ONE DOT
WORKING BETTER TOGETHER

U.S. Department of Transportation

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June 22, 2022

Mr. Patrick McKenna, Director
Missouri Department of Transportation
Jefferson City, Missouri 65102

> RE: SFY 2023 State Planning and Research Work Program Missouri Project SPR-PL-00 FY (23) and SFY FY2022 Annual Report Missouri Project SPR-PL-00 FY (22)

Dear Mr. McKenna:

In your letter dated June 22, 2022, we received your request for the Federal Highway Administration's (FHWA) and the Federal Transit Administration (FTA) review and approval of the final version of Missouri Department of Transportation's (MoDOT) state fiscal year (SFY) 2023 State Planning and Research (SPR) Work Program and SFY 2022 Annual Report. After prior discussion and review of draft copies, we find the SFY 2023 SPR Work Program satisfactory and approve it as requested, effective July 1, 2022. The MoDOT SFY 2023 SPR Work Program year begins on July 1, 2022 and ends on June 30, 2023.

This approval includes the estimated funding amounts for the Unified Planning Work Programs (UPWPs) for Missouri's eight metropolitan planning areas. However, the UPWPs for each of the Metropolitan Planning Organizations (MPOs) continue to be subject to ONE DOT's individual review and written approval.

The SFY 2023 SPR Work Program and SFY 2022 SPR Annual Reporting data are presented in one planning work product. Please provide our Division Office the addendum that adds the actual cost to the SFY 2022 SPR Work Program by August 31, 2022 and take steps to close out the SPR-PL-00 FY (22) project within 90 days of the close of the state fiscal year 2022 work program.

If you have any questions, please contact Brad McMahon at FHWA (573) 638-2609 or Eva Steinman at FTA (816) 329-3931.

Sincerely,

Mokhtee Ahmad
Regional Administrator
Federal Transit Administration

For: Kevin W. Ward
Division Administrator, P.E.
Federal Highway Administration

cc: Eric Curtit, MoDOT
Britni O'Connor, MoDOT
Jennifer Harper, MoDOT
Dave Ahlvers, MoDOT
Dana Kaiser, MoDOT
Jeffrey Cremer, MoDOT

State Planning and Research Program

SPR-PL-00 FY (23)
2023 State Fiscal Year
(7/1/22 to 6/30/23)

And

SPR-PL-00 FY (22)
2022 State Fiscal Year
(7/1/21 to 6/30/22)

Missouri Department of Transportation

In Cooperation with the
U.S. Department of Transportation
Federal Highway Administration Federal
Transit Administration

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List of Abbreviations

AASHTO – American Association of State Highway and Transportation Officials
APA – American Planning Association
ARAN – Automatic Road Analyzer
ASTM – American Society for Testing and Materials
BEAP – Bridge Engineering Assistance Program
CAP – Compliance Assessment Program
CFR – Code of Federal Regulations
CPG – Consolidated Planning Grants
DOT – Department of Transportation
EPG – Engineering Policy Guide
EV – Electric Vehicle
EWG – East-West Gateway Council of Governments
FEMA – Federal Emergency Management System
FFY – Federal Fiscal Year
FHWA – Federal Highway Administration
FRP – Fiber Reinforced Polymer
FTA – Federal Transit Administration
FTZ – Foreign Trade Zone
GIS – Geographic information system
GPR – Ground-Penetrating Radar
HPMS – Highway Performance Monitoring System
HSM – Highway Safety Manual
IMISS – Implementing Maintenance Innovations from State to State
ITE – Institute of Transportation Engineers
ITS – Intelligent Transportation System
LED – Light Emitting Diode
LETS – Law Enforcement Technology System
LIDAR – Light Detection and Ranging
LKD – Lime Kiln Dust
LPA – Local Public Agencies
LRFD – Load and Resistance Factor Design
LRS – Linear Referencing System Network
LRTP – Long-Range Transportation Plan
LTAP – Local Technical Assistance Program
MACOG – Missouri Association of Councils of Government
MAFC – Mid-America Freight Coalition
MARC – Mid-America Regional Council
MDA – Mixture Design and Analysis
MERIC – Missouri Economic Research and Information Center
MHTC – Missouri Highway Transportation Commission
MoDOT – Missouri Department of Transportation
MPO – Metropolitan Planning Organization
MUTCD – Manual on Uniform Traffic Control Devices
NCAT – National Center for Asphalt Technology
NCHRP – National Cooperative Highway Research Program
NDT – Non-destructive Testing
NHI – National Highway Institute

NTPEP – National Transportation Product Evaluation Program
ONEDOT – Federal Highway Administration and Federal Transit Administration
OTO – Ozarks Transportation Organization
PCC – Portland Cement Concrete
PI – Principal Investigator
PIERS – Port Import Export Reporting Service
PL – Metropolitan Planning
PPG – Planning and Policy Group
QA – Quality Assurance
QC – Quality Control
RAS – Recycled Asphalt Shingles
RCA – Recycled Concrete Aggregate
RPC – Regional Planning Commission
RTAP – Rural Technical Assistance Program
RTS – Right Transportation Solutions
SASW – Spectral Analysis of Surface Waves
SCC – Self-Consolidating Concrete
SDE – Service Desk Express
SEMA – State Emergency Management System
SFY – State Fiscal Year
SHAL – Safety Handbook for Locals
SICOP – Snow and Ice Pooled Fund Cooperative Program
SPF – Safety Performance Functions
SPR – State Planning and Research
SPT – Standard Penetration Test
STARS – Missouri Statewide Traffic Accident Records System
STIP – Statewide Transportation Improvement Program
STSFA –Transportation Systems Funding Alternative
TAC – Technical Advisory Committee
TCD – Traffic Control Device
TCOAP – Thin-White Topping Concrete Overlays of existing Asphalt Pavement
TE – Transportation Enhancement
TEAP – Traffic Engineering Assistance Program
TIG – Technology Implementation Group
TMC – Transportation Management Center
TMS – Transportation Management Systems
TRB – Transportation Research Board
TP – Transportation Planning
TPF – Transportation Pooled Funds
TSP2 – Transportation Pavement Preservation Program
TTAP –Technology Transfer Assistance Program
TTCC – Technology Transfer Concrete Consortium
TTIC – Technology Transfer Intelligent Compaction
TWLT – Two-Way Left Turn
UAB – Urban Area Boundary
UPWP – Unified Planning Work Program
USGS – United States Geological Survey
UTCOAP – Ultra-Thin White Topping Concrete Overlays of existing Asphalt Pavement
VMT – Vehicle Miles of Travel

PREFACE

This SPR Work Program is prepared as an overview of the MoDOT activities that relate to Section 505, State Planning and Research, of Title 23, United States Code.

This report focuses on three parts. Part I (Planning) describes the state planning activities. Part II (Urban – Metropolitan planning organizations, MPO – CPG) describes the planning activities of the MPO. Part III (Research-SR) describes the technology transfer, development and research activities.

State Planning (SP) funds identify and develop methods to evaluate, prioritize and finance transportation needs.

Consolidated Planning Grant (CPG) funds are distributed to the nine metropolitan areas for their use in urban planning. The combined state and local urban planning work is coordinated into the Unified Work Program for each of the urbanized areas.

Research, Development and Technology Transfer (SR) funds are used for research, and for development and technology transfer activities necessary in connection with the planning, design, construction and maintenance of highway, public transportation and intermodal transportation systems. The SFY 2023 SPR work program describes the proposed work activities and estimated budgets for each work program element and the accomplishments for the prior year.

An administrative action will be completed for the purpose of incorporating the actual expenditure amounts for SFY 2022 work activities into the SFY 2023 SPR work program. This administrative action will be in the form of an addendum and provided to FHWA for informational purposes. It will be available for viewing on www.modot.org.

INTRODUCTION

Planning in general involves a method for accomplishing a desired objective – deciding in advance planning activities for the upcoming year. It is a continuous process aimed at maintaining the entire transportation system. Planning is the orderly and continuing assembly of information – including the history of development, the extent, dimensions, condition, use, economic and social effects, costs and future needs. It includes the analysis of this information for use by the administrators for the development and management of the transportation system in an efficient and cost-effective manner.

MoDOT's Mission:

Our mission is to provide a world-class transportation system that is safe, innovative, reliable and dedicated to a prosperous Missouri.

MoDOT's Tangible Results:

- Moving Missourians Safely
- Providing Outstanding Customer Service
- Delivering Efficient and Innovative Transportation Projects
- Operating a Reliable Transportation System
- Managing our Assets
- Stabilizing Resources and Engaging our Workforce
- Building a Prosperous Economy for All Missourians

MoDOT's Value Statements:

- Be Safe,
- Be Accountable,
- Be Respectful,
- Be Inclusive,
- Be Bold,
- Be Better,
- Be One Team

Financial Summary Sheet

As of May 31, 2022

A. Total Estimated Costs	SFY 2023	SFY 2022
Part I – Planning	$27,241,576	$22,682,502
Part II – Metropolitan Planning	$11,817,415	$10,754,280
*Part III – Research, Development and Technology	$5,408,873	$4,487,808
TOTAL ESTIMATED COST	**$44,467,864**	**$37,924,590**
B. Available Federal Funds	SFY 2023	SFY 2022
Part I - State Planning		
Obligated but Not Spent	$5,890,750	$3,860,670
Unobligated Funds	$26,666,800	$27,209,673
Estimated Annual Apportionment	$17,642,929	$15,371,000
Less:	($39,800)	($39,800)
- Pooled Funds……….$39,800 estimated		
SUBTOTAL – STATE PLANNING	**$50,160,679**	**$46,401,543**
Part II - Metropolitan Planning		
Obligated but Not Spent	$8,001,787	$8,289,978
Unobligated Funds	$12,077,735	$10,761,659
Estimated FHWA PL Annual Allocation	$6,856,999	$5,571,000
Estimated FTA 5303 Annual Allocation	$2,365,250	$1,817,756
SUBTOTAL – METRO PLANNING	**$29,301,771**	**$26,440,393**
Part III – Research		
**Obligated but not spent	$3,678,473	$2,772,545
Unobligated Funds	$12,335,947	$11,781,234
Estimated Annual Apportionment	$5,880,976	$5,124,000
Less:	($2,351,000)	($2,158,000)
- NCHRP………….$1,294,000 estimated		
- TRB Core………...$207,000 estimated		
- Pooled Funds…..….$850,000 estimated		
SUBTOTAL – RESEARCH	**$19,544,396**	**$17,519,779**
TOTAL FEDERAL FUNDS AVAILABLE	**$99,006,846**	**$90,361,715**

* This table does not include NCHRP, TRB, Core, and Pooled Funds.

**The majority of "Obligated but Not Spent" funds are obligated for pooled fund projects proposed project financing for SFY 2023.

C. Proposed Budget Estimates for SFY 2023

Proposed Budget Estimates for SFY 2023	Federal Funds	Percent	Matching Funds	Total
State Planning	$21,793,261	80%	$5,448,315	$27,241,576
Metropolitan Planning (PL and 5303) (Estimated)	$9,453,932	80%	$2,363,483	$11,817,415
* Research	$4,442,098	varies	$966,775	$5,408,873
TOTAL SP, SR & CPG	**$35,689,291**		**$8,778,573**	**$44,467,864**

* This does not include NCHRP, TRB, Core, and Pooled Funds.

