; 6) Develop webinars and training materials for use by the partner agencies to assist with implementation of pavement structural data into their respective pavement management systems.

The technical activities for this study will be led by the Virginia Tech Transportation Institute (VTTI). The Virginia Department of Transportation (VDOT) will serve as the lead agency through its research division, the Virginia Transportation Research Council (VTRC). This collaborative research program will provide an accessible and efficient way for highway agencies and other organizations to evaluate tools and products, conduct research, and coordinate testing, training, and deployment activities to enhance the life-cycle performance of their pavement assets. Consortium participants will have access to extensive sources of data, information, and knowledge and decide on the focus of the study and the specific research projects carried out by the consortium. The benefit-cost ratio will be very significant because the cost of the different projects will be shared by a group of participants.

**FISCAL YEAR 2024 ACCOMPLISHMENTS**

- Traffic speed deflectormeter data was collected on Michigan state trunklines. Data analyzes during 2024. The raw data along with the analyzed data will be delivered to MDOT for its use and records.
- Attend remote pool fund annual symposium.
- Develop route(s) for additional collection.
- The delivered data will assist in MDOTs project program planning, recommendations, and investigation(s). The data will help reduce construction costs and traffic delays.

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

- Continued work on the QA/QC procedures
  - Started developing a software application to automate QA/QC procedures for TSDD measurements
- Reviewed the proposed solution by ARRB Systems to correct the calibration error of TSD measurements
  - Organized a webinar to inform the pooled fund members of the issue and the proposed solution (on 05/14/2025)
- Finalized the plans for the 4th Symposium on TSDDs
  - Date: September 16 and 17, 2025
  - Location: Alexandria, Virginia
  - Organized a webinar with pooled fund members to discuss conference registration and travel reimbursements
  - Solicited from pooled fund members and industry a request to present at the Symposium
- Started work on the TSD verification report (Phase I to IV of the work performed)
- Organized a meeting with pooled fund members to vote on the purchase of a Laser Doppler Vibrometer (LDV) to be used for verification efforts of the TSD
- Developed a list of routes to perform TSD repeated testing in Virginia
- Finalized the RFQ

**FISCAL YEAR 2026 PROPOSED ACTIVITIES**

- Finalize the TSD verification report (Phase I to IV of the work performed).
- Finalize the TSD QA/QC data collection report.
- Evaluate the responses to the RFQ (for TSDD data collection) and present the results to the technical panel. Share technical panel results with pooled fund members and vendors that submitted a response to the RFQ.
- Perform verification of the RoadRunner TSDD at the Virginia Smart Road in early October.
- Review data of repeated testing.
- Prepare for the pooled fund meeting on Thursday January 11, 2026.

**JUSTIFICATION(S) FOR REVISION(S)**

None.

**SUMMARY OF THE IMPLEMENTATION RECOMMENDATION**

Project expected completion FY 2028.

Michigan Department
Of Transportation
5307 (11/17)

# RESEARCH ADMINISTRATION
# MDOT TRANSPORTATION POOLED FUND STUDY
# ANNUAL REPORT - FISCAL YEAR 2025

STUDY TITLE: National Partnership to Improve the Quality of Pavement Preservation Treatment Construction & Data Collection Practices (PG Phase III)

FUNDING SOURCE: ☒ FHWA ☐ OTHER (*PLEASE EXPLAIN*)

| | | | | |
|---|---|---|---|---|
| TPF NO. | TPF-5(522) | | MDOT START DATE | 8/07/2023 |
| OR NO. | OR24-205 | | MDOT COMPLETION DATE (Original) | 9/30/2027 |
| | | | COMPLETION DATE (Revised) | 12/31/2028 |
| MDOT TECHNICAL CONTACT | Tyler Hunt, 517-256-9592<br>Email: HuntT2@Michigan.gov | | | |
| LEAD AGENCY | Minnesota DOT | | | |
| LEAD STUDY CONTACT | Joel Ulring, 651-366-5432<br>Email: joel.ulring@state.mn.us | | | |
| CONTRACTOR | | | | |

**BUDGET STATUS**

| FY 2025 MDOT Budget | | | | MDOT Total Budget | | |
|---|---|---|---|---|---|---|
| FY25 FUNDS | (Original) | $50,000.00 | | TOTAL BUDGET | (Original) | $200,000.00 |
| | (Revised) | | | | (Revised) | |
| TOTAL FY 2025 EXPENDITURES | | $50,000.00 | | TOTAL COMMITTED FUNDS AVAILABLE | | $100,000.00 |

**PARTICIPATING STATES**

AK, AL, AR, CO, DE, FHWA, ID, IL, KS, MD, MI, MN, MO, MS, NC, ND, NM, NY, SC, TX, WA, WI

**PURPOSE AND SCOPE**

This pooled-fund study is being developed to assist SHAs and LPAs in reviewing and developing pavement PM treatments which can advance their pavement preservation programs. This study also supplements ongoing data analysis of existing pavement test sections in Minnesota (NRRA-MnROAD) and Alabama (NCAT) and support continued implementation activities established. Combining these efforts will establish a national construction and data collection effort of pavement PM treatments applied to roadways at the direction of the study's Technical Advisory Committee (TAC). Participation in the study is being encouraged by SHAs, LPAs, FHWA, Federal Lands Highway Division, academia and industry representatives. Collaboration with experts from these groups will help set criteria for identifying PM construction practices and data collection requirements, discuss optimal timing for placing of PM treatments and establishing the minimum number of pavement sections required for each type of PM treatment used for statistical analysis. Non-financial participants can provide technical knowledge and input; however, financial contributors will make final decisions on treatments to be constructed.

Using the outcome from the above collaborative activities, the study partners will initiate and monitor State, local, and Federal PM treatments and projects to develop preventive maintenance solutions (i.e. decision trees, toolboxes, etc.). Implementation of practical research results from other PM cooperative projects (i.e. NCAT, MnROAD, NCPP) will be used to assess the impact of preventive maintenance treatments on extending service life of pavements. Lessons learned will be documented and shared along with information to assist in the updating of the national pavement preservation research roadmap.

The scope of this project consists of several tasks including project administration, identifying selecting pavement sections/projects, constructing PM test sections incorporating established AASHTO standards to validate and verify existing construction practices. The tasks of this study will build off the success of previous pavement preservation pooled fund projects PG1 TPF-5(267), & PG2 TPF-5(375).

The intent of the study is to assist SHAs, LPAs and Federal Lands by developing guidance and design methods. With assistance from the SHAs, the TAC will develop the scope of work for the study. It will also provide the technical knowledge and oversight of the construction and data gathering for the projects.

**FISCAL YEAR 2024 ACCOMPLISHMENTS**

Task 1 -
Begin identifying, updating, and/or drafting project documentation forms. All LTPP data forms were collected and reviewed. Specific PG3 items included Project Nomination form (online), Project flowchart, and Chip Seal Construction field data form.

Task 5 -
Held the initial TAP Kickoff meeting on March 1. Most of the participating states attended, and their respective project contact representatives were identified.

- Starting March 8, held weekly "Touch Point" meetings with the MnDOT and NCAT leads.

- Worked out the logistics to have the second annual in person TAP meeting in conjunction with the Rocky Mountain West Pavement Preservation Partnership Meeting in November in Sacramento, CA.

Task 6 -
In preparation for the May 2024 TAP Meeting, conducted and performed planning and logistical activities that included the following:
- Procured and finalized the lodging contract.
- Coordinated with NCAT to procure a meeting facility.
- Coordinated with NCAT to procure registration for TAP Panel Members attending the NCAT Annual Meeting.
- Communicated meeting details to TAP Members and attendees.
- Made Travel Arrangements (i.e. flights, rental cars, lodging, etc.).
- Set up alternative virtual options for participation.
- Performed miscellaneous associated tasks including correspondence and documentation.

NCAT

Task 1 –
Performance data collection and analysis of existing sections continued following the same process established during Phases I and II of the study.

Task 2 –
Worked with MnDOT and NCPP to develop project nomination and construction data forms.

Task 5 –
Performed an update to the online tool for visualization of performance results of existing test sections.
Coordinated with NCPP to organize an in-person TAP meeting in conjunction with the NCAT Test Track Conference.

BENEFITS:
MOT will benefit from all deliverables, especially the NCAT and MnROAD test track data. This allows numerous test sections to be performed on one road network without each state needing to perform its own testing. This allows for economies of scale and MDOT benefits from the large research resources available in Auburn and Minnesota that would not be practical for the small MDOT CPM staff to perform in house.

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

Task 1 –
Provided technical support for the following participating agency projects:
- Mississippi DOT Scrub Cape Seal
- Project Pre Con April 2
- Project training for DOT and contractor staff May 8
- North Carolina DOT Spray Applied Rejuvenator
- Meeting with project personnel April 4
- Project training pre-meeting June 10 ▪ Project training for DOT staff June 12
- Idaho DOT – RAP Chip Seal ▪ Specification comments April 4
- Project training scheduled for July 18
- Delaware DOT – Micro Surfacing ▪ Specification comments April 9
- Michigan DOT – Variations on Mill/Fill with Chip Seal ▪ Specification comments April 22 ▪ Note MDOT has pulled this project nomination, will submit a new project for 2026
- Construction form review and update for thin HMA, UBWC, Milling, Patching and Crack Sealing

Task 2 –
Mississippi DOT onsite support for scrub seal test cell construction. Performed testing on pretreatment cores.

Task 4 –
Pavement Preservation Journal article for Fall 2025 edition was drafted. PG3 update provided to Emulsion Task Force by Joel Ulring and completed PG3 Website updates, including State Project Nomination Map and March TAP meeting information

Task 5 –
Weekly “Touch Point” meetings were conducted with the MnDOT leads and NCAT PI on April 4, April 11, May 2, May 9, May 23, May 28, June 13, June 20, and June 27, respectively. Coordinated planning for virtual TAP meeting held July 23 and in-person meeting September 18. Submitted article for Pavement Preservation Journal, Summer issue.

Task 6 –
Finalized processing of travel reimbursements for March 2025 TAP Meeting and submitted financial information on total meeting travel costs to MN DOT for payment. Communicated meeting details with TAP Members for September Fall 2024 TAP Meeting, worked with Doubletree for room layout and catering, and prepared miscellaneous and associated correspondence.

| FISCAL YEAR 2026 PROPOSED ACTIVITIES |
| --- |
| NCPP:<br>Complete project nominations.<br>Work with states to provide technical support for post construction activities.<br>Finalize and submit Pavement Preservation Journal Article for Winter issue<br>Prepare for next virtual TAP meeting January 2026.<br><br>NCAT:<br>Continue data collection and analysis of existing sections.<br>Perform testing on pretreatment cores from Minnesota DOT and asphalt mixture from Idaho DOT.<br>Continue to assist with planning and participate in TAP meetings (online and in-person). Present research findings at RMWPPP meeting and Missouri Asphalt Conference.<br>Deploy new tool for preservation treatment selection and LCCA. |
| **JUSTIFICATION(S) FOR REVISION(S)** |
| None. |
| **SUMMARY OF THE IMPLEMENTATION RECOMMENDATION** |
| Project expected completion FY 2029. |

Michigan Department
Of Transportation
5307 (11/17)

# RESEARCH ADMINISTRATION
# MDOT TRANSPORTATION POOLED FUND STUDY
# ANNUAL REPORT - FISCAL YEAR 2025

STUDY TITLE: Building Information Modeling (BIM) for Bridges and Structures - Phase II

FUNDING SOURCE: ☒ FHWA ☐ OTHER (*PLEASE EXPLAIN*)

| | | | | |
|---|---|---|---|---|
| TPF NO. | TPF-5(523) | | MDOT START DATE | 12/01/2023 |
| OR NO. | OR24-203 | | MDOT COMPLETION DATE (Original) | 9/30/2028 |
| | | | COMPLETION DATE (Revised) | 1/31/2029 |
| MDOT TECHNICAL CONTACT | Brad Wagner, 517-256-6451<br>Email: WagnerB@Michigan.gov | | | |
| LEAD AGENCY | Iowa DOT | | | |
| LEAD STUDY CONTACT | Khyle Clute, 515-239-1646<br>Email: Khyle.Clute@iowadot.us | | | |
| CONTRACTOR | | | | |

## BUDGET STATUS

| FY 2025 MDOT Budget | | | | MDOT Total Budget | | |
|---|---|---|---|---|---|---|
| FY25 FUNDS | (Original) | $15,000.00 | | TOTAL BUDGET | (Original) | $100,000.00 |
| | (Revised) | | | | (Revised) | |
| TOTAL FY 2025 EXPENDITURES | | $15,000.00 | | TOTAL COMMITTED FUNDS AVAILABLE | | $60,000.00 |

## PARTICIPATING STATES

AL, CA, DE, FL, GA, IA, IL, IN, MI, MN, MO, MS, MT, NC, NE, NY, OH, OK, PA, TX, UT, VT, WA, WI

## PURPOSE AND SCOPE

This pooled fund project will provide the primary mechanism for AASHTO COBS T-19 to expand and refine the outcomes of TPF-5(372) and developing additional guide specifications for open BIM national data standards to support model-based exchanges of workhorse bridges.

Major tasks in this scope of work include:

1. Based on the BIM uses prioritized under TPF-5(372), develop national standards for data definitions, requirements and validation tools for the bridge life cycle for multiple data exchanges for transportation bridges and structures. These national standards are to follow building SMART open BIM requirements.
2. Develop training materials to continue deployment of the outcomes from TPF-5(372) and additional data standards developed under this project.
3. Provide technical support, organize training workshops, and facilitate pilot/demonstration projects for bridge owners to encourage and accelerate the adoption of BIM for Bridges and Structures.
4. Assist AASHTO members with collaboration efforts with the AASHTO Joint Subcommittee on Data Standardization, FHWA, the Transportation Research Board, and other transportation pooled funds.
5. Collaborate with building SMART and software vendors.
6. Collect and quantify the benefits of using the IFC standard per the methodology suggested in TPF-5(372).
7. Explore technology or tools to enable secure mechanisms for signing and sealing model-based deliverables.
8. Conduct a literature search on contractual provisions for digital model-based delivery and develop recommendations for a national framework.
9. Investigate opportunities to improve existing workflows to leverage model exchanges for the bridge lifecycle.

## FISCAL YEAR 2024 ACCOMPLISHMENTS

The project officially began in December of 2023; however, work didn't start until March/April of 2024, due to efforts to finalize TPF-5(372).

Work began on Task 1" Development of Open Data Standards". A significant amount of effort was expended to formalize a methodology for future development with BuildingSmart International. A recommendation memo was delivered and approved by the pooled fund.
Additionally, efforts were spent to prioritize data exchanges for development by the pooled fund team. Several exchanges were prioritized, including As- Built and Fabrication. Lastly, the study team developed draft recommendations for training outlines and shared for pooled fund members' review.

## FISCAL YEAR 2025 ACCOMPLISHMENTS

During FY 2025, the team focused on software vendor engagement, development of prioritized data exchanges, and support for state DOTs' project pilots. Example training templates were completed. Several construction related exchanges were prioritized, incorporating MDOT input, and a subgroup has been established (with MDOT participation) for the fabrication exchange. The pooled fund also worked to update the phase 1 deliverables as they were implemented to support DOT model delivery projects.

| FISCAL YEAR 2026 ACCOMPLISHMENTS |
| --- |
| Develop refinements to the design-to-construction IDS and other work products based on feedback from State DOT pilot projects<br>Continue with efforts for the fabrication detail exchange<br>Continue coordination with State DOT pilot projects on use of TPF-5(372) outcomes<br>Solicit DOT participants for the Technical Working Group and conduct kickoff activities |
| **JUSTIFICATION(S) FOR REVISION(S)** |
| None. |
| **SUMMARY OF THE IMPLEMENTATION RECOMMENDATION** |
| Project expected completion FY 2029. |

Michigan Department
Of Transportation
5307 (11/17)

# RESEARCH ADMINISTRATION
# MDOT TRANSPORTATION POOLED FUND STUDY
# ANNUAL REPORT - FISCAL YEAR 2025

STUDY TITLE: Mid-America Association of State Transportation Officials (MAASTO) Connected Automated Vehicle (CAV) Steering Committee

FUNDING SOURCE: ☒ FHWA ☐ OTHER (*PLEASE EXPLAIN*)

| | | | |
|---|---|---|---|
| TPF NO. | TPF-5(532) | MDOT START DATE | 6/11/2024 |
| OR NO. | OR23-309 | MDOT COMPLETION DATE (Original) | 9/30/2028 |
| | | COMPLETION DATE (Revised) | |
| MDOT TECHNICAL CONTACT | Jason Bodell, 989-370-1526<br>Email: BodellJ@Michigan.gov | | |
| LEAD AGENCY | Michigan Department of Transportation | | |
| LEAD STUDY CONTACT | Andre Clover, 517-749-9001<br>Email: CloverA@Michigan.gov | | |
| CONTRACTOR | | | |

**BUDGET STATUS**

| FY 2025 MDOT Budget | | | MDOT Total Budget | | |
|---|---|---|---|---|---|
| FY25 FUNDS | (Original) | $60,000.00 | TOTAL BUDGET | (Original) | $150,000.00 |
| | (Revised) | | | (Revised) | |
| TOTAL FY 2025 EXPENDITURES | | $60,000.00 | TOTAL COMMITTED FUNDS AVAILABLE | | $90,000.00 |

**PARTICIPATING STATES**

IA, IL, IN, KS, KY, MI, MN, MO, OH, WI

**PURPOSE AND SCOPE**

As connected/automated vehicle (CAV) technology and cooperative/automated transportation (CAT) sectors advance, several states have established programs or designated staff to plan and prepare for the changes these technologies bring to transportation. The objective of this study is to provide as needed engineering and/or technical support services for the research, development, deployment, operations, and maintenance of CAV technology, along with advancing various CAV related initiatives. The Mid-America Association of State Transportation Officials (MAASTO) Board unanimously nominated MDOT to lead this initiative to support a collaborative research and project consortium on the topic of CAV technology that will focus on a common direction for the participating states in the Region with consideration for shared values of safety, sustainability, equity, and mobility.