D. SPR Budget Estimates for SFY 2022

SPR Budget Estimates for SFY 2022	Federal Funds	Percent	Matching Funds	Total
State Planning	$18,146,002	80%	$4,536,500	$22,682,502
Metropolitan Planning (PL and 5303) (Estimated)	$8,603,424	80%	$2,150,856	$10,754,280
* Research	$3,752,246	varies	$735,562	$4,487,808
TOTAL SP, SR, & CPG	$30,501,672		$7,422,918	$37,924,590

* This does not include NCHRP, TRB Core and Pooled Funds.

Itemized Cost Budget Estimates and Actual Expenditures

Part I – Planning

Transportation Planning Activities	SFY 2023	SFY 2022
• Transportation Planning Division (SPR2340S)	$7,881,256	$7,086,893
• Safe and Accessible Transportation Options (SPR23SAS)	$200,000	$0
SUBTOTAL	**$8,081,256**	**$7,086,893**
District Transportation Planning		
• CD (SPR23CDS)	$2,016,000	$1,520,450
• KC (SPR23KCS)	$2,490,367	$1,933,394
• NE (SPR23NES)	$775,187	$979,904
• NW (SPR23NWS)	$749,534	$760,138
• SE (SPR23SES)	$1,276,962	$1,249,427
• SL (SPR23SLS)	1,936,935	$1,434,074
• SW (SPR23SWS)	$1,186,971	$822,769
SUBTOTAL	**$10,431,956**	**$8,700,156**
Other Activities		
• Information Systems (SPR23ISS)	$2,578,873	$2,578,936
• Regional Planning Commission (SPR2327S)	$1,657,500	$1,375,000
• Financial Services (SPR2393S)	$1,314,505	$1,366,530
• Bridge Division (SPR23BRS)	$791,954	$783,855
• Design Division (SPR2395S)	$2,360,532	$766,132
• Communications (SPR23CRS)	$25,000	$25,000
SUBTOTAL	**$8,728,364**	**$6,895,453**
TOTAL PART I	**$27,241,576**	**$22,682,502**

Part II – Urban (MPO)

Metropolitan Areas	Current CPG Contract Amount	Estimated FFY 2023 Local Match	Estimated Total FFY 2023 CPG Funds with Match
NW Arkansas	$5,000	$1,250	$6,250
Kansas City	$2,358,868	$589,717	$2,948,585
St. Louis	$4,585,004	$1,146,251	$5,731,255
Springfield	$889,575	$222,394	$1,111,969
Columbia	$504,276	$126,069	$630,345
Jefferson City	$252,359	$63,090	$315,449
Joplin	$441,689	$110,422	$552,111
St. Joseph	$239,534	$59,884	$299,418
Cape Girardeau	$177,627	$44,407	$222,034
TOTAL PART II	**$9,453,932**	**$2,363,483**	**$11,817,415**

Note: - The estimated total of MPO contracts (CPG agreements) in place for the SFY 2023 SPR work program is $11,817,415

- The estimated PL amount is before post-apportionment set-asides; before penalties; before sequestration.
- For SFY 2023 SPR, estimated total apportioned PL Funds = $6,856,999 and Obligation limitation applied at 98%.

Part III – Research – SPR

Activity	SFY 2023	SFY 2022
• Administration (SPR23ADS)	$468,873	$436,900
• Research (SPR23RDS)	$4,290,000	$3,430,908
• Technology Transfer (SPR23TTS)	$650,000	$620,000
*TOTAL PART III	**$5,408,873**	**$4,487,808**

* This does not include NCHRP, TRB, Core, and Pooled Funds.

Total MoDOT SPR Work Program

	SFY 2023	SFY 2022
• Part I – Planning	$27,241,576	$22,682,502
• Part II – Metropolitan Planning	$11,817,415	$11,122,355
• * Part III – Research	$5,408,873	$4,487,808
TOTAL MoDOT SPR WORK PROGRAM	**$44,467,864**	**$38,292,665**

* This does not include NCHRP, TRB, Core, and Pooled Funds.

CFR 420.107(c) Summary

FY 2022 FHWA Research Apportionment (25%)	$5,880,976
FY 2023 Research Budget	**$6,793,098**
Pooled Funds	*$850,000*
NCHRP	*$1,294,000*
TRB Core	*$207,000*
Part III Research (Federal Portion Only)	*$4,442,098*

WORK PLANS

CORE AND MANDATED ACTIVITIES

PART I – PLANNING

TRANSPORTATION PLANNING ACTIVITIES

TRANSPORTATION PLANNING DIVISION

ADMINISTRATION

Purpose and Scope: Administration provides for the management of Transportation Planning's core functions. Included are items such as training, for example: NHI courses, supervisory/management training, APA training and other various training courses. Also included are such items as office supplies, equipment and travel expenses. The budget amount includes personal services and fringe benefits for employees in this unit.

This unit also includes MoDOT's participation in the Midwest Regional Rail Initiative that involves sharing of information regarding freight and passenger movements on rail and freight data update coordination, planning/economic studies and conducting MoDOT's satisfaction survey.

Proposed Activities:
- Continue providing for the management of Transportation Planning's core functions including, but not limited to, trainings and office supplies, equipment and travel expenses
- Host an annual statewide planning partner meeting to share transportation information and best practices
- Continue participating in the Midwest Regional Rail Initiative
- Attend conferences, peer exchanges, AASHTO meetings and training courses
- Conduct an economic impact analysis for the STIP
- Conduct MoDOT's report card survey
- Ongoing freight software server fee
- Continue to address emerging planning needs as directed by MoDOT's Commission and Executive Team

Prior Year Accomplishments:
- Hosted planning partner meeting and shared information regarding transportation funding, safety initiatives and planning for the next Statewide Transportation Improvement Program and asset management planning by regional group
- Attended conferences, peer exchanges, AASHTO meetings and training courses
- Conducted an economic impact analysis for the STIP
- Finalized State Freight and Rail Plan

PLANNING AND PERFORMANCE GROUP

Purpose and Scope: Planning and Performance Group (PPG) includes the Planning and Policy, Strategic Planning, Organization Performance and Innovative Partnerships and Alternative Funding activities. The amounts include personal services and fringe benefits for employees in these units.

Planning and Policy activities include maintaining the 20-year long-range transportation plan. This plan analyzes needs for all modes of transportation and provides policy and goal direction for MoDOT as it develops the Statewide Transportation Improvement Program. Additional activities ensure MoDOT's program delivery processes are compliant with federal regulations and move as seamless as possible. Strategic Planning activities include aligning MoDOT's strategic planning process with its mission, values and tangible results. Additional activities include performance management coordination, Tracker production and innovative partnerships and alternative funding administration.

Proposed Activities:
- Engage the public in discussions about additional transportation investments and needs
- Continue assisting RPCs in:
    - developing and maintaining work programs and regional transportation plans
    - providing local consultation with rural local officials
- Continue assisting MPOs in developing and maintaining the following work products
    - unified planning work programs
    - transportation improvement programs
    - long-range transportation plans
    - air quality conformity determinations
    - public involvement plans
- Attend MPOs board and technical committee meeting
- Coordinate and support MoDOT's national involvement in performance measure development, coordination and implementation
- Coordinate transportation asset management plan development
- Administer the State Planning and Research Work Program
- Provide team facilitation for process improvement and business planning teams
- Continue to support and develop the Tracker performance management system
- Continue to coordinate and develop the Innovations Challenge program
- Conduct Transportation Planning Division's internal and external customer satisfaction surveys
- Manage OA, FHWA and AASHTO Awards coordination
- Assessment of various FHWA and USDOT credit assistance tools for initiation in Missouri
- Advising on preparation of various discretionary grant applications to USDOT and FHWA
- Development of Electric Vehicle (EV) Infrastructure Development Plan
- Development of Carbon Reduction Strategy
- Produce and maintain Unfunded Needs List

Prior Year Accomplishments:
- Assisted the RPCs with:
    - developing and maintaining work programs and regional transportation plans and
    - providing local consultation with rural local officials
- Facilitated the receipt of ONE DOT approval of MPO TIPs, UPWPs and Air Quality Conformity Determination work products, and TIP and UPWP amendments
- Engaged in public discussion about additional transportation investment needs

- Continued collaborating with RPCs and MPOs and MoDOT district offices on a variety of planning issues targeted at improving federal required work products and to further enhance transportation planning efforts
- Attended MPO Board & Technical committee meetings
- Coordinated and supported MoDOT's national involvement in performance measure development, coordination and implementation
- Coordinated transportation asset management plan development and assessed department performance in respect to the plan
- Updated and submitted State Planning and Research Work Program
- Supported and developed the Tracker performance management system including the production of the quarterly Tracker publications and coordination of the quarterly Tracker Review meetings
- Coordinated and further developed the Innovations Challenge program
- Managed OA, FHWA and AASHTO Awards Program
- Developed applications for competitive discretionary grant programs
- Began work on EV Infrastructure Development Plan
- Published Unfunded Needs List

STATEWIDE PROGRAMMING

Purpose and Scope: The Statewide Programming unit develops the STIP and STIP-related products. This includes efforts by MoDOT Central Office personnel only. Personal services and fringe benefits for all employees within this work unit are also included in the budget amount.

Proposed Activities:
- Produce and maintain the STIP in accordance with the guidelines of the Planning Framework and state and federal regulations
- Produce and maintain the Missouri Road and Bridge Program
- Produce various reports on STIP programs and projects as needed
- Maintain and modernize the new SIMS application (the application used to produce the STIP)

Prior Year Accomplishments:
- Updated STIP through the amendment process as needed.
- Developed STIP reports
- Posted Program vs. Award report on the STIP web site
- Development and Implementation of new SIMS application

TRANSPORTATION SYSTEM ANALYSIS

Purpose and Scope: Transportation System Analysis Group includes Mapping and Customer Service, Pavement Analysis and Application Development, and Traffic Collection and Data. The group manages and administers field acquisition, asset data, traffic data, travel way data, analysis of asset/travel way data, data query and traffic operations. The budget amount also includes personal services and fringe benefits for all employees within this work unit.

Proposed Activities:
- Administer and continue to improve the HPMS program

- Analyze transportation data and provide timely and accurate information to MoDOT's customers
- Provide analysis, custom queries and reports using TMS data
- Maintain and publish the official Missouri State Highway Map
- Maintain and update state, county, and city maps and develop specialty maps as requested
- Conduct monthly TMS application update testing, provide support and TMS data restoration as required by our route update process
- Provide pavement data, analysis and projections for transportation decision-making
- Verify, maintain, and update MoDOT's linear referencing system for all public roads
- Monitor pavement data to evaluate current and past best practices in pavement management
- Calculate and provide statewide travel data
- Collect, manage, and report data on all public roads in an effort to support the strategic and performance-based goals in the SHSP and HSIP
- Maintain roadway data and its attributes
- Continue the development of data zone applications
- Install and maintain Continuous Traffic count sites
- Collect short duration traffic counts
- Provide traffic data, analysis and projections for making transportation decisions

Prior Year Accomplishments:
- Administered HPMS program
- Analyzed and provided transportation data to customers and transportation decision makers
- Provided data for the development of the MoDOT Asset Management Plan
- Conducted monthly TMS application update testing, provided support and TMS data restoration
- Created state, county, city, and/or specialty maps as needed
- Published the official Missouri State Highway Map
- Provided analysis, custom queries and reports using TMS data
- Continued development of data zone applications
- Maintained MoDOT's linear referencing system and continually worked with counties to verify local roads
- Processed portable and permanent counts in accordance with the traffic monitoring guide for HPMS submittal
- Calculated and provided statewide travel data and reports
- Collected pavement data of Missouri's roadways
- Maintained an inventory of roadway lane data and its attributes
- Collected, managed, and reported data on all public roads

Financials	Amount	Work ID Code
Projected Budget SFY 2023	**$7,881,256**	SPR2340S
Budget Amount SFY 2022	$7,086,893	SPR2240S

SAFE AND ACCESSIBLE TRANSPORTATION OPTIONS

Purpose and Scope: Incorporate planning processes that ensure the safe and adequate accommodation of all users of the transportation system, including pedestrians, bicyclists, public transportation users, children, older individuals, individuals with disabilities, motorists, and freight vehicles. This task is utilizing the 2.5% set aside of Safe and Accessible Transportation Options Planning funds.