As lead agency, MDOT will perform the program's required administrative duties and tasks, in compliance with the federal program's administrative regulations/laws and guidance.

Committee Major Tasks:

- Develop a CAV regional strategy.
- Direct and guide collaborative information sharing among the member states.
- Review/assess past and present research and testing partnerships and active pooled fund projects, relating to CAV technologies.
- Uniform polices and laws.
- Outreach and education.
- Coordinated policy and pilot projects.
- Organizational alignment and coordination.
- Establishing the "Midwest" region as a leader in CAV.
- A unified vision for CAV.

**FISCAL YEAR 2023 ACCOMPLISHMENTS**

Still under solicitation. The proposed project target budget has not been reached with pledge commitment. Thus, FHWA approval is still pending.

**FISCAL YEAR 2024 ACCOMPLISHMENTS**

FHWA project approval/assign TPF federal project number and partners transfer funds to lead agency to secure a research vendor.

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

Request for Proposal (RFP) was posted for the as-needed consultant RFP to support the actions of the pooled fund study. Five vendors were selected to support actions in all 10 states. Contracting is underway and currently working on the initial actions to be taken to move committee efforts forward. These efforts include but are not limited to the refinement of the regional strategy into a short-term implementation plan and collaborative information sharing for two focus groups surrounding data sharing and community outreach.

| FISCAL YEAR 2026 PROPOSED ACTIVITIES |
| --- |
| Continue to secure the recommended selected vendors under contract. |
| **JUSTIFICATION(S) FOR REVISION(S)** |
| None. |
| **SUMMARY OF THE IMPLEMENTATION RECOMMENDATION** |
| Project expected completion FY 2028. |

Michigan Department
Of Transportation
5307 (11/17)

# RESEARCH ADMINISTRATION
# MDOT TRANSPORTATION POOLED FUND STUDY
# ANNUAL REPORT - FISCAL YEAR 2025

STUDY TITLE: Phase II: Continuous Asphalt Mixture Compaction Assessment using Density Profiling System (DPS)

FUNDING SOURCE: ☒ FHWA ☐ OTHER (*PLEASE EXPLAIN*)

| | | | | |
|---|---|---|---|---|
| TPF NO. | TPF-5(538) | | MDOT START DATE | 8/12/2024 |
| OR NO. | OR25-209 | | MDOT COMPLETION DATE (Original) | 9/30/2028 |
| | | | COMPLETION DATE (Revised) | |
| MDOT TECHNICAL CONTACT | Fawaz Kaseer, 517-599-1498<br>Email: KaseerF@Michigan.gov | | | |
| LEAD AGENCY | Minnesota Department of Transportation | | | |
| LEAD STUDY CONTACT | Kyle Hoegh<br>Email: kyle.hoegh@state.mn.us | | | |
| CONTRACTOR | | | | |

**BUDGET STATUS**

| FY 2025 MDOT Budget | | | | MDOT Total Budget | | |
|---|---|---|---|---|---|---|
| FY25 FUNDS | (Original) | $25,000.00 | | TOTAL BUDGET | (Original) | $100,000.00 |
| | (Revised) | | | | (Revised) | |
| TOTAL FY 2025 EXPENDITURES | | $25,000.00 | | TOTAL COMMITTED FUNDS AVAILABLE | | $75,000.00 |

**PARTICIPATING STATES**

AK, FHWA, GA, IA, ID, MD, ME, MI, MN, MO, MS, ND, NY, OH, UT, WA, WI

**PURPOSE AND SCOPE**

The density of an asphalt pavement after construction is a key indicator of its durability and ability to withstand traffic demands in the coming years. Achieving desired and consistent pavement density can have a tremendous impact on pavement life, with small differences having major cost implications for future maintenance, repair, and reconstruction. Drilling and testing core samples remains a common method for testing density, but such spot checks are time intensive, damage the pavement, and cannot accurately represent the density of the entire paved area. A promising alternative is the dielectric profiling system (DPS), sometimes referred to as a density profiling system, which uses noninvasive ground-penetrating technology at the pavement's surface to measure and report the density of the area in real-time, continuously and completely. However, while the science is sound, many questions stand as barriers to the deployment of DPS in the field. To develop DPS into an effective and efficient technology that can be put into practice, the Transportation Pooled Fund study TPF-5(443) was initiated in 2020, funded by the lead organization, the Minnesota Department of Transportation (DOT), 13 additional state DOTs and FHWA. This pooled fund study undertook research and study in seven task areas: (1) software and hardware improvements; (2) development of AASHTO data collection and analysis specification; (3) precision and bias testing; (4) equipment and operator certification; (5) support communications; (6) training and technical assistance; and (7) promotion of DPS technology. Representatives from national and state transportation agencies, academia, and industry provided study guidance and oversight over findings, as documented at: https://www.dot.state.mn.us/materials/dps/, and together moved this technology forward by determining barriers to the implementation of DPS for field measurement and acceptance, as well as tools and paths to overcome these barriers. Lab and field full-scale testing were expanded to include simulation work by the FHWA nondestructive evaluation lab at Turner Fairbanks that shows promise in defining optimal conditions and best use of DPS technology. Near the end of the pooled fund study, which is scheduled to conclude in late 2024, participants in an informal poll unanimously agreed that a second phase of the study is needed to complete the study's mission with emphasis on assisting states in implementation.

MDOT borrowed the DPS unit from the FHWA Equipment Loan Program and tested the DPS technology on six projects in 2022 and on 19 projects in 2023. DPS test results were encouraging, and positive feedback was received from MDOT's construction team and contractors. Therefore, MDOT is considering another round of testing during the 2024 construction season (pending unit availability from FHWA) to test more projects and validate the DPS accuracy in measuring the asphalt layer density. MDOT is interested in working and sharing knowledge with other agencies, and in acquiring more data, particularly to cover all the standard MDOT hot mix asphalt mixes, before considering this technology for implementation.

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

In 2024, the Michigan Department of Transportation (MDOT) officially joined the TPF-5(538) Phase II: Continuous Asphalt Mixture Compaction Assessment using the Density Profiling System (DPS) pooled fund study.

As part of this effort, MDOT participated in the TPF-5(443) Phase I wrap-up virtual meeting on March 20, 2025. Although MDOT was not a participant in Phase I, this meeting provided valuable context and preparation for Phase II involvement. The discussion included an overview of Phase I accomplishments, a recap of previously identified priorities, and a detailed exchange on Phase II goals and research directions, all of which informed MDOT's ongoing DPS initiatives.

MDOT also participated in the Phase II kickoff meeting held virtually on April 18, 2025, which introduced the proposed workplan, highlighted DPS technology capabilities, and facilitated collaboration among participating agencies. In addition, MDOT attended a Phase II update meeting on August 9, 2025, where participants heard recent updates from NYSDOT and MnDOT on their DPS testing efforts and proposed revisions to standard specifications for using DPS in QA/QC acceptance.

Concurrently, MDOT collected its own DPS data during the 2025 construction season on the two I-96 reconstruction projects in Howell and Ionia, complementing data previously obtained in 2024 from the US-127 project. MDOT plans to present the results of this work at the TRB DPS webinar in December 2025 and at the TRB Annual Meeting workshop in January 2026, contributing valuable field-based insights to the pooled fund study and the broader pavement materials community.

**FISCAL YEAR 2026 PROPOSED ACTIVITIES**

Continue Aurora website updates.
Continue working with venue to facilitate future meetings and conference calls.
Continue monthly Board meeting calls.
Schedule and host project meetings for existing and new projects.
Track project status and timelines.

- Edit and publish pertinent final reports and technology transfer information.

**JUSTIFICATION(S) FOR REVISION(S)**

None.

**SUMMARY OF THE IMPLEMENTATION RECOMMENDATION**

Expected project completion FY 2028.