Proposed Activities:
- Various studies to increase safe and accessible options for multiple travel modes for people of all ages and abilities

Prior Year Accomplishments:
- None

Financials	Amount	Work ID Code
Projected Budget SFY 2023	**$200,000**	SPR23SAS
Budget Amount SFY 2022	$0	

DISTRICT TRANSPORTATION PLANNING

This program supports the department's district planning staff in efforts to provide comprehensive, cooperative and continuing transportation planning assistance and direction to the district staff, MPOs and RPCs. It includes the district staff efforts and activities with the MPOs, RPCs, local government officials and federal transportation agencies that support the long-range planning process and programming of transportation needs and pre-scoping activities.

District Transportation Planning	SPR Number	SFY 2023 Budget	SFY 2022 Budget
• CD	SPR23CDS	2,016,000.00	1,520,450.00
• KC	SPR23KCS	2,490,367.00	1,933,394.00
• NE	SPR23NES	775,187.00	979,904.00
• NW	SPR23NWS	749,534.00	760,138.00
• SE	SPR23SES	1,276,962.00	1,249,427.00
• SL	SPR23SLS	1,936,935.00	1,434,074.00
• SW	SPR23SWS	1,186,971.00	822,769.00
SUBTOTAL		**10,431,956.00**	**8,700,156.00**

OTHER ACTIVITIES

INFORMATION SYSTEMS

Purpose and Scope: MoDOT is directing a portion of the SPR funds for support, maintenance and modernization of the Transportation Management System.

Proposed Activities:
- Maintain and modernize the Transportation Management System
    - Repair, maintenance and fix of current system including the following key areas of TMS that provide critical support to MoDOT users and customers: Bridge, Adopt A Highway, Outdoor Advertising, Statewide Transportation Improvement Program, Traffic & Congestion,

Pavement Tools, Maintenance Management System, Intelligent Transportation System and Safety System.

Prior Year Accomplishments:
- Provided TMS Core Maintenance Support

<u>Financials</u>	<u>Amount</u>	<u>Work ID Code</u>
Projected Budget SFY 2023	**$2,578,873**	SPR23ISS
Budget Amount SFY 2022	$2,578,936	SPR22ISS

REGIONAL PLANNING COMMISSIONS

Purpose and Scope: MoDOT is directing a portion of the SPR funds to regional planning agencies for transportation planning activities. These funds provide sources of funding for the Missouri RPCs to carry out comprehensive and continuing transportation planning processes in cooperation with state and local planning partners. State Planning and Research funds that are allocated to RPCs assist with producing regional transportation plans, work programs involving transportation planning activities, citizen involvement processes, and other rural transportation planning efforts. Seventeen RPCs will receive federal SPR funding at approximately $78,000 each. Budget and actual amounts include local match.

Proposed Activities:
- Cooperate and collaborate with MoDOT on transportation planning processes
- Attend MACOG meetings held monthly in Jefferson City to discuss various issues with RPCs
- Participate in RPCs' transportation advisory committee meetings held in the respective regions throughout the state
- RPCs work with MoDOT and districts with developing work programs involving transportation planning activities
- Participate in monthly Partner Collaboration conference calls
- Assist MoDOT in developing Unfunded Needs list

Prior Year Accomplishments:
- Attended MACOG meetings held monthly in Jefferson City to discuss various issues with RPCs
- Participated in RPCs technical committee meetings held in the respective regions throughout the state
- Worked with RPCs and districts with developing work programs involving transportation planning activities
- Attended Statewide Planning Partner meeting hosted by MoDOT
- Assisted MoDOT in developing Unfunded Needs list

<u>Financials</u>	<u>Amount</u>	<u>Work ID Code</u>
Projected Budget SFY 2023	**$1,657,500**	SPR2327S
Budget Amount SFY 2022	$1,375,000	SPR2227S

FINANCIAL SERVICES

Purpose and Scope: These activities support MoDOT's budget, finance, funds management and infrastructure bank activities. In addition, funds will be managed to achieve a balanced budget and provide coordination of STIP and federal-aid projects. The budget amount also includes personal services and fringe benefits for employees within this work unit.

Proposed Activities:
- Provide activities to support MoDOT's budget, finance, funds management and infrastructure bank activities
    - o Provide coordination of STIP and federal-aid projects
    - o Prepare financial models to support department long-term plans and short-term cash needs
    - o Provide information on innovative sources of funding for the department's transportation projects

Prior Year Accomplishments:
- Provided activities to support MoDOT's budget, finance, funds management and infrastructure bank activities

Financials	Amount	Work ID Code
Projected Budget SFY 2023	**$1,314,505**	SPR2393S
Budget Amount SFY 2022	$1,366,530	SPR2293S

BRIDGE DIVISION

Purpose and Scope: MoDOT is directing a portion of the SPR funds for Bridge Division staff spending all or a portion of their time working on projects prior to them being included in the STIP.

Proposed Activities:
- Prepare projects to be included in the STIP

Prior Year Accomplishments:
- Prepared projects to be included in the STIP

Financials	Amount	Work ID Code
Projected Budget SFY 2023	**$791,954**	SPR23BRS
Budget Amount SFY 2022	$783,855	SPR22BRS

DESIGN DIVISION

Purpose and Scope: MoDOT is directing a portion of the SPR funds for Design Division staff spending all or a portion of their time working on projects prior to them being included in the STIP. The budget also includes work for MoDOT safety initiatives.

Proposed Activities:
- Prepare projects to be included in the STIP
- Assist consultant with federal grant applications
- Develop guidance to enhance safety considerations on every project
- Develop Basic of Traffic Engineering Course
- Develop Intersection Control Evaluation (ICE) guidance and implementation
- Public Involvement for Safety System Strategies
- Planning and Activities for Smart Work Zone Implementation
- Improve safety performance through data driven approach
- Planning and Activities for Transportation Systems Management & Operations (TSMO) Strategies, including education

Prior Year Accomplishments:
- Prepared projects to be included in the STIP
- Enhanced data driven safety analysis for STIP projects
- Developed guidance for performing Transportation Impact Analysis

Financials	Amount	Work ID Code
Projected Budget SFY 2023	**$2,360,532**	SPR2395S
Budget Amount SFY 2022	$766,132	SPR2295S

COMMUNICATIONS

Purpose and Scope: The Division will direct the Customer Satisfaction Survey. This study evaluates MoDOT customer satisfaction through use of a customer survey.

Proposed Activities:
- Administer MoDOT Customer Satisfaction Survey
  - During each month of the quarter, approximately 200 people who contacted MoDOT's customer service center in the previous month are contacted by Heartland Research, LLC via telephone or a provided email address to take a short survey regarding their experience.
  - The survey data and all comments are provided to MoDOT in a detailed report each month. On the last month of the quarter, information is also provided on the results by quarter.
  - The data is reported in MoDOT's Statewide Tracker.

Prior Year Accomplishments:
- Administered MoDOT Customer Satisfaction Survey

Financials	Amount	Work ID Code
Projected Budget SFY 2023	**$25,000**	SPR23CRS
Budget Amount SFY 2022	$25,000	SPR22CRS

PART II – URBAN TRANSPORTATION PLANNING

TRANSPORTATION PLANNING IN METROPOLITAN AREAS – CONSOLIDATED PLANNING GRANT (CPG)

The U.S Department of Transportation's CPG Program allows States and Metropolitan Planning Organizations (MPOs) to merge FTA metropolitan or statewide planning funds with FHWA Planning (PL) funds to provide States support for both highway and transit planning activities to single consolidated grants. This CPG program fosters a cooperative effort between the Federal agencies and the participating States to streamline the delivery of their planning programs providing the flexibility in the use of planning funds. Beginning July 1, 2003, MoDOT elected to have FHWA PL Funds and FTA Section 5303 Metropolitan Transportation Planning Funds consolidated. As of June 2016, the designated lead agency for administering the CPG funds was changed from FTA to FHWA.

CPG funds provide the principal source of funding for Missouri MPOs to carry out a comprehensive and continuing transportation planning process in cooperation with local, state and federal transportation agencies. This process is a prerequisite for receiving federal-aid funding for transportation improvements in metropolitan areas. BIL reaffirmed the leading role of the MPOs in the transportation improvement decision-making process, particularly in the large, urbanized areas of more than 200,000 populations.

CPG funds, which are all allocated to MPOs, assist MPOs with producing long-range multimodal transportation plans, transportation improvement programs, planning work programs, studies, citizen involvement processes and other urban transportation planning requirements and goals

Under CPG, the FTA and FHWA continue to distribute metropolitan planning funds according to each agency's statutory formulas that the MoDOT distributes to MPOs by formulas that meet the legislative factors for each category of funds in 23 U.S.C. 104(f)(4) and 49 U.S.C. 5305(d)(2). MoDOT's distribution formula has been developed in consultation with the MPOs, and approved by FTA and FHWA for their respective programs.

The following chart shows the estimated amount of CPG funds (FHWA PL and FTA Section 5303) available for Missouri's MPOs to carry out the metropolitan transportation planning work activities to be budgeted for in each MPO's annual Unified Planning Work Program (UPWP). The MPOs will include the below listed CPG amounts or similar amounts in their UPWPs to complete activities necessary to carry out metropolitan transportation planning. Each MPO's UPWP is approved by the MPO's Policy Board and the FHWA/FTA (ONEDOT). Planning grant agreements based on approved UPWPs are executed between the MPOs and MoDOT to allow the pass through of FHWA PL funds and 5303 Transit funds to the MPOs. SFY 2023 allocation estimate amount used 2010 census urbanized area populations.

Table 1: Total CPG Funds Available to MPOs for SFY 2023 UPWP Work Activities

Metropolitan Areas (Fiscal Year)	MPO Balances as of May 2022 (with FY 2022 allocation)	Estimated FFY23 PL Allocation	Estimated FFY23 5303 Allocation Amounts	Estimated Total CPG Funds	Current CPG Contract Amount
NW Arkansas 07/01 -06/30	$0	$5,000	$0	$5,000	$5,000
Kansas City 01/01 - 12/31	$3,194,349	$1,855,724	$656,546	$5,706,619	$2,358,868
St. Louis 07/01 - 06/30	$13,247,577	$3,328,158	$1,240,411	$17,816,146	$4,585,004
Springfield 07/01 - 06/30	$1,271,401	$581,633	$190,982	$2,044,016	$889,575
Columbia 10/01 - 09/30	$1,013,799	$269,501	$87,039	$1,370,339	$504,276
Jefferson City 11/01 - 10/31	$651,054	$152,992	$40,840	$844,886	$252,359
Joplin 11/01 - 10/31	$847,028	$195,647	$57,754	$1,100,429	$441,689
St. Joseph 01/01 - 12/31	$883,279	$188,667	$54,986	$1,126,932	$239,534
Cape Girardeau 07/01 - 6/30	$702,831	$142,537	$36,694	$882,062	$177,627
TOTAL PART II	**$21,811,318**	**$6,719,859**	**$2,365,252**	**$30,896,429**	**$9,453,932**

* The MPOs balance is adjusted to include the actual SFY 2022 CPG allocation and equals the unobligated prior year (SFY 2022 and older) CPG allocated amounts. The MPOs balance column updates with payments of invoices and the allocation of CPG funds. The balance reported is a snapshot for the SPR work program update. The estimated total of MPOs' contracts (CPG agreements) that will be in place for the SFY 2023 SPR work program is $9,453,932.