Michigan Department
Of Transportation
5307 (11/17)

# RESEARCH ADMINISTRATION
# MDOT TRANSPORTATION POOLED FUND STUDY
# ANNUAL REPORT - FISCAL YEAR 2025

STUDY TITLE: Aurora Program (FY25-FY29)

FUNDING SOURCE: ☒ FHWA ☐ OTHER (*PLEASE EXPLAIN*)

| | | | |
|---|---|---|---|
| TPF NO. | TPF-5(543) | MDOT START DATE | 1/02/2025 |
| OR NO. | OR25-206 | MDOT COMPLETION DATE (Original) | 12/31/2029 |
| | | COMPLETION DATE (Revised) | |
| MDOT TECHNICAL CONTACT | James Roath, 517-230-5361<br>Email: RoathJ1@Michigan.gov | | |
| LEAD AGENCY | Iowa Department of Transportation | | |
| LEAD STUDY CONTACT | Khyle Clute, 515-239-1646<br>Email: Khyle.Clute@iowadot.us | | |
| CONTRACTOR | | | |

**BUDGET STATUS**

| FY 2025 MDOT Budget | | | MDOT Total Budget | | |
|---|---|---|---|---|---|
| FY25 FUNDS | (Original) | $25,000.00 | TOTAL BUDGET | (Original) | $125,000.00 |
| | (Revised) | | | (Revised) | |
| TOTAL FY 2025 EXPENDITURES | | $25,000.00 | TOTAL COMMITTED FUNDS AVAILABLE | | $100,000.00 |

**PARTICIPATING STATES**

AK, AZ, CA, CO, DE, IA, IL, KS, ME, MI, MN, MO, ND, OH, PA, UT, WI

**PURPOSE AND SCOPE**

A CONTINUATION OF TPF-5(435) AURORA PROJECT

The Aurora program is a partnership of highway agencies that began in 1996 to collaborate on research, development, and the deployment of Road Weather Information Systems (RWIS) to improve the efficiency, safety, and reliability of surface transportation. It is managed by the Center for Weather Impacts on Mobility and Safety (CWIMS) which is housed under InTrans at Iowa State University. Aurora's initiatives are funded by member agencies to conduct research that services the needs of its members. The board meets twice each year to set the agenda for RWIS research, keep informed about progress on program initiatives, and discuss solutions for common in the field problems. Newly selected initiatives are led by "champion" member agencies, managed by committees of Aurora members.

Aurora works closely with the Federal Highway Administration (FHWA), having been approved for federal-aid research and development funds without state match using 100% SPR funding. Aurora also has a strong relationship with the American Association of State Highway Transportation Officials (AASHTO) and its Snow and Ice Pooled Fund Cooperative Program (SICOP). In addition, Aurora coordinates with the American Meteorological Society (AMS), the National Severe Storm Laboratory, ITS America, Clear Roads, and the National Center for Atmospheric Research (NCAR). Aurora also works closely with industry as initiated by each participating entity.

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

Project: Optimal RWIS Sensor Density and Location-Phase 4

Project: Automating Variable Speed Limits Using Weather, Traffic Data Project: Standardized Framework for Winter Weather Road Condition Indices
Project: An Intelligent Human-Centric Communication System for Adverse Weather and Road Conditions
Project: Roadway Friction Forecasting using Stationary and Mobile Friction Data

Continue monthly Board meeting calls.
Continue to communicate with new Aurora representatives.
Seek additional project ideas from members. Gather and distribute project ideas to members.
Continue to hold project-related meetings.
Collaborate and facilitate addressing project needs, relating to scope and/or budget changes, that may arise.

Meetings and Conferences: Board member monthly conference calls

- Financials • Membership
- Submitted ideas
- Additional solicitation Spring 2025 Meeting location was Anchorage, Alaska. Fall 2025 Meeting location was Minneapolis, Minnesota and will be a peer exchange between Aurora, Clear Roads, and AASHTO.

| FISCAL YEAR 2026 PROPOSED ACTIVITIES |
| --- |
| Continue Aurora website updates.<br>Continue working with venue to facilitate future meetings and conference calls.<br>Continue monthly Board meeting calls.<br>Schedule and host project meetings for existing and new projects.<br>Track project status and timelines.<br>Edit and publish pertinent final reports and technology transfer information. |
| **JUSTIFICATION(S) FOR REVISION(S)** |
| None. |
| **SUMMARY OF THE IMPLEMENTATION RECOMMENDATION** |
| Project expected completion FY 2030. |

Michigan Department
Of Transportation
5307 (11/17)

# RESEARCH ADMINISTRATION
# MDOT TRANSPORTATION POOLED FUND STUDY
# ANNUAL REPORT - FISCAL YEAR 2025

STUDY TITLE: Technology Transfer Concrete Consortium (FY25-FY29)

FUNDING SOURCE: ☒ FHWA ☐ OTHER (*PLEASE EXPLAIN*)

| | | | | |
|---|---|---|---|---|
| TPF NO. | TPF-5(544) | | MDOT START DATE | 1/02/2025 |
| OR NO. | OR25-210 | | MDOT COMPLETION DATE (Original) | 12/31/2029 |
| | | | COMPLETION DATE (Revised) | |
| MDOT TECHNICAL CONTACT | Chris Byrum, 517-285-7085<br>Email: ByrumC@Michigan.gov | | | |
| LEAD AGENCY | Iowa DOT | | | |
| LEAD STUDY CONTACT | Khyle Clute, 515-239-1646<br>Email: Khyle.Clute@iowadot.us | | | |
| CONTRACTOR | Iowa State University | | | |

**BUDGET STATUS**

| FY 2025 MDOT Budget | | | | MDOT Total Budget | | |
|---|---|---|---|---|---|---|
| FY25 FUNDS | (Original) | $12,000.00 | | TOTAL BUDGET | (Original) | $60,000.00 |
| | (Revised) | | | | (Revised) | |
| TOTAL FY 2025 EXPENDITURES | | $12,000.00 | | TOTAL COMMITTED FUNDS AVAILABLE | | $48,000.00 |

**PARTICIPATING STATES**

AL, CA, CO, FL, GA, IA, ID, IL, IN, KS, KY, MA, MI, MN, MO, MT, NC, ND, NE, NY, OH, OK, OR, PA, SC, SD, TN, TX, UT, VT, WI, WV, WY

**PURPOSE AND SCOPE**

State Departments of Transportation (DOTs) are challenged to design and build longer life concrete pavements that result in a higher level of user satisfaction for the public. One of the strategies for achieving longer life pavements is to use innovative materials and construction optimization technologies and practices. To foster new technologies and practices, experts from state DOTs, Federal Highway Administration (FHWA), academia and industry must continue collaborating to identify and examine new concrete pavement research initiatives. The purpose of this pooled fund project is to identify, support, facilitate, and fund concrete research and technology transfer initiatives. This consortium would become the national forum for state involvement in the technical exchange needed to collaborate and implement new initiatives in providing tactical strategies and solutions to address issues identified by the member states.

- Identify and guide the development and funding of technology transfer materials
- Providing research ideas to funding agencies
- Identify and instigate the need for research projects
- Post updates to the CP Tech Center website of the current activities and deliverables of the pooled fund
- Maintain the pooled fund project website with current activities and deliverables
- Maintain the TTCC pooled fund listserv
- Track TTCC listserv posted problems and discussions and categorized them for inclusion in a library on the project website
- Act as a technology exchange forum for the participating entities
- Contribute to a technology transfer newsletter on concrete pavement research activities every six months
- Submit quarterly electronic reports of the pooled fund project activities and expenditures.

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

This pooled fund is an extension of the previous pooled fund TPF-5(437).

Held periodic meetings, tracked progress of work plan, provided administrative contract oversight, tracked work progress, etc. Planned the Spring Meeting held in Rosemont (Chicago), April 8-10, 2025, made meeting arrangements, prepared and tracked/documented travel costs, etc. Planned anticipated research activities for future quarters. Also planned the Fall meeting held in Springfield, Mass., Sept. 9-11. Published MAP Brief: Utilizing the Maturity Method for Early Opening of Concrete Pavements.

**FISCAL YEAR 2026 PROPOSED ACTIVITIES**

- Plan future Board meetings.
- Publishing MAP Brief
- Continue monitoring/tracking project updates and budget/expenditure information.

**JUSTIFICATION(S) FOR REVISION(S)**

None.

**SUMMARY OF THE IMPLEMENTATION RECOMMENDATION**

Project expected completion FY 2030.