MPOs annually program consolidated federal planning fund amounts in approved UPWPs to complete activities necessary to implement the metropolitan transportation planning process. MPO's UPWPs identify the available amounts of FHWA PL and FTA Section 5303 funds separately as funding sources but are not requested to identify the separate amounts on each work activity or in the financial summary. Each MPO's UPWP is approved by the MPO's Policy Board and the FHWA/FTA (ONE DOT). CPG agreements, based on approved UPWPs, are executed between the MPOs and MoDOT to allow the pass through of Federal planning funds to the MPOs. MPOs have up to four years to spend CPG balances.

MoDOT allows MARC, OTO and EWG (Kansas City, Springfield and St. Louis, respectively) to use the value of MoDOT's state-funded only metropolitan planning activities to leverage the CPG funds. These MoDOT District planning activities include data collection, data analysis and data sharing that supports and enhances the overall planning process within each metropolitan planning area. Activities include such work items as traffic counts, signal timing, analysis of planning and/or traffic studies and analysis of traffic volumes and safety concerns. These work items support a more informed, better decision-making process for the MPOs and can be demonstrated to be directly attributable to the MPOs planning

work elements. MPOs are able to utilize 80 percent of the value of MoDOT eligible metropolitan planning work as a credit to help provide the MPOs required 20 percent match for the Federal planning funds.

The estimated values of the MoDOT state-funded metropolitan planning work activities based on the most current fiscal year are as follows:

Kansas City MPO	$310,394
St. Louis MPO	$258,458
Springfield MPO	$82,806

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PART III – RESEARCH

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ADMINISTRATION

Purpose and Scope: Provide general administration funds for the development and monitoring of research programs that benefit the Missouri Department of Transportation. This includes distributing available information concerning past, current and proposed research work related to highways and transportation to supporting agencies; evaluation and development of proposed research studies; and, implementation and dissemination of research results.

Financials	**Amount**	**Work ID Code**
Projected Budget SFY 2023	**$468,873**	SPR23ADS
Budget Amount SFY 2022	$436,900	SPR22ADS
Actual Cost SFY 2022	(See Addendum)	SPR22ADS

RESEARCH

Purpose and Scope: Research at MoDOT primarily expands and advances our knowledge in all areas of transportation, so we may provide the best, total-transportation system for Missourians. The research program responds to our customer needs, provides information and technology for management policy decisions and undertakes research and development issues that have high possibilities of being implemented. It also includes contingency funds for contract research studies approved after the start of the fiscal year.

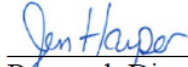| **Financials**	**Amount**	**Work ID Code**
Projected Budget SFY 2023	**$4,290,000**	SPR23RDS
Amended Budget Amount SFY 2022	$3,430,908	SPR22RDS
Actual Cost SFY 2022	(See Addendum)	SPR22RDS

TECHNOLOGY TRANSFER

Purpose and Scope: Technology transfer provides mechanisms to coordinate the transfer of research results and information with MoDOT divisions and districts as well as with outside organizations. The Local Technical Assistance Program provides transportation information and training opportunities to local transportation agencies. Funding is provided to match other funds to support the BEAP and the TEAP. These programs offer assistance to local entities for bridge design and traffic studies. In addition, technology transfer provides direction and support to department personnel to maintain an understanding of new methodologies and technologies.

Financials	**Amount**	**Work ID Code**
Projected Budget SFY 2023	**$650,000**	SPR23TTS
Budget Amount SFY 2022	$620,000	SPR22TTS
Actual Cost SFY 2022	(See Addendum)	SPR22TTS

Certification Statement

I, Jen Harper, Research Director, of the State of Missouri, do hereby certify that the State is in compliance with all requirements of 23 U.S. Code 505 and its implementing regulations with respect to the research, development, and technology transfer program, and contemplate no changes in statutes, regulations, or administrative procedures which would affect such compliance.

_____   6/17/2022
Research Director   Date

Part III Research Summary

Project No.	Project Name	SFY 2023 Budget
TA206601	Research Administration	$468,873
TR22CONT	Research Contingencies	$262,446
TR201313	Secretary of State Library MOU	$5,210
TR201610	AASHTO Technical Service Program FY22 & FY23	$190,000
TR201813	Leader-Follower TMA System	$357,449
TR201814	Leader-Follower TMA System Misc. Expenses	$27,531
TR202007	Geotechnical Asset Management of NW and NE	$60,905
TR202010a	Missouri Systemic Countermeasures to Improve Pedestrian Safety	$126,139
TR202013	The Effect of Rubber Fills on the Performance of Infrastructure Phase 1	$1,549
TR202016	Monitoring an Active Landslide on Route 465 Near Branson	$43,158
TR202017	Scour Analysis at Missouri Bridges	$67,443
TR202020	Evaluation of Recycled Components in SMA Mixes	$82,625
TR202025	MCTI Administration	$75,000
TR202102	Safety Evaluation of Flashing Yellow Left-Turn Arrows in Missouri	$87,763
TR202103	Lightweight Deflectometer (LWD) for Acceptance of Unbound Materials	$13,724
TR202107	TITANv2 – Interactive, Web-Based Platform for Transportation Data Integration, Visualization and Predictive Analytics	$100,000
TR202109	Impact of Silt and Clay Particles on Freshwater Mussels	$50,000
TR202110	Industrial Internet-of-Things Asset Monitoring-Phase 2	$40,000
TR202110a	Industrial Internet of Things Drilling	$17,000
TR202111	Deep Learning for Unmonitored Water Level Prediction and Risk Assessment	$37,564
TR202112	GFRP Reinforced Barrier Curbs	$369
TR202113	Fiber Reinforced Concrete for Bridge Decks and Overlays	$40,707
TR202114	Accessing Standards and Specifications	$33,259
TR202115	Effectiveness of Speed Management Methods in Work Zones	$79,786
TR202117	Asset Management for Mobility and Intelligent Transportation Systems	$19,816
TR202121	Perform. of Cost-Effec. Non-Prop. UHPC in Thin Bonded Bridge Overlay	$88,406
TR202122	LRFR Methodology for Missouri Bridges	$111,707
TR202123	High Tension Guard Cable Inspection and Life Cycle	$150,000
TR202124	Implementation of Data QA for Innovative Technology at MoDOT	$34,020
TR202125	Lab and Field Evaluation of Asphalt Mixtures with Post-Consumer Recycled Plastic Waste, Phase II	$23,938
TR202201	Library Support Contract (2022-2023)	$115,276
TR202202	Deep Learning Models and Tools for Disaster Evacuation and Routing	$174,874
TR202203	Intermediate Bents-Calculation of Restraint Factor	$75,000
TR202204	Type N PTFE Bearing Designs	$50,000
TR202205	Analysis of Asphalt Mix. Using Alternative Aggregate in SMA or SuperPave	$100,000
TR202206	Friction Enhancements to Asphalt Pavement Surfaces	$100,000
TR202207	Pile Set-up and Restrike Procedures	$80,000

TR202208	Bats and Bridges-Best Practices	$81,465
TR202210	Increasing Revenue from Amtrak	$63,871
TR202212	Mitigating and Preventing MoDOT Safety-Related Incidents through Root-Cause Elimination and Utilization of Leading Safety Indicators	$125,000
TR202213	Ingress and Egress in the St. Louis Region in the Aftermath of an Earthquake in the St. Louis Region	$75,000
TR202214	Devel. a Hazard Detection and Alert System to Prevent Worker Fatalities	$115,000
TR202215	MoDOT Data Acq.& Data Processing Utilizing AI and Machine Learning	$125,000
TR202216	I-155 Pemiscot County NRRA Test Sections for the Mobile Test Track	$145,000
TR202219	HFST Review of Service Life	$75,000
TR202221	Consultant Support for Intelligent Compaction and Paver-Mounted Thermal Profiling Projects in 2022-2023	$200,000
TR202222	Consultant Support for Intelligent Compaction and Paver-Mounted Thermal Profiling Projects in 2022-2023 Misc. Expenses	$5,000
TR202301	GPR Analysis of I-44 Pavement Data	$7,000
TR202302	Recent Developments and Technology Assessment of Automated Weather Observing Systems	$25,000
TR202303	Consultant Estimating	$25,000
TR202304	Investigating the Expanded Use of Waste Plastic in Asphalt	$75,000
TR202305	Asphalt Binder Replacement Performance	$25,000
TR202306	River Gravel in Asphalt Mixes	$25,000
TR202307	Investigation of the HVSR (Horizontal-to-Vertical Spectral Ratio) Method to Determine Site Class for Seismic Design	$25,000
TR202308	LRFD seismic maps	$25,000
TR202309	Audible Alert and TMA Lighting	$25,000
TR202310	Magnesium Chloride and Cement Paste	$25,000
TR202311	Asset Characterization Using Automated Methods	$25,000
Potential PF	Quality Assurance Techniques for Innovative Construction Technologies	$0
Potential PF	Missouri/Kansas 2022 Peer Exchange Pooled Fund	$40,000
Potential PF	CO2 Reduction in Concrete Pooled Fund (name will change)	$10,000
TTAPT001	Local Technical Transfer Assistance Program (LTAP)	$335,000
S068202C	FY20 009 MoSTIC LTAP Safety Circuit Rider 2020, 2021 & 2022	N/A
TT200701	National Highway Institute (NHI)	$40,000
TTAPT001	BEAP and TEAP	$275,000
	Total	**$5,408,873**

Pooled Funds

TPF-5(317)	Evaluation of Low-Cost Safety Improvements	$5,000
TPF-5(343) / Solic 1567	Roadside Safety Research for MASH Implementation	$65,000
TPF-5(357)	Connecting the DOTs: Implementing ShakeCast	$15,000
TPF-5(385)	Pavement Structural Evaluation with Traffic Speed Deflection Devices	$45,000
TPF-5(396)	Mid-America Freight Coalition (MAFC) Phase 3 (new solic. coming in 23)	$50,000 est.