Michigan Department
Of Transportation
5307 (11/17)

# RESEARCH ADMINISTRATION
# MDOT TRANSPORTATION POOLED FUND STUDY
# ANNUAL REPORT - FISCAL YEAR 2025

STUDY TITLE: Smart Work Zone Deployment Initiative (FY25-FY29)

FUNDING SOURCE: ☒ FHWA ☐ OTHER (*PLEASE EXPLAIN*)

| | | | | |
|---|---|---|---|---|
| TPF NO. | TPF-5(545) | | MDOT START DATE | 1/02/2025 |
| OR NO. | OR25-211 | | MDOT COMPLETION DATE (Original) | 12/31/2029 |
| | | | COMPLETION DATE (Revised) | |
| MDOT TECHNICAL CONTACT | Chris Brookes, 517-242-6486<br>Email: BrookesC@Michigan.gov | | | |
| LEAD AGENCY | Iowa DOT | | | |
| LEAD STUDY CONTACT | Khyle Clute, 515-239-1646<br>Email: Khyle.Clute@iowadot.us | | | |
| CONTRACTOR | Iowa State University | | | |

**BUDGET STATUS**

| FY 2025 MDOT Budget | | | | MDOT Total Budget | | |
|---|---|---|---|---|---|---|
| FY25 FUNDS | (Original) | $25,000.00 | | TOTAL BUDGET | (Original) | $125,000.00 |
| | (Revised) | | | | (Revised) | |
| TOTAL FY 2025 EXPENDITURES | | $25,000.00 | | TOTAL COMMITTED FUNDS AVAILABLE | | $100,000.00 |

**PARTICIPATING STATES**

AK, GA, IA, IL, KS, MI, MN, MO, NE, PA, TX, WI

**PURPOSE AND SCOPE**

MDOT participation in this Pooled Fund Study would allow us to take part in conversations with other state DOTs to address high priority issues related to work zone safety and mobility. This participation would put us in contact with vendors providing commercial products for evaluation and allow us to innovate and increase safety within the work zone year-round. Technology advancements have necessitated a nationwide discussion on Smart or Connected Work Zones to enhance safety and was instrumental in the creation of a MDOT and Industry Joint Work Zone Safety Task Force which demonstrates our continued support of these initiatives.
MDOT participation in this pooled fund study would allow us an opportunity to advocate for technologies that best fit with our current tools and platforms. Also, with MDOT as a contributing partner, Michigan universities would be allowed to submit proposals in response to Request for Proposal (RFP) solicitations prepared by the Technical Advisory Committee (TAC) members.

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

During the 2025 fiscal year, the Development of an Analytical Tool for Work Zone Performance report was completed.

The following research projects are ongoing:

| Project Title | Principal Investigator | University |
|---|---|---|
| The Effect of Nighttime Lighting Systems on Workers' Visibility and Safety | Chun-Hsing Ho | University of Nebraska - Lincoln |
| Mobility and Safety Impacts of Work Zone Lane and Shoulder Widths – Part 2 | Madhav Chitturi | University of Wisconsin - Madison |
| Traffic Control for Work Zones in Alternative Intersections | Henry Brown | University of Missouri - Columbia |
| Improving Work Zone Management and Safety through AI-Powered Connected Vehicle Data Analysis | Anuj Sharma | Iowa State University |

For the 2026 fiscal year the following problem statements have been developed and are posted.

- TPF5(545)
- Evaluation of Expanded Uses of Residential Driveway Temporary Signals (RDTS): Turn Lane -Volumes and Storage (Restriction Applies. Review RFP for additional information)
- Evaluation of Positive Protection in Work Zones (Restriction Applies. Review RFP for additional information)

| FISCAL YEAR 2026 PROPOSED ACTIVITIES |
| --- |
| Ranking topics of problem statement requests.<br>Advance cooperative work across various specific topic areas with available pooled funds. |
| **JUSTIFICATION(S) FOR REVISION(S)** |
| None. |
| **SUMMARY OF THE IMPLEMENTATION RECOMMENDATION** |
| Project expected completion FY 2030. |

Michigan Department
Of Transportation
5307 (11/17)

# RESEARCH ADMINISTRATION
# MDOT TRANSPORTATION POOLED FUND STUDY
# ANNUAL REPORT - FISCAL YEAR 2025

STUDY TITLE: Transportation Materials Resource Center

FUNDING SOURCE: ☒ FHWA ☐ OTHER (*PLEASE EXPLAIN*)

| | | | | |
|---|---|---|---|---|
| TPF NO. | TPF-5(546) | | MDOT START DATE | 2/14/2025 |
| OR NO. | OR25-205 | | MDOT COMPLETION DATE (Original) | 9/30/2029 |
| | | | COMPLETION DATE (Revised) | |
| MDOT TECHNICAL CONTACT | Kevin Kennedy, 517-749-9067<br>Email: KennedyK@Michigan.gov | | | |
| LEAD AGENCY | Iowa Department of Transportation | | | |
| LEAD STUDY CONTACT | Khyle Clute, 515-239-1646<br>Email: Khyle.Clute@iowadot.us | | | |
| CONTRACTOR | | | | |

## BUDGET STATUS

| FY 2025 MDOT Budget | | | | MDOT Total Budget | | |
|---|---|---|---|---|---|---|
| FY25 FUNDS | (Original) | $40,000.00 | | TOTAL BUDGET | (Original) | $200,000.00 |
| | (Revised) | | | | (Revised) | |
| TOTAL FY 2025 EXPENDITURES | | $40,000.00 | | TOTAL COMMITTED FUNDS AVAILABLE | | $160,000.00 |

## PARTICIPATING STATES

IA, MD, MI, MN, MO, NE, PA, TX

## PURPOSE AND SCOPE

The Transportation Materials Resource Center (TMRC) has a history spanning over three decades, marked by its evolution and adaptability to the changing transportation infrastructure needs. Initially founded to address the challenges surrounding the use of recycled materials in transportation infrastructure, RMRC's journey started with its first generation in 1998 at the University of New Hampshire through an agreement with the Federal Highway Administration (FHWA) based on a stipulation in TEA-21 Recycled Materials Resource Center-1 (RMRC-1). In its second generation, RMRC-2, a joint venture between the University of New Hampshire (UNH) and the University of Wisconsin-Madison, furthered its mission with competitive funding from the FHWA and state support through a pooled fund. The third generation, RMRC-3G, continued this mission by consolidating activities at the University of Wisconsin-Madison, funded by a state-pooled fund (TPF-5(270)) with contributions from multiple states.

The mission of the fourth and last generation of the center (RMRC-4G) was to facilitate the development and distribution of cost-effective and environmentally sound technology for incorporating recycled materials into transportation infrastructure. To achieve this mission, RMRC-4G aimed at developing effective technology transfer mechanisms, including educating designers, regulators, and end-users about the appropriate use of recycled materials and procedures to assess their environmental suitability and economic viability. Creating a nationwide market for recycled materials in transportation infrastructure was another pivotal plan, which entailed the establishment of a Green Highway/Roadway program and the development economic evaluation tools and design guidelines for various materials. RMRC-4G also collaborates with federal and state agencies to formulate a methodology for evaluating the environmental suitability of recycled materials on a national scale.

The history of the RMRC underscores its vital role in advancing sustainability and innovation in transportation infrastructure. State Departments of Transportation (DOTs) have shown a growing interest in harnessing the benefits of recycled materials, from economic value to environmental responsibility. Building on past research and knowledge, there's an urgent need to explore the full potential of recycled materials to create more resilient infrastructures capable of withstanding future challenges. Therefore, to sustain momentum and continue enhancing sustainability, service life, and cost savings while unlocking the highest and best uses of materials and resources, a fifth generation or TMRC is valuable and imperative. Focusing on resilient infrastructure can be a defining feature, aligning with the ever-evolving transportation industry needs and reaffirming the RMRC's crucial role in shaping a more sustainable and resilient future.

## FISCAL YEAR 2025 ACCOMPLISHMENTS

1. A historical overview of the Recycled Materials Resource Center was presented, emphasizing its rebranding into the Transportation Materials Resource Center (TMRC) in its fifth cycle.
2. Strategic research directions were outlined. Regional materials assessment.
3. Innovative solutions for highway materials and construction.
4. Advancing resilience research in transportation infrastructure.

5. The funding model and agency commitments were reviewed.
6. Current participants include Iowa, Maryland, Michigan, Minnesota, Missouri, Nebraska, Pennsylvania, and Texas DOTs. Other agencies are expected to join in the future. Actions to involve other agencies were postponed.
7. Research Project Process • Bora Cetin presented the annual funding cycle and project selection process.
8. The original plan scheduled the in-person proposal selection meeting for January in Washington, DC (prior to the TRB Annual Meeting)
9. Members discussed challenges with this arrangement:
10. The group approved the new plan
11. The May meeting will be in-person, focused on idea discussion and ranking.
12. The January proposal selection meeting will also be online, and after the TRB Annual Meeting.
13. Michigan State University will host the first in-person meeting in May 2026.
14. The hosting agency for the subsequent year will be selected at the May 2026 meeting. Synthesis Projects- MSU presented the proposed process for synthesis project requests, including open calls in September and selection in January.
15. It was confirmed that MSU can accommodate off-cycle synthesis needs from DOT Technical Advisory Committees (TACs). Future Planning • Outreach: MSU will prepare a draft email and supporting documents for member agencies to share with colleagues from other agencies who may be interested in joining.
16. Branding: MSU will develop new draft versions of the TMRC logo. Members will review and vote on the preferred version. Adjournment The next virtual meeting will be scheduled once the Synthesis Project Ideas are received. MSU will summarize the ideas and present them to the members for their vote

**FISCAL YEAR 2026 PROPOSED ACTIVITIES**

PFS began in February 2025, when Iowa DOT accepted lead agency responsibilities.