TPF-5(430)	Midwest Roadside Safety Pooled Fund Program	$65,000
TPF-5(435)	Aurora Program (FY20-FY24)	$25,000
TPF-5(437)	Technology Transfer Concrete Consortium (FY20-FY24)	$8,000
TPF-5(438)	Smart WZ Deployment Initiatives (FY20-FY24)	$50,000
TPF-5(441)	No Boundaries Transportation Maintenance Innovations	$10,000
TPF-5(447)	Traffic Control Device (TCD) Consortium (3)	$25,000
TPF-5(448)	Integrating Construction Practices and Weather Into Freeze Thaw Specs	$0
TPF-5(460)	Flood-frequency Analysis in the Midwest	$55,600
TPF-5(463)	Pavement Surface Properties Consortium: Phase III - Managing the Pavement Properties for Improved Safety	$20,000
TPF-5(464)	Hydrologic and Hydraulic Software Enhancements (SMS, WMS, Hydraulic Toolbox, and HY-8)	$10,000
TPF-5(465)	Consortium for Asphalt Pavement Research and Implementation (CAPRI)	$14,000
TPF-5(466)	National Road Research Alliance - NRRA (Phase II)	$150,000
TPF-5(471)	Real-time Monitoring of Concrete Strength	$25,000
TPF-5(479)	Clear Roads Phase III (previously TPF-5(353)	$25,000
TPF-5(485)	Consequences-Based Analysis of Undrained Shear Behavior of Soils and Liquefaction Hazards, Phase 1: Filling the Data Gaps	$20,000
TPF-5(487)	Transp. Management Center Pooled Fund Study (previously TPF-5(319))	$50,000
TPF-5(495)	Tech. Exchange on Low Volume Road Design, Const. and Maintenance	$12,000
Solic. 1569	Cont. Bituminous Pvmnt Stripping Asses. Through Non-destructive Testing	$25,000
Solic. 1577	Highway Safety Manual 2nd Edition (HSM2) Implementation	$16,000
N/A	Transportation Pooled Fund Contingency	$64,400
	Total Pooled Funds	$850,000
	TRB Core Subscription estimate	$207,000
	NCHRP FY 2023 estimate	$1,294,000
	Total	**$2,351,000**

Administration – SPR23ADS

Estimated Cost - $468,873

TAyy6601 – Research Administration

Project Type: Contracts Other
MoDOT Contact: Jen Harper
Total Contract Amount SFY 2023: $468,873
Contract Period: 7/1/1966 to 6/30/2023
Funding: SPR 80%, State 20%

Project Description and Objectives:
Research administration is a funding source for the administration of research activities. The type of project is "contract other" because project work will include contract management. The purpose of this item is to provide funds for the development and monitoring of a program designed to meet the research needs of the Missouri Department of Transportation.

Proposed Activities for SFY 2023:
The salary and expenses of the Research Director and Research Analysts will be charged against this item.

SFY 2022 Accomplishments:
The Research Section had 55 active contract research projects and a total of 10 projects were completed at the end of the third quarter. The Research Section also published 13 reports as of May 1, 2022.

Financials	**Amount**
Projected Budget SFY 2023	$468,873
Budget Amount SFY 2022	$436,900
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	N/A

Research – SPR23RDS

Estimated Cost - $4,290,000

TRyyCONT – Research Contingencies

Project Type: Contracts Other
MoDOT Contact: Jen Harper
Total Contract Amount: $262,446
Contract Period: 7/1/2022 to 6/30/2023
Contract Investigator: N/A
Funding: SPR 80%, State 20%

Project Description and Objectives:
Research and development contingencies are funds for unanticipated costs on current or new activities. These funds are for proposed research projects that are in the initiation stage and for unanticipated projects during the year. The type of project is "Contract Other" because project funded work will include contract management and contract expenditures.

Proposed Activities for SFY 2023:
In addition to funds for unanticipated costs on current or ongoing activities, funds have been included for studies that may be initiated during State Fiscal Year 2023. These include administrative and other eligible costs.

SFY 2022 Accomplishments:
Four new projects were approved for funding in State Fiscal Year 2022 and a few budget increases due to COVID-19. The new projects are:
TR202010a Missouri Systemic Countermeasures to Improve Pedestrian Safety (new contract)
TR202110a Industrial Internet of Things Drilling
TR202221 Consultant Support for Intelligent Compaction and Paver-Mounted Thermal Profiling Projects in 2022-2023
5102402C Post-Consumer Recycled Plastic Waste, Phase II—Columbia Stadium Blvd Implementation Project

Financials	**Amount**
Projected Budget SFY 2023	$262,446
Budget Amount SFY 2022	$30,255
Adjusted Budget Amount SFY 2022	$0
Actual Cost SFY 2022	N/A
Prior to SFY 2022 Actual Cost	N/A

TR201313 – Secretary of State Library MOU

Project Type: Contract Research
MoDOT Contact: Jen Harper
Total Contract Amount: N/A
Contract Period: 7/1/2013 to 6/30/2023
Contract Investigator: Laura Kromer
Funding: SPR 80%, State 20%

Project Description and Objectives:
MoDOT has established a library to serve employees, researchers and industry partners. This library contains materials (hardcopy and electronic) that are catalogued according to current national bibliographic standards. MoDOT and the Secretary of State Library have executed a Memorandum of Understanding that outlines the responsibilities of each organization. MoDOT and the Secretary of State Library agree to maintain the MoDOT library collection at the Missouri State Library. The library holdings will be included in the state library's integrated online library catalog. The bibliographic records in the MoDOT library collection will be included in the statewide MOBIUS catalog to facilitate resource sharing.

Proposed Activities for SFY 2023:
It is expected that the SFY 2022 invoice will be received and sent for payment during the first quarter.

SFY 2022 Accomplishments:
The MOU with the Secretary of State's office was signed at the end of FY2021. This triggered the invoice to be sent for MoDOT's portion of MOBIUS. The invoice was paid on August 18, 2021.

Financials	**Amount**
Projected Budget SFY 2023	$5,210
Budget Amount SFY 2022	$5,189
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	N/A

TR201610 – AASHTO Technical Service Program FY22 & FY23

Project Type: Contract Research
MoDOT Contact: Jen Harper
Total Contract Amount: $380,000
Contract Period: 7/1/2021 to 06/30/2023
Contract Investigator: FHWA
Funding: SPR 100%

Project Description and Objectives:
Each year, the Standing Committee on Highways and the board of directors of American Association of State Highway and Transportation Official's (AASHTO) approves the listing of Technical Service Programs. The type of project is "Contract Other" because the project is to participate in the Technical Service Programs. The purpose of this item is to support continued participation in various AASHTO Technical Service Programs.

Proposed Activities for SFY 2023:
MoDOT's Construction and Materials Division is expected to participate in the following AASHTO Technical Service Programs for State Fiscal Year 2023:
• National Transportation Product Evaluation Program (NTPEP), $20,000.
• AASHTO Innovation Initiative (AII), formerly Technology Implementation Group (TIG), $6,000.
• Transportation Curriculum Coordination Council (TC3), $20,000
• Technical Service Program to Develop AASHTO Materials Standards (DAMS), $10,000.
• Technical Service Program AASHTO Resource (formerly AMRL), $20,000.
The total amount for SFY2023 for Construction and Materials is $76,000. Other MoDOT Divisions are participating in various Technical Service Programs that total up to $114,000 making the total MoDOT TSP commitment $190,000.

SFY 2022 Accomplishments:
Multimodal requested that their TSPs use SPR Part B funding this year. A request was made to FHWA and approval was given, so the Multimodal TSPs were paid for with SPR Part B funds from Research this fiscal year. Research worked with Multimodal to get these funds identified in their budget for Fiscal Year 2023. The AASHTO Resource TSP which comes in the fall (not with the rest of the TSPs) was received in early October and posted on October 4, 2021. Research worked with each Division to ensure funds were in their budgets during spring refresh.

Financials	Amount
Projected Budget SFY 2023	$190,000
Budget Amount SFY 2022	$180,000
Adjusted Budget Amount SFY 2022	$190,000
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	N/A

TR201807 – Understanding and Improving Heterogeneous, Modern Recycled Asphalt Mixes-Completed

Project Type: Contract Research
MoDOT Contact: Jen Harper

Total Contract Amount: $580,567
Contract Period: 3/1/2018 to 8/31/2021
Contract Investigator: Bill Buttlar
Funding: SPR 80%, State 20%

Project Description and Objectives:
The research goal will be to focus on high-type mixes (MoDOT Sec. 403 mixes), although findings will provide useful insight for all asphalt mixes used in Missouri. A comprehensive suite of binder and mixture tests will be carried out in order to link mix designs and materials to eventual field performance (rutting, cracking, and moisture damage predictions). This project will allow us to evaluate the potential performance of modern crumb rubber mixes, RAP and RAS mixtures, and rejuvenators in Missouri.

Proposed Activities for SFY 2023:
This project was completed in SFY 2022.

SFY 2022 Accomplishments:
The draft report was submitted and reviewed by the technical committee. Comments and corrections were submitted to the research team and the final report was received. The report was published in the innovation library in October. The final invoice posted on November 1, 2021. This project is completed.

Financials	Amount
Projected Budget SFY 2023	$0
Budget Amount SFY 2022	$26,703
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	$553,864

TR201813 – Leader-Follower TMA System

Project Type: Contract Research
MoDOT Contact: Jen Harper
Total Contract Amount: $549,921
Contract Period: 3/5/2018 to 12/31/2022
Contract Investigator: Robert Cabido
Funding: SPR 80%, State 20%

Project Description and Objectives:
MoDOT's mobile and slow-moving operations, such as striping, sweeping, bridge flushing and pothole patching, are critical for efficient and safe operation of the highway transportation system. MoDOT's slow moving operations have been crashed into over 80 times since 2013 resulting in many injuries to MoDOT employees. The objective of this RFP is to provide a NCHRP 350 Level 3 compliant Leader-Follower TMA System capable of operating a driverless rear advanced warning truck in mobile highway operations as described in Traffic Application TA-35a. The system shall consist of a Lead Truck (LT) and a Rear Advanced Warning Truck called the Follow Truck (FT). The goal is to avoid operator injury by eliminating the need for a human operator in the FT.

Proposed Activities for SFY 2023:
It was anticipated some of the 250-hour testing in a live mobile work zone will have taken place in State Fiscal Year 2022, but it is unlikely it will have been completed. At least the first quarter will likely be

spent completing the 250-hour live-road test. Once the testing is completed, Kratos will submit the final report for review and acceptance.

SFY 2022 Accomplishments:
At the end of June 2021 one of the trucks had an emissions issue. The part was on backorder due to COVID-19 supply chain issues. The truck was released from the dealership on September 2nd, 2021, but unfortunately most of the striping season was lost due to this downtime. Another extension was executed in December. During the winter some upgrades were done to the firmware. Testing started back up during the spring striping season.

Financials	**Amount**
Projected Budget SFY 2023	$357,449
Budget Amount SFY 2022	$357,449
Adjusted Budget Amount SFY 2022	$0
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	$192,472

TR201814 – Leader-Follower TMA System Misc. Expenses

Project Type: Contract Research
MoDOT Contact: Jen Harper
Total Contract Amount: $70,000
Contract Period: 3/5/2018 to 12/31/2022
Contract Investigator: N/A
Funding: SPR 80%, State 20%

Project Description and Objectives:
This project is set up for the miscellaneous expenses for the Leader-Follower TMA project that are not part of the contract. Items such as shipping of the trucks to the contractor would fall under this project number.

Proposed Activities for SFY 2023:
It is unclear if additional miscellanous expenses will be required for State Fiscal Year 2023.

SFY 2022 Accomplishments:
There were no charges this fiscal year.

Financials	**Amount**
Projected Budget SFY 2023	$27,531
Budget Amount SFY 2022	$19,298
Adjusted Budget Amount SFY 2022	$0
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	$42,469

TR201904 – Compacted Concrete Pavement-SE District-Completed

Project Type: Contract Research
MoDOT Contact: Jen Harper

Total Contract Amount: $125,000
Contract Period: 9/28/2018 to 12/31/2021
Contract Investigator: Kamal Khayat
Funding: SPR 80%, State 20%

Project Description and Objectives:
In order to assess the construction issues and characterize the long-term performance of Compacted Concrete Pavement (CCP), three CCP test sections made with and without fiber will be part of a larger project constructed in Scott County, Missouri. The test section pavement will be designed and tested. The project objective is to determine the performance of designed CCP mixtures given special design features and durability of surface texture through field implementation and detailed laboratory testing. The primary performance characteristics include mechanical properties, drying shrinkage, durability, optimum joint spacing, and enhancement of joint load transfer gained from fiber-reinforcement of the pavement.