During FY 2026 the lead agency will commence activities centered around the study's primary objective championing the identification and evaluation of innovative materials for use in transportation infrastructure.

**JUSTIFICATION(S) FOR REVISION(S)**

None.

**SUMMARY OF THE IMPLEMENTATION RECOMMENDATION**

Project expected completion FY 2029.

Michigan Department
Of Transportation
5307 (11/17)

# RESEARCH ADMINISTRATION
# MDOT TRANSPORTATION POOLED FUND STUDY
# ANNUAL REPORT - FISCAL YEAR 2025

STUDY TITLE: Traffic Safety Culture - Phase 3

FUNDING SOURCE: ☒ FHWA ☐ OTHER (*PLEASE EXPLAIN*)

| | | | | |
|---|---|---|---|---|
| TPF NO. | TPF-5(547) | | MDOT START DATE | 10/01/2024 |
| OR NO. | OR25-208 | | MDOT COMPLETION DATE (Original) | 9/30/2029 |
| | | | COMPLETION DATE (Revised) | |
| MDOT TECHNICAL CONTACT | Linda Powell (517)331-7880<br>Email: PowellL2@Michigan.gov | | | |
| LEAD AGENCY | Montana DOT | | | |
| LEAD STUDY CONTACT | Rebecca Ridenour, 406-444-7203<br>Email: rridenour@mt.gov | | | |
| CONTRACTOR | | | | |

**BUDGET STATUS**

| FY 2025 MDOT Budget | | | | MDOT Total Budget | | |
|---|---|---|---|---|---|---|
| FY25 FUNDS | (Original) | $15,000.00 | | TOTAL BUDGET | (Original) | $75,000.00 |
| | (Revised) | | | | (Revised) | |
| TOTAL FY 2025 EXPENDITURES | | $15,000.00 | | TOTAL COMMITTED FUNDS AVAILABLE | | $60,000.00 |

**PARTICIPATING STATES**

AK, CT, FHWA, GA, IA, ID, IL, KS, KY, LA, MI, MN, MS, MT, NV, TX, VT, WI, WV

**PURPOSE AND SCOPE**

The study will continue to bring interested partners together to find ways to influence behavior and decisions to promote safety for all road users. Traffic Safety Culture (TSC) is the values and beliefs shared amongst road users that determine their choice of behavior which affects traffic safety. Many national agencies and organizations have identified that growing safety culture is a core strategy to moving towards the goal of zero road user deaths and serious injuries. Cultivating a positive traffic safety culture supports traffic safety goals and increases public acceptance of other effective traffic safety programs.

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

- Attended and engaged in an in-person kick-off meeting to create a management plan that will identify common research needs, select and prioritize research tasks, and provide oversight of these tasks.
- Finalized management plan.
- Resources and Tools to Improve Pedestrian Safety (8882-444-22) project: All final deliverables were completed.
- Understanding Aggressive Driving and Ways to Reduce It – Phase 2 (8882-444-26): The CHSC team completed the Task 1 report and submitted it for review. Work in Task 3 will include developing messages and detailing the plan for message testing.

**FISCAL YEAR 2026 PROPOSED ACTIVITIES**

- Hold planned November 19, 2025 quarterly meeting.
- Commence Year 2 planned research activities.
- Hold TAC meeting on October 15, 2025 to discuss project summaries.
- Monthly meetings.
- Begin travel planning for the 2026 in-person meeting in Boise, ID.

**JUSTIFICATION(S) FOR REVISION(S)**

None.

**SUMMARY OF THE IMPLEMENTATION RECOMMENDATION**

Project expected completion FY 2029.

Michigan Department
Of Transportation
5307 (11/17)

# RESEARCH ADMINISTRATION
# MDOT TRANSPORTATION POOLED FUND STUDY
# ANNUAL REPORT - FISCAL YEAR 2025

STUDY TITLE: No Boundaries Transportation Maintenance Innovations: Phase IV

FUNDING SOURCE: ☒ FHWA ☐ OTHER (*PLEASE EXPLAIN*)

| | | | | |
|---|---|---|---|---|
| TPF NO. | TPF-5(548) | | MDOT START DATE | 10/29/2024 |
| OR NO. | OR25-212 | | MDOT COMPLETION DATE (Original) | 9/30/2027 |
| | | | COMPLETION DATE (Revised) | |
| MDOT TECHNICAL CONTACT | Matt Pratt, 517-643-5372<br>Email: PrattM@Michigan.gov | | | |
| LEAD AGENCY | Colorado DOT | | | |
| LEAD STUDY CONTACT | David Reeves, 303-757-9518<br>Email: david.reeves@state.co.us | | | |
| CONTRACTOR | | | | |

**UDGET STATUS**

| FY 2025 MDOT Budget | | | | MDOT Total Budget | | |
|---|---|---|---|---|---|---|
| FY25 FUNDS | (Original) | $13,000.00 | | TOTAL BUDGET | (Original) | $39,000.00 |
| | (Revised) | | | | (Revised) | |
| TOTAL FY 2025 EXPENDITURES | | $13,000.00 | | TOTAL COMMITTED FUNDS AVAILABLE | | $26,000.00 |

**PARTICIPATING STATES**

CA, CO, CT, GA, IA, IL, IN, LA, MD, ME, MI, MN, MO, MS, ND, NY, OH, PA, SC, TX, UT, VA

**PURPOSE AND SCOPE**

State departments of transportation (DOTs) are continually challenged to provide their customers with a high level of service despite tightening financial resources and staffing challenges. Innovation is the key to achieving more with less. By identifying and implementing innovative tools, technologies and practices, DOTs can get a job done faster, better and more cost-effectively and in many cases safer. The No Boundaries pooled fund is dedicated to helping states save time and money on all aspects of their maintenance-related activities by promoting the adaptation, implementation and broader use of successful strategies, and facilitating opportunities that encourage collaboration and the transfer of innovative technologies. Over the first three phases of the No Boundaries Transportation Maintenance Innovations pooled fund spanning 13 years, member states have benefited from real-world experiences and knowledge of transportation maintenance peers who have sought to solve similar challenges. In Phase IV, No Boundaries will continue to assist in and accelerate the successful technology and innovation transfer among state DOTs. The Colorado Department of Transportation will serve as lead state and work with other member agencies to streamline the transfer of tried and tested innovations and avoid potential pitfalls that can be time-consuming and costly.

1) Promote member engagement and collaboration, each year hold two full TAC in-person peer exchanges, and two virtual meetings. The Steering Committee will meet quarterly.
2) Identify promising and ready-to-deploy maintenance-related innovations and technologies that have been developed by participating DOTs, non-participating DOTs and outside entities
3) Promote achievements through documented case studies of successful member-to-member innovation exchange and deployment
4) Develop marketing plans for selected ready to deploy innovations and technologies
5) Work with training staff at state DOTs to provide a channel to put innovative tools to work across member states' maintenance offices
6) Maintain and expand the searchable Innovations Database previously developed by No Boundaries where innovations and research projects developed across the country can be identified and accessed
7) Act as a liaison between groups and organizations (AASHTO MAC, NLTAPA, FHWA, etc.) that also focus on transportation maintenance innovations and provide guidance on national innovation sharing efforts, such as Every-Day Counts
8) Maintain and manage content for the pooled fund's website at *https://maintainroads.org*
9) As directed by members, develop short-turnaround syntheses to report on the state of practice for important topical issues
10) In considering the results of task 9; and as directed by members, additional tasks may include: a. Developing appropriate workshops; b. Peer Exchanges; c. Webinars; d. Website enhancements (https://maintainroads.org/); e. Best practice guidance or manual development
11) Identify and develop research needs studies for further development of innovative technologies that may not yet be market ready
12) Identify innovative technologies that can be deployed through the FHWA EDC initiative.

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

No Boundaries continued to add entries to the on-line maintenance innovations database, updated the No Boundaries website and sent weekly news posts to the No Boundaries mailing list. One in-person meeting was held from April 29-May 1, 2025, in Portland, ME. TAC teleconferences were held on 2/24/25 and 6/2/25. All informal surveys sent to TAC members were organized, posted and made available to members on the No Boundaries website. A four-page Summary of Activities showcasing the achievements of phase III, which ends on 11/1/25, was published on the No Boundaries website. The lead state, Colorado, posted a solicitation for phase IV of the pooled fund, which has 23 members. CDOT is currently processing an RFP for the phase IV administration contract and will post it on their website in late 2025.

| FISCAL YEAR 2026 PROPOSED ACTIVITIES |
| --- |
| Ongoing management and record keeping will continue, along with working on financials as TPF-5(441) comes to an end and this new version gets up and running. The vendor will be asked to keep the website up and running until a new vendor is awarded. |
| **JUSTIFICATION(S) FOR REVISION(S)** |
| None. |
| **SUMMARY OF THE IMPLEMENTATION RECOMMENDATION** |
| Project expected completion FY 2027. |

Michigan Department
Of Transportation
5307 (11/17)

# RESEARCH ADMINISTRATION
# MDOT TRANSPORTATION POOLED FUND STUDY
# ANNUAL REPORT - FISCAL YEAR 2025

STUDY TITLE: High Performance Computational Fluid Dynamics (CFD) Modeling Services for Highway Hydraulics

FUNDING SOURCE: ☒ FHWA ☐ OTHER (*PLEASE EXPLAIN*)

| | | | |
|---|---|---|---|
| TPF NO. | TPF-5(552) | MDOT START DATE | 2/10/2025 |
| OR NO. | OR25-213 | COMPLETION DATE (Original) | 9/30/2026 |
| | | COMPLETION DATE (Revised) | |
| MDOT TECHNICAL CONTACT | Erik Calson, 517-230-8180<br>Email: CarlsonE2@Michigan.gov | | |
| LEAD AGENCY | FHWA | | |
| LEAD STUDY CONTACT | James Pagenkopf, 202-493-7080<br>Email: james.pagenkopf@dot.gov | | |
| CONTRACTOR | | | |

## BUDGET STATUS

| *FY 2025 MDOT Budget | | | MDOT Total Budget | | |
|---|---|---|---|---|---|
| FY25 FUNDS | (Original) | $90,000.00 | TOTAL BUDGET | (Original) | $180,000.00 |
| | (Revised) | $0.00 | | (Revised) | |
| TOTAL FY 2025 EXPENDITURES | | $0.00 | TOTAL COMMITTED FUNDS AVAILABLE | | $180,000.00 |

* MDOT's FY 2025 commitment will be transferred with FY 2026 funds.

## PARTICIPATING STATES

CO, MI, OH, TX

## PURPOSE AND SCOPE

FHWA's HEC-22 Design Guidance Document provides guidance on how to calculate storm inlet capture efficiency, however, the guidance is not specific to the style of MDOT standard grates. Designers are currently using conservative estimates to perform these calculations that may require placing more inlets than are necessary.
Special Note: At the request of the lead agency, MDOT moved its original total pledge commitment in the amount of $180,000.00 from TPF- 5(446) to Solicitation #1629. TPF-5(552) federal project number has been assigned.

## FISCAL YEAR 2025 ACCOMPLISHMENTS

Continuation of TPF-5(446). Kickoff meeting was held on September 4, 2025, between MDOT (Erik Carlson and Scott Douglas), FHWA, and Argonne National Laboratories (ANL). CAD cells for grates J and K were shared with Marta Sitek at ANL. Capture scenarios were determined for each grate type to determine capture efficiency curves. Sample photos of each grate were shared with ANL.

## FISCAL YEAR 2026 PROPOSED ACTIVITIES

Computational Mechanics Research on a Variety of Projects
Perform hydraulic analysis of catch basins on grade and in sump
Perform culvert hydraulics
Modeling of water film on pavements
Continue Computational Mechanics Research Support

## JUSTIFICATION(S) FOR REVISION(S)

None.

## SUMMARY OF THE IMPLEMENTATION RECOMMENDATION

Project expected completion FY 2026.

Michigan Department
Of Transportation
5307 (11/17)

# RESEARCH ADMINISTRATION
# MDOT TRANSPORTATION POOLED FUND STUDY
# ANNUAL REPORT - FISCAL YEAR 2025

STUDY TITLE: Vehicle to Everything (V2X) Pooled Fund Study

FUNDING SOURCE: ☒ FHWA ☐ OTHER (*PLEASE EXPLAIN*)

| | | | | |
|---|---|---|---|---|
| TPF NO. | TPF-5(555) | | MDOT START DATE | 3/11/2025 |
| OR NO. | OR25-204 | | MDOT COMPLETION DATE (Original) | 9/30/2029 |
| | | | COMPLETION DATE (Estimate Revised Date) | |
| MDOT TECHNICAL CONTACT | Michele Mueller, 248-431-1443<br>Email: MuellerM2@Michigan.gov | | | |
| LEAD AGENCY | Georgia DOT | | | |
| LEAD STUDY CONTACT | Sephara Raymond, 404-347-0618<br>Email: sraymond@dot.ga.gov | | | |
| CONTRACTOR | | | | |

**BUDGET STATUS**

| FY 2025 MDOT Budget | | | | MDOT Total Budget | | |
|---|---|---|---|---|---|---|
| FY25 FUNDS | (Original) | $50,000.00 | | TOTAL BUDGET | (Original) | $250,000.00 |
| | (Revised) | | | | (Revised) | |
| TOTAL FY 2025 EXPENDITURES | | $50,000.00 | | TOTAL COMMITTED FUNDS AVAILABLE | | $200,000.00 |

**PARTICIPATING STATES**

AK, CA, CT, DE, FHWA, FL, GA, MD, MI, NH, NY, OH, TC, TN, TX, UT, VA, WA, WI

**PURPOSE AND SCOPE**

A vehicle to everything (V2X) environment holds the potential to support a fundamental advance in surface transportation. While the vehicle component and infrastructure component of the transportation system have traditionally been only loosely coupled (through static signing, vehicle presence detectors, etc.), connected vehicle technologies will allow the components to “work” actively together – creating a fully connected vehicles and infrastructure environment. This provides the potential for substantial safety improvements, reduction in congestion and improvement in safety and environment, resulting in improved traveler services. To realize this potential, a connected vehicles system and environment will require unprecedented collaboration between the private and public sectors, on a scale not required in the current loosely coupled system. To date, the national United States Department of Transportation (USDOT) Connected Vehicle initiative has focused largely on “how” to technically accomplish the integration. A considerable amount of solid technical work at the local, state and national level has been devoted to developing communications standards (e.g., Dedicated Short Range Communications (DSRC) or Cellular Vehicle – to – everything (CV2X)), developing and deploying field equipment for small-scale prototype/proof-of-concept testing, and high-level conceptual development.

As owners and operators of the nation’s surface transportation infrastructure, state and local transportation agencies are at the core of the connected vehicle infrastructure. While automakers and device manufacturers will dictate availability of vehicular equipment, transportation agencies will control the deployment and operation of roadside infrastructure and the incorporation of connected vehicle technologies into infrastructure applications (such as traffic signal control). There have been multiple projects and efforts by many standards development organizations to advance the availability and interoperability of V2X. USDOT has also produced guidance documents for deploying and supporting connected vehicle technology. While great strides have been made over the last decade, additional research is still needed to develop, field-test, and perform technology transfer for applications that will make full use of the connected vehicle environment.

The V2X Pooled Fund Study (V2XPFS) (successor to the Connected Vehicle Pooled Fund Study) acts as a continuation of the Research Program to Support the Research, Development, and Deployment of System Operations Applications of Vehicle Infrastructure Integration (VII) (TPF-5(389)). TPF-5(389) was a continuation of TPF-5(206) which was initiated in 2009 and was active for nearly 10 years. During that time, the program has been successful in its pursuit to provide technology transfer to aid transportation agencies and OEMs in justifying and promoting the connected vehicle environment and applications through modeling, development, engineering and planning activities. As of May 2018, eleven research projects have been completed and four additional projects are currently underway. The new CV PFS will continue the work of TPF-5(389) after that project ends.