Proposed Activities for SFY 2023:
This project was completed in SFY 2022.

SFY 2022 Accomplishments:
The only work that occurred during SFY 2022 was preparing the final report. The final report was submitted on December 13, 2021. The final report was published in January 2022. The final invoice was paid on January 31, 2022. This project is complete.

Financials	Amount
Projected Budget SFY 2023	$0
Budget Amount SFY 2022	$547
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	$124,453

TR202001 – Library Support Contract (2020-2021)-Completed

Project Type: Contract Research
MoDOT Contact: Jen Harper
Total Contract Amount: $225,640
Contract Period: 7/1/2019 to 6/30/2021
Contract Investigator: Henry Brown
Funding: SPR 80%, State 20%

Project Description and Objectives:
The demand for information services has increased as more MoDOT users are realizing the timely, diverse and high-quality information they receive using the services of the current librarian. The major objective of this project is to provide library, research and reference support services for MoDOT. University of Missouri-Columbia will provide the services of a Master of Library Science (MLS) librarian who will work 40 hours per week and will be located at the Secretary of State's State Library and MoDOT in Jefferson City.

Proposed Activities for SFY 2023:
This project was completed in SFY 2022.

SFY 2022 Accomplishments:
The only thing left during SFY 2023 was the final invoice which was paid on October 19, 2021. This project is closed out.

Financials	Amount
Projected Budget SFY 2023	$0
Budget Amount SFY 2022	$0
Adjusted Budget Amount SFY 2022	$37,706
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	$187,934

TR202002 – Snow and Ice Treatment Products Evaluation-Completed

Project Type: Contract Research
MoDOT Contact: Ryan Martin
Total Contract Amount: $99,461
Contract Period: 8/16/2019 to 11/31/2021
Contract Investigator: Dr. Jenny Liu
Funding: SPR 80%, State 20%

Project Description and Objectives:
The Missouri Department of Transportation (MoDOT) Maintenance Division employs various tools to reduce the impact of snow and ice on State travelways. Rock salt (sodium chloride) has been used for decades as the primary snow and ice treatment solution, as both a spread solid and sprayed brine solution, to treat the pavement before and during inclement weather. In addition, abrasives such as sand or cinders are sometimes utilized in an attempt to provide a level of skid resistance in situations when temperatures render chloride treatment less effective. Both treatments have been deployed on state routes for many a winter and are considered the standard. MoDOT would like an evaluation of chemical treatments, including those being chloride-based and agriculture-based, in addition to viable alternatives on the market. The evaluation will address the cost effectiveness of the treatments, the impacts to varied pavement structures and the overall performance of the treatments.

Proposed Activities for SFY 2023:
This project was completed in SFY 2022.

SFY 2022 Accomplishments:
The draft final report was received on August 15, 2021 and was reviewed. The final report was submitted in October. The report was posted in the Innovation Library in December. The final invoice was paid on January 31, 2022. This project is complete.

Financials	Amount
Projected Budget SFY 2023	$0
Budget Amount SFY 2022	$61
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	$99,400

TR202005 – Evaluation of Alternatives to Calcined Bauxite for HFST-Completed

Project Type: Contract Research
MoDOT Contact: Brent Schulte
Total Contract Amount: $116,974
Contract Period: 11/22/2019 to 9/1/2021
Contract Investigator: Dr. Magdy Abdelrahman and Dr. John Myers
Funding: SPR 80%, State 20%

Project Description and Objectives:
Maintaining the appropriate amount of pavement friction is critical for safe driving. High friction surface treatment (HFST) can enhance the ability of a road surface to provide pavement friction to vehicles in critical braking or cornering maneuvers. MoDOT has used HFST since 2013 to restore pavement surface friction where traffic has worn down pavement surface aggregates and also to improve wet crash locations. Although several aggregates have been evaluated, only calcined bauxite aggregate has met the threshold for performance necessary to be called a HFST. Currently, calcined bauxite is the primary aggregate used for HFST in Missouri. Calcined bauxite has very limited sources, which makes it more expensive than locally available aggregates. The objective of this study is to identify and compare alternatives to calcined bauxite through testing and laboratory evaluation.

Proposed Activities for SFY 2023:
This project was completed in SFY 2022.

SFY 2022 Accomplishments:
The final report was received on September 2, 2021 and posted to the Innovation Library September 24, 2021. The final invoice was posted on October 19, 2021. This project is completed.

Financials	Amount
Projected Budget SFY 2023	$0
Budget Amount SFY 2022	$8,916
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	$108,058

TR202007 – Geotechnical Asset Management of NW and NE

Project Type: Contract Research
MoDOT Contact: Brent Schulte
Total Contract Amount: $114,864
Contract Period: 9/26/2019 to 12/31/2022
Contract Investigator: Aine Mines
Funding: SPR 80%, State 20%

Project Description and Objectives:
The goal of Geotechnical Asset Management is to align asset design, operation and maintenance decisions with the goals and objectives of an agency. Geotechnical Asset Management of Missouri's rock slopes, engineered embankments, retaining walls, subgrades and sinkholes can be a vital tool for MoDOT to successfully operate its transportation system. The objective of this project is to create a Geotechnical Asset Management (GAM) program along with condition and risk assessment of MoDOT's Northwest and Northeast Districts. The preferred (GAM) program developed in this project would be a mobile

application or a cloud-based program that could be executed from a smart phone or tablet while in the field.

Proposed Activities for SFY 2023:
The researchers will begin working on field data collection in early State Fiscal Year 2023. Once the field work has been completed the research team can finalize the GAM program. An extension was approved so now the draft report and research summaries are due September 31, 2021. The final report is due November 30, 2022 with the contract ending December 31, 2022.

SFY 2022 Accomplishments:
Landslide Tech (LT) worked with the technical committee, IT, and other MoDOT representatives to finalize the data collection application and database tables within MoDOT's TMS and ESRI's Portal systems. MoDOT's IT and TMS groups worked to make sure that data will be collected and managed within TMS in a way that works with the Survey123 interface. LT staff have received MoDOT accounts to access the IT Portal. LT will schedule travel for field inspections once TMS completes their work and the technical committee completes the internal testing of the new Survey123 data collection app. At that point the researchers required an additional time and cost extension. Landslide Tech (LT) had continued to respond to questions from the TMS group as they arose. The project had been extended again following input from TMS on their internal timeline. MoDOT's IT and TMS groups have been using information provided in the previous quarters to build the data collection and storage infrastructure. The IT group sent two phones that could connect the virtual private network (VPN) and be used for field work, and one phone was set up without issue to test the Survey123 App. The app needed to be reviewed and finalized. As of mid-June errors with the app have still prevented the field collection.

Financials	**Amount**
Projected Budget SFY 2023	$60,905
Budget Amount SFY 2022	$66,350
Adjusted Budget Amount SFY 2022	$5,445
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	$48,514

TR202009 – Optimizing Work Zone Zipper Merge Operations Using Driving Simulations-Completed

Project Type: Contract Research
MoDOT Contact: Ryan Martin
Total Contract Amount: $130,000
Contract Period: 11/1/2019 to 9/30/2021
Contract Investigator: Carlos Sun
Funding: SPR 80%, State 20%

Project Description and Objectives:
The zipper merge concept can reduce time lost in the queue prior to a work zone, driver frustration and accidents that commonly occur when less efficient merging techniques are employed. Even with these benefits, the zipper merge is not always the most ideal merging operation for all scenarios. Travelways with higher speeds, irregular lane setups, large variations in observed traffic speeds, and other situations might not be prime zipper merge candidates. This project will utilize a driving simulator study to help to identify the most appropriate travelway situations for implementing the zipper merge along with the most

effective signage and sign packages to help the traveling public properly navigate the closure of lanes prior to a work zone.

Proposed Activities for SFY 2023:
This project was completed in SFY 2022.

SFY 2022 Accomplishments:
The draft final report was received in August and reviewed by the TAC. The report was returned to the researchers with comments and recommendations. The final report was received and accepted early second quarter. The report was published in the Innovation Library in December. The final invoice posted on December 7, 2021. This project is complete.

Financials	**Amount**
Projected Budget SFY 2023	$0
Budget Amount SFY 2022	$17,296
Adjusted Budget Amount SFY 2022	$42,296
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	$87,704

TR202010 – Missouri Systemic Countermeasures to Improve Pedestrian Safety—Canceled

Project Type: Contract Research
MoDOT Contact: Ryan Martin
Total Contract Amount: $79,916
Contract Period: 11/25/2019 to 10/31/2021
Contract Investigator: Jalil Kianfar
Funding: SPR 80%, State 20%

Project Description and Objectives:
Pedestrian safety on and around Missouri's travelways is of the utmost importance to MoDOT and our county, city and other local partners. Improving awareness in the driving public and visibility for pedestrians at uncontrolled crossings is not a one-size-fits-all approach, and many variables contribute to making one or more safety measures more ideal than another proven option when addressing pedestrian crossings. This project will focus on providing an easy-to-use tool for local and state selection of better pedestrian safety countermeasures. Long-term measures of success would be implementation of more and better pedestrian improvements, followed by annual decreases in pedestrian related crashes and pedestrian fatalities.

Proposed Activities for SFY 2023:
This project is being completed under a new contract which is project TR202010a.

SFY 2022 Accomplishments:
The draft report was due in July but the PI continued to miss the deadlines and not respond to correspondence. A decision was made to terminate the contract with SLU. The letter to terminate the project was sent via USPS Certified Mail on September 8th, 2021 and e-mailed to SLU and the PI. SLU acknowledged receipt. The data was turned over to MoDOT in October and sent to Arora and Associates so they could develop a workplan and timeline for completing the project. The contract was signed with Arora and Associates. All work will be moved under the new number, TR202010a. The final invoice from SLU was finally received and paid on February 8, 2022. This project is closed.

Financials	Amount
Projected Budget SFY 2023	$0
Budget Amount SFY 2022	$19,699
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	$60,217

TR202010a – Missouri Systemic Countermeasures to Improve Pedestrian Safety

Project Type: Contract Research
MoDOT Contact: Jenni Hosey
Total Contract Amount: $131,884
Contract Period: 4/1/22 to 11/15/22
Contract Investigator: Priscilla Tobias
Funding: SPR 80%, State 20%

Project Description and Objectives:
Pedestrian safety on and around Missouri's travelways is of the utmost importance to MoDOT and our county, city and other local partners. Improving awareness in the driving public and visibility for pedestrians at uncontrolled crossings is not a one-size-fits-all approach, and many variables contribute to making one or more safety measures more ideal than another proven option when addressing pedestrian crossings. This project will focus on providing an easy-to-use tool for local and state selection of better pedestrian safety countermeasures. Long-term measures of success would be implementation of more and better pedestrian improvements, followed by annual decreases in pedestrian related crashes and pedestrian fatalities.

Proposed Activities for SFY 2023:
The final report draft is due August 15, 2022 with the final report due October 14, 2022.

SFY 2022 Accomplishments:
The contract was signed with Arora and Associates in February with a start date of April 1, 2022. A kick-off meeting was held between MoDOT Research, Arora staff, and members of the TAC on April 8, 2022. TAC members reevaluated / reprioritized pedestrian safety countermeasures for the consultant to consider in the report.

Financials	Amount
Projected Budget SFY 2023	$126,139
Budget Amount SFY 2022	$0
Adjusted Budget Amount SFY 2022	$5,745
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	$0

TR202012 – Evaluation of MO Bridge Inventory for Effective Service Life-Completed

Project Type: Contract Research
MoDOT Contact: Jen Harper
Total Contract Amount: $193,280
Contract Period: 4/2/2020 to 9/1/2021

Contract Investigator: Glenn Washer and John Myers
Funding: SPR 80%, State 20%

Project Description and Objectives:
The Missouri National Bridge Inventory data for the past 27 years is available for downloading in a text format from FHWA's website. By using data mining techniques to retrieve and organize this data, information can be derived for the deterioration of different bridge systems that have been used over the years. Developing deterioration curves for the various rated items on bridges and culverts is desired for use by MoDOT for their data driven asset management plan. Knowing approximately how many years each part of a bridge (deck, superstructure, substructure) or a culvert will be at a particular NBI rating can lead to more informed programming decisions within the asset management plan. MoDOT is interested in the trends in deterioration for different types of bridges on the MoDOT system based on some of the following criteria: structure type, era of construction, span length, material type, traffic volume, and environmental exposure. The research team will also provide recommendations of which types of bridges have been cost effective.

Proposed Activities for SFY 2023:
This project was completed in SFY 2022.

SFY 2022 Accomplishments:
The draft report was received on August 4, 2021. MoDOT reviewed the report and sent comments and suggestions to the research team. There were several issues with 508 compliance that needed to be addressed as well. The university sent a new draft of the report based on the MoDOT TAC feedback in December. A few tweaks to the report were still required. The final report was received in the third quarter and was posted in the Innovation Library. The final invoice was paid on March 28, 2022. This project is complete.

Financials	Amount
Projected Budget SFY 2023	$0
Budget Amount SFY 2022	$36,433
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	$156,847

TR202013 – The Effect of Rubber Fills on the Performance of Infrastructure Phase 1

Project Type: Contract Research
MoDOT Contact: Jen Harper
Total Contract Amount: $170,066
Contract Period: 10/15/2019 to 12/31/2022
Contract Investigator: Dr. Mohamed Elgawady
Funding: SPR 80%, State 20%

Project Description and Objectives:
This project investigates using large chips of scrap tires having various shapes and sizes as tire derived aggregate (TDA) in different infrastructure applications including subgrade fill and the core of embankment fills as well as backfill material for retaining walls and bridge abutments. The TDA possesses unique engineering properties of being durable, lightweight, allowing drainage, and having cohesive abilities. Due to its lightweight, using TDA backfill will reduce the lateral pressures on retaining walls and bridge abutments which can reduce the design forces and hence lighter structural

elements can be used. The lightweight backfill will also reduce the settlement of underlying soils and increase the global stability of the structural elements which may allow using a spread footing rather than deep foundations leading to significant savings in the construction costs. The drainage capabilities of the TDA can eliminate the need for a clean granular backfill.

Proposed Activities for SFY 2023:
Testing will be concluded in the summer. Work will then focus on documenting the required engineering parameters of rubberized soil for use on DOT projects. The research team will also finalize the specifications to build the shear box and a procedure to that can be used in situ by MoDOT engineers and staff. The final report is due late fall and the final at the end of November.

SFY 2022 Accomplishments:
Work progressed slowly due to the COVID restrictions within the lab. A one year no cost extension was given in early fall. The soil and soil/TDA mixture properties were completed. Running the full-scale shear boxes resulted in inconsistent results. It is worth noting that this is the largest shear box in the world and having some difficulties during testing is anticipated. The issue with the test setup was determined and testing will be resumed and concluded over the summer.

Financials	Amount
Projected Budget SFY 2023	$1,549
Budget Amount SFY 2022	$56,609
Adjusted Budget Amount SFY 2022	$55,060
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	$113,457

TR202014 – Impact Factor for Winter Severity Indices-Completed

Project Type: Contract Research
MoDOT Contact: Ryan Martin
Total Contract Amount: $139,966
Contract Period: 4/15/2020 to 12/15/2021
Contract Investigator: Richard Bennett
Funding: SPR 80%, State 20%

Project Description and Objectives:
Winter severity indices have been utilized for several years by a variety of groups and organizations who deal with winter weather. These indices take into account weather attributes such as total snow and/or ice accumulation, snow and ice rates, persistence of cold weather and other variables, and quantify those attributes by event or events to give a historical perspective of the weather being evaluated. This index can then be used to compare response costs to weather events of varying intensities. Unfortunately, the intensity of the weather event alone doesn't give the full picture of the challenges of responding to that event. The true "total" cost of [responding to] a winter event is affected by a combination of the severity, timing and location of the winter event, along with its effect on the surface transportation system and area traffic. The purpose of this research project is to determine those impacts, quantify them, and develop a factor that can be applied to a winter severity index value to take into account the timing, location and underlying effects of those winter events and to normalize the events for reporting purposes.

Proposed Activities for SFY 2023:
This project was completed in SFY 2022.

SFY 2022 Accomplishments:
The Research team completed Task 4 (Establish Baseline Standards for Measures/Factors) and Task 5 (Data Evaluations and Impact Calculations), along with working on putting finishing touches on the Impact Calculation Tool (Task 6) during the first quarter. Also during the first quarter the researcher submitted a draft report for TAC review. A meeting was held with the TAC to review the dashboard and impact tool setup, solicit feedback, and provide directions on use and getting the most out of the tool. The tool was received and used in the January 1st winter event. The final report was received and published in February. The final invoice was paid on February 17, 2022. This project is closed.

Financials	Amount
Projected Budget SFY 2023	$0
Budget Amount SFY 2022	$59,174
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	$80,792

TR202015 – Using Thermal Integrity Profiling for Detecting Defects in Drilled Shafts-Completed

Project Type: Contract Research
MoDOT Contact: Brent Schulte
Total Contract Amount: $149,985
Contract Period: 4/1/2020 to 12/31/2021
Contract Investigator: Andy Boeckmann
Funding: SPR 80%, State 20%

Project Description and Objectives:
Drilled shafts are deep foundations used to support structures with large axial and lateral loads and are constructed by excavating cylindrical shafts into the ground and filling them with concrete. The construction of the drilled shafts relies heavily on good practices from the contractor, engineer and inspector to produce a quality foundation element. Most installation methods involve blind concreting, so it is difficult to be certain of an intact concrete mass of the intended dimensions. The objective of this project is to evaluate the effectiveness, accuracy and cost of using Thermal Integrity Profiling versus Cross-Hole Sonic Logging for detecting defects in drilled shafts used in deep foundation construction for MoDOT. MoDOT also wants to evaluate the use of optical fiber-based TIP or other materials/techniques as opposed to the conventional thermal wire-based TIP for detecting defects in drilled shafts. This project will include both laboratory and field investigation.

Proposed Activities for SFY 2023:
This project was completed in SFY 2022.

SFY 2022 Accomplishments:
The research team completed analysis of the data collected during the field research. Data analysis included creating summary reports for the as-built construction data, summary plots for conventional TIP data, and reports for the SONICaliper data. The research team completed the draft report, addressed a few minor formatting issues, responded to comments, and revised the report accordingly. The research team made a final presentation to the project committee. The final report was submitted and was posted to the Innovations Library. The final invoice was posted on December 30, 2021.

Financials   **Amount**
Projected Budget SFY 2023 $0
Budget Amount SFY 2022 $49,188
Actual Cost SFY 2022   (See Addendum)
Prior to SFY 2022 Actual Cost $100,797

TR202016 – Monitoring an Active Landslide on Route 465 Near Branson

Project Type: Contract Research
MoDOT Contact: Brent Schulte
Total Contract Amount: $149,992
Contract Period: 4/8/2020 to 2/25/2023
Contract Investigator: Landslide Technologies
Funding: SPR 80%, State 20%

Project Description and Objectives:
Slope movements, including types of landslides and extremely slow soil creep occur throughout the United States and along many state highway systems. Successful prediction of the risk and consequences of landslides depends on knowing the geometry of the slide surface and slip surfaces, as well as the material and hydrological properties. Early warnings against the instability and failures of slopes can help the Missouri Department of Transportation (MoDOT) effectively manage the potential mitigation of the landslide and maintenance of the effected highway. The objective of this project is to monitor a slow-moving landslide on Route 465 near Branson, Missouri using remote sensing techniques. The landslide will be monitored for a minimum of 12 months. The results of this study will provide MoDOT with better understandings and methods to predict and lessen the effects of landslides around the state. Preliminary recommendations and guidelines will be established for use in other slope movements along Missouri's highway systems.

Proposed Activities for SFY 2023:
The contract for this project was extended a year to allow for additional monitoring over multiple seasons to allow time for movement of the landslide. Researchers will continue to monitor groundwater data and location LT-3 IPI data. A draft report is due November 11, 2022 with the final report due on January 25, 2023. The contract will end February 25, 2023.

SFY 2022 Accomplishments:
Landslide Tech. (LT) continued monitoring the IPI in LT-3 installed in late June. The IPI initially showed correlation between precipitation and movement but stopped moving during the summer. LT renewed the modem subscriptions to continue remote monitoring. MoDOT and LT discussed crack sealing the damaged pavement above the location. The initial plan was to crack seal in September/October and monitor the impact of that maintenance on slope stability using the installed IPI, but not enough movement was picked up at that date to move forward with that option. After meeting with the TAC, MoDOT helped coordinate with the Branson Maintenance shed to get crack sealing above the IPI completed on December 15, 2021. LT continued monitoring the groundwater data and LT-3 IPI data returned by the remote monitoring system, looking for changes in behavior caused by the recent crack sealing work. LT continued monitoring movement at LT-3 using the IPI through the wet season (May) while developing a correlation between movement and precipitation.

Financials   **Amount**
Projected Budget SFY 2023 $43,158
Budget Amount SFY 2022 $10,000
Adjusted Budget Amount SFY 2022 $10,014
Actual Cost SFY 2022   (See Addendum)
Prior to SFY 2022 Actual Cost $96,820

TR202017 – Scour Analysis at Missouri Bridges

Project Type: Contract Research
MoDOT Contact: Jen Harper
Total Contract Amount: $199,996
Contract Period: 4/1/2020 to 6/30/2023
Contract Investigator: Amanda Cox
Funding: SPR 80%, State 20%

Project Description and Objectives:
In the late 1990s MoDOT had a consultant perform a scour analysis on a number of bridges that had a high potential of being "scour critical" using Water-Surface PROfile (WSPRO) modeling to determine the hydraulic data. MoDOT would like to have a sampling of these bridges re-studied to evaluate the validity of the original scour analysis. The main objectives of the project are as follows: provide a methodology used to determine soil/rock sampling locations and depths, and the soil sampling and testing methods used; do a comparison of the scour analysis results using HEC-RAS (1D) hydraulic modeling data to results using SMS/SHR-2D hydraulic modeling data using the sampling methodology employed for this study; do a comparison of the scour analysis developed in the second objective to the current analysis method of using a single soil sample from the stream bed, and to the existing scour analysis results developed using WSPRO hydraulic model data; and do a risk assessment, due to scour, for the bridges studied by the project.

Proposed Activities for SFY 2023:
Progress during the first year was slow due to travel restrictions due to COVID-19. A no-cost extension has been sent for signatures. Work will focus on finishing the 1-D and 2-D modeling and then comparison of the model results. The draft final report is expected to be completed in early 2023.