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

Georgia DOT accepted the lead role for this pooled fund.

| FISCAL YEAR 2026 PROPOSED ACTIVITIES |
| --- |
| Participation in the pooled fund study began in March 2025, when Georgia DOT accepted lead agency responsibilities. Work will continue in FY 2026 focused on the following high- level tasks: Research, development, and evaluation of connected vehicle applications and improvements to technology transfer to state and local agencies. |
| **JUSTIFICATION(S) FOR REVISION(S)** |
| None. |
| **SUMMARY OF THE IMPLEMENTATION RECOMMENDATION** |
| Project expected completion FY 2029. |

Michigan Department
Of Transportation
5307 (11/17)

# RESEARCH ADMINISTRATION
# MDOT TRANSPORTATION POOLED FUND STUDY
# ANNUAL REPORT - FISCAL YEAR 2025

STUDY TITLE: Uncrewed Aircraft Systems (UAS) Standardization

FUNDING SOURCE: ☒ FHWA ☐ OTHER (*PLEASE EXPLAIN*)

| | | | | |
|---|---|---|---|---|
| TPF NO. | TPF-5(556) | | MDOT START DATE | 10/01/2024 |
| OR NO. | OR25-207 | | MDOT COMPLETION DATE (Original) | 9/30/2029 |
| | | | COMPLETION DATE (Revised) | |
| MDOT TECHNICAL CONTACT | Linn Smith, 517-335-9949<br>Email: SmithL50@Michigan.gov | | | |
| LEAD AGENCY | Alaska DOT & Public Facilities | | | |
| LEAD STUDY CONTACT | Brian Edinger, 703-509-3464<br>Email: brian.edinger@alaska.gov | | | |
| CONTRACTOR | | | | |

**BUDGET STATUS**

| *FY 2025 MDOT Budget | | | | MDOT Total Budget | | |
|---|---|---|---|---|---|---|
| FY25 FUNDS | (Original) | $25,000.00 | | TOTAL BUDGET | (Original) | $125,000.00 |
| | (Revised) | $0.00 | | | (Revised) | |
| TOTAL FY 2025 EXPENDITURES | | $0.00 | | TOTAL COMMITTED FUNDS AVAILABLE | | $125,000.00 |

*FY 2025 commitment will be transferred during FY26.

**PARTICIPATING STATES**

AK, AL, CA, CT, IA, ID, KS, MA, MI, MT, NE, OH, OR, TN, TX, WI

**PURPOSE AND SCOPE**

Uncrewed Aircraft Systems (UAS) have been widely accepted by State Departments of Transportation (DOTs) over the last decade. Although UAS have been integrated into workflows and are being leveraged as a supplemental tool across a large variety of use cases there are yet to be defined standards developed. State DOTs need UAS data collection standards, specifically for leading use cases such as surveying, construction inspection and bridge inspections.

Each study use case will include: Literature Review; Focus Group Meeting; Gap Analysis; Test Flights; Standards Development; Standards Validation; Technical Memorandum - Summary of Research Activities; UAS Standards and Specifications Guidebook; Field Reference Guide.

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

The scope of work was finalized, and the project has just been kicked off.

**FISCAL YEAR 2026 PROPOSED ACTIVITIES**

MDOT's FY 2025 commitment that did not get transferred due to lack of acceptance letter on the TPF website will be transferred with FY 2026 commitment. This pooled fund study got underway in mid-FY25. The study will produce a set of deliverables to State DOT partners annually. Roughly one-use case per year will be accomplished. The set of deliverables provided with each use case will provide utility and benefit to operators at State DOTs and elsewhere throughout the industry, starting with FY 2026.

**JUSTIFICATION(S) FOR REVISION(S)**

None.

**SUMMARY OF THE IMPLEMENTATION RECOMMENDATION**

Project expected completion FY 2029.

Michigan Department
Of Transportation
5307 (2011)

# RESEARCH ADMINISTRATION
# MDOT TRANSPORTATION POOLED FUND STUDY
# ANNUAL REPORT - FISCAL YEAR 2025

STUDY TITLE: TRB Core Program Activities FFY 2025 (TRB FY 2026)

FUNDING SOURCE: ☒ FHWA ☐ OTHER (*PLEASE EXPLAIN*)

| | | | | |
|---|---|---|---|---|
| TPF NO. | TPF-5(557) | | MDOT START DATE | 10/01/2024 |
| OR NO. | OR25-200 | | MDOT COMPLETION DATE (Original) | 9/30/2025 |
| | | | PROJECT COMPLETION DATE (Revised) | |
| MDOT TECHNICAL CONTACT | Andre Clover, 517-749-9001<br>Email: CloverA@Michigan.gov | | | |
| LEAD AGENCY | Federal Highway Administration (FHWA) | | | |
| LEAD STUDY CONTACT | Jean Landolt, 202-493-3146<br>Email: Jean.Landolt@dot.gov | | | |
| CONTRACTOR | | | | |

**BUDGET STATUS**

| FY 2025 MDOT Budget | | | | Total Budget | | |
|---|---|---|---|---|---|---|
| FY25 FUNDS | (Original) | $230,000.00 | | BUDGETED AMT. | (Original) | $230,000.00 |
| | | | | ACTUAL COST | | $236,046.00 |
| TOTAL FY 2025 EXPENDITURES | | $236,046.00 | | TOTAL COMMITTED FUNDS AVAILABLE | | $0.00 |

**PARTICIPATING STATES**

AK, AZ, CA, CO, CT, DC, IL, IN, ME, MI, MO, NM, NY, OH, PA, SC, TX, UT, WA

**PURPOSE AND SCOPE**

The Michigan Department of Transportation (MDOT) 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. This pooled fund study permits states to make their contributions to the TRB Core Program instead of sending their contributions to the TRB directly. TRB FY 2025 covers the period from July 1, 2024- June 30, 2025

**FISCAL YEAR 2025 ACCOMPLISHMENTS**

The pooled fund study permits States to contribute their funds to the TRB Core Program Services instead of sending their contributions directly to TRB. The TRB Core Program Services provides support funding for the TRB annual meeting, committees, conferences, webinars, TRID, and TRB publications.

**JUSTIFICATION(S) FOR REVISION(S)**

The TRB Executive Committee recommend annual contributions from each state be based on the most current SP&R funding tables available. MDOT elected to transfer its federal fund contribution for FY 2024 through the TPF-5(530) pooled fund study. MDOT fiscal year commitment level was paid in full.

**SUMMARY OF THE IMPLEMENTATION RECOMMENDATION**

MDOT technical experts have access to all TRB publications to review and share internally as appropriate.

## APPENDIX

## FISCAL YEAR 2024 REPORT UPDATES

The following update notes changes to the MDOT *State Planning and Research Part II Program Fiscal Year 2024 Annual Report*:

**Table 1 – 80% Federally Funded Projects (Pg. 5-6):**

- $177,380.47 in expenditures were reported for project number **213316** (Pg. 5), "Michigan Hydrologic Calculation Procedures," under contract with Michigan Technological University (MTU) number 2019-0311 Authorization 3. Expenses should have been reported as *$170,016.65* with total cost to date through fiscal year-end of *$487,520.97.* The cost reported on the project form should also be revised (Pg. 33).

- $48,664.05 in expenditures were reported for project number **213321** (Pg. 5), "Operational Baseline for the 2nd Avenue Network Arch Bridge," under contract with Western Michigan University (WMU) number 2019-0313 Authorization 8. Expenses should have been reported as *$48,836.73* with total cost to date through fiscal year-end of *$217,734.70*. The cost reported on the project form should also be revised (Pg. 38).

- $170,546.07 in expenditures were reported for project number **218398** (Pg. 6), "Pavement ME Rehabilitation Design Protocols for MDOT Implementation," under contract with Michigan State University (MSU) number 2023-0342. Expenses should have been reported as *$215,525.85* with total cost to date through fiscal year-end of *$256,441.35*. The cost reported on the project form should also be revised (Pg. 65).

- $200,084.95 in expenditures were reported for project number **219527** (Pg. 6), "Unmanned Aircraft System Communications Mesh Test Deployment," under contract number 2023-0679 with WSP. Expenses should have been reported as $*279,331.76* with total cost to date through fiscal year-end of *$279,331.76*. The cost reported on the project form should also be revised (Pg. 73).

**Table 2 – 100% Federally Funded Projects (Pg. 7-9):**

- $47,197.35 in expenditures were reported for project number **213316** (Pg. 5), "Automatic Signal Retiming Using Vehicular Trajectory Data – University Transportation Center (UTC)," under contract with the University of Michigan (UM) number 2022-0433 Authorization 6. Expenses should have been reported as *$67,424.79* with total cost to date through fiscal year-end of *$67,424.79.* The cost reported on the project form should also be revised (Pg. 93).

- $26,853.01 in expenditures were reported for project number **213321** (Pg. 5), "End-to-End Learning Framework for Transportation Network Equilibrium Modeling," under contract with the University of Michigan University (UM) number 2022-0433 Authorization 7. Expenses should have been reported as *$33,566.26* with total cost to date through fiscal year-end of *$33,566.26*. The cost reported on the project form should also be revised (Pg. 95).

*If you require assistance accessing this information or require it in an alternative format, contact the Michigan Department of Transportation's (MDOT) Americans with Disabilities Act (ADA) coordinator at Michigan.gov/MDOT-ADA.*