SFY 2022 Accomplishments:
On October 7th the SLU research team delivered a virtual zoom presentation to the MoDOT TAC with details of the ongoing progress of the research project. The research team developed the protocols to collect data over water; particularly for the bridges that carried significant amount of water which required a boat. The research team completed topographic / bathymetric data collection and TIN surface development for all sites. The laboratory analysis of all five sites was completed as well as digitizing all relevant sections of the MoDOT bridge drawings. The team also geo-referenced the plan view bridge drawings for all sites, which enables them to have a precise location for the abutment and piers in the modeling and analysis. Modeling activities for the bridges is an ongoing activity.

Financials   **Amount**
Projected Budget SFY 2023 $67,443
Budget Amount SFY 2022 $103,256
Adjusted Budget Amount SFY 2022 $85,813
Actual Cost SFY 2022   (See Addendum)

Prior to SFY 2022 Actual Cost $46,740

TR202020 – Evaluation of Recycled Components in Stone Matrix Asphalt Mixes

Project Type: Contract Research
MoDOT Contact: Scott Breeding
Total Contract Amount: $320,000
Contract Period: 7/27/2020 to 11/1/2022
Contract Investigator: Bill Buttlar
Funding: SPR 80%, State 20%

Project Description and Objectives:
Stone matrix asphalt (SMA), also called stone mastic asphalt, is a durable, rut-resisting wearing course employing a gap-graded aggregate structure and thick modified asphalt binder, typically with higher asphalt content and fibers. It has improved deformation resistance and durability due to the stone-on-stone structure of the mix. Recycled asphalt pavement (RAP), also called reclaimed asphalt pavement, is previously laid pavement that has been removed and reprocessed. When properly crushed and screened, RAP consists of high-quality, well-graded aggregates coated by asphalt cement. Recycled (or reclaimed) asphalt shingles (RAS) is the reprocessed byproduct of tear-off sheets of roofing shingles. These reclaimed products, along with other alternatives like select plastic wastes, processed tire rubber, and other viable recycled material sources can potentially provide a "win-win" in identifying an end-use for a waste stream and reducing material costs for pavement. MoDOT has employed the use of RAP and RAS in conventional hot mix asphalt pavements for some time now, along with using the two in SMAs, albeit in limited quantity. This project aims to focus in on the optimal contents for various recyclable materials to be used in SMA mixes.

Proposed Activities for SFY 2023:
The research is scheduled to be completed late summer/early fall. The draft report is due August 1, 2022 and the final report is due on September 1, 2022.

SFY 2022 Accomplishments:
The research team has completed volumetric trials of lab mixes along with the field and laboratory testing of plant produced mixes. The research team at S&T are still underway with trials on the British Pendulum testing. Analyzing data is ongoing in preparation for the draft report due in first quarter of SFY 2023.

Financials	Amount
Projected Budget SFY 2023	$82,625
Budget Amount SFY 2022	$71,162
Adjusted Budget Amount SFY 2022	$88,537
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	$148,838

TR202021 – Consultant Support for Intelligent Compaction and Paver-Mounted Thermal Profiling Projects in 2020-2021-Completed

Project Type: Contract Research
MoDOT Contact: Jen Harper
Total Contract Amount: $283,660

Contract Period: 3/16/2020 to 4/29/2022
Contract Investigator: George Chang
Funding: SPR 80%, State 20%

Project Description and Objectives:
This project provides consultant support for MoDOT projects for the 2020 and 2021 construction seasons. The consultant has developed and led contractor Intelligent Compaction (IC) and Paver-Mounted Thermal Profiling (PMTP) training and project support for MoDOT projects in previous years. This current research project will provide training, data and field support as needed for each of the IC-PMTP MoDOT asphalt projects constructed in 2020 and 2021. This project will also begin the process of addressing the Quality Assurance (QA) testing required by FHWA.

Proposed Activities for SFY 2023:
This project was completed in State Fiscal Year 2022. A new contract has been executed for the next two construction seasons which is TR202221.

SFY 2022 Accomplishments:
The consultants closely monitored the 2021 IC-PMTP project data submissions to the MoDOT SharePoint Site and addressed issues as they came up. The research team conducted a one-day hybrid annual feedback meeting on December 1, 2021 with MoDOT staff, contractors, and vendors. Accomplishments and issues were discussed during the meeting in order to plan for the 2022/2023 contract. Focus was on how to provide additional support and "recharge" efforts coming out of COVID-19. The final report was published in May. Work for next construction season is already started and will be done on research project TR202221.

Financials	Amount
Projected Budget SFY 2023	$0
Budget Amount SFY 2022	$104,746
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	$178,914

TR202024 – Performance of Wicking Geotextile (H2Ri) to Mitigate Pavement Pumping - Phase 2

Project Type: Contract Research
MoDOT Contact: Scott Breeding
Total Contract Amount: $49,916
Contract Period: 4/1/2020 to 5/31/2022
Contract Investigator: Xiong Zhang
Funding: SPR 80%, State 20%

Project Description and Objectives:
Pumping is one of the major factors contributing toward pavement failures. In a recently completed project, three field test sections were established in a full depth shoulder replacement project at Milepost 117.2 on I-44 in September 2018 to assess the effectiveness of the H2Ri wicking fabric in mitigating pumping of concrete shoulders. The main objective of this project is to maintain the data collection system at the I-44 test sections and continue to monitor the long-term performance of the H2Ri wicking fabric at the test site for another two years from April 1, 2020 to March 30, 2022.

Proposed Activities for SFY 2023:
This project was completed in State Fiscal Year 2022.

SFY 2022 Accomplishments:
The research team made visits to the project site to gather data and perform field observations. The draft report was due on February 28, 2022 and not received until on March 28, 2022. The draft report was reviewed by the TAC and checked for 508 compliance. Several comments and suggestions were sent to the research team. The final report was received in the fourth quarter and posted in the Innovation Library. The final invoice was paid in June. This project is complete.

Financials	**Amount**
Projected Budget SFY 2023	$0
Budget Amount SFY 2022	$35,716
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	$14,200

TR202025 – MCTI Administration

Project Type: Contract Research
MoDOT Contact: Jen Harper
Total Contract Amount: $225,000
Contract Period: 11/18/2019 to 6/30/2023
Contract Investigator: Bill Buttlar
Funding: SPR 80%, State 20%

Project Description and Objectives:
MCTI is a partnership between MoDOT and the 4 University Campuses: Columbia, KC, St. Louis, and Missouri S&T. MoDOT and the University of Missouri System (UMS) have a long-standing, collegial relationship in working on transportation problems together, leading to local and national impact. This relationship includes MoDOT funding of sponsored research projects, MoDOT projects serving as center matching funds, access to field demonstration projects and test sections, educational programs, scholarships, and internships. However, the administration of research funding to universities is a significant burden on MoDOT, along with the transfer of technology across Missouri and beyond. In addition, the lack of streamlined, highly coordinated research efforts have, at times, led to MoDOT research dollars flowing out of Missouri, and to redundancies with other national efforts. Following the practice of other states, this center is a collaboration to move transportation research forward in Missouri. This administrative funding will help MoDOT with some of the administrative duties such as tracking project process and report editing and 508 compliance.

Proposed Activities for SFY 2023:
This summer will be the kick-off of the Technical Advisory Groups (TAGs) which had been put on hold due to COVID-19. The MMU will expire in November so one of the early tasks will be in renewing the MMU.

SFY 2022 Accomplishments:
MoDOT's executive team requested that there be a presentation on MCTI at one of the Commission Meetings in early 2022 and MCTI made a presentation to the Commission on March 1, 2022. Planning has started on the next round of University Transportation Centers. Solicitation for the Technical Advisory Groups has started. The MCTI advisory group met on April 25, 2022 and one of the items was

going through the list of people that had previously expressed an interest in serving on the TAG and updating their information. An e-mail was sent on April 28, 2022 soliciting new nominations for the TAG.

Financials	Amount
Projected Budget SFY 2023	$75,000
Budget Amount SFY 2022	$75,000
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	$75,000

TR202101 – Enhanced Camber Calculations for Prestressed Concrete Bridge Girders-Completed

Project Type: Contract Research
MoDOT Contact: Ryan Martin
Total Contract Amount: $79,999
Contract Period: 10/8/2020 to 12/17/2021
Contract Investigator: Sarah Orton
Funding: SPR 80%, State 20%

Project Description and Objectives:
Like many State Departments of Transportation, MoDOT has been utilizing prestressed concrete I-girders in bridge construction for quite some time. Similarly, like other DOTs, MoDOT has observed issues of late with increased occurrences of negative camber in completed prestressed concrete bridges. Positive bridge camber in prestressed concrete I-girders is a critical design component in the ride, appearance, maintenance requirements and overall life of a concrete superstructure bridge. There are a variety of components that go into the final camber of prestressed concrete girders, including the initial calculation, casting and release, shipping and eventual loading with the deck components. MoDOT is actively exploring new ways to improve the efficiency, constructability and overall performance of bridge replacements and new construction. An enhanced girder camber calculation, taking into account many different factors and lessons learned over the years, will be a primary deliverable from this project.

Proposed Activities for SFY 2023:
This project was completed in SFY 2022.

SFY 2022 Accomplishments:
The first quarter of the fiscal year work was focused on preparing the draft report. The report was distributed to the technical advisory committee and comments and questions were sent back to the PI. The final report was received and posted to the innovation library in December. The final invoice was paid on March 10, 2022. This project is completed.

Financials	Amount
Projected Budget SFY 2023	$0
Budget Amount SFY 2022	$25,636
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	$54,363

TR202102 – Safety Evaluation of Flashing Yellow Left-Turn Arrows in Missouri

Project Type: Contract Research
MoDOT Contact: Jenni Hosey
Total Contract Amount: $199,436
Contract Period: 1/2/2021 to 4/30/2023
Contract Investigator: Joe Jones
Funding: SPR 80%, State 20%

Project Description and Objectives:
The Missouri Department of Transportation (MoDOT) has been utilizing flashing yellow arrows for left turns on state routes since 2006 after receiving interim approval from FHWA. MoDOT has been installing these signal indications at new signalized intersections where a permissive left turn is needed and updating current locations with a circular green ball for permissive movements to the flashing yellow arrow across the state. For various reasons, there have been questions whether the change to the flashing yellow arrow for left turns has actually led to an increase in crashes over recent years. Given that there is sufficient crash data at this point, this project will provide a valuable Missouri-focused study on the before and after safety of flashing yellow left-turn arrows for left turns.

Proposed Activities for SFY 2023:
Leidos will review as-built construction plans, interview MoDOT district personnel, review existing databases, and review photologs to determine installation dates for flashing yellow arrow (FYA) signals for which MoDOT has no data. This work will be limited to the St. Louis and Central districts. Kittleson will finish the safety performance and benefit-costs analyses by December 2022. The draft and final reports are due in the third quarter of SFY 2023 with the final invoice occurring during the fourth quarter.

SFY 2022 Accomplishments:
The research team investigated available as-built project and permit as-built plans to discern FYA installation dates in the CD and SL regions (this will continue into SFY 2023). They also worked with MoDOT data analysts to query crash data per the sub-consultant's needs and submitted preliminary data to the sub-consultant for analysis. The sub-consultant began preliminary data analysis to shape their safety evaluation. Leidos worked on determining if leg-level crash assignments could be automatically determined for further analysis and began work on the before/after study. The researchers also conducted quarterly progress meetings and submitted meeting minutes.

Financials	Amount
Projected Budget SFY 2023	$87,763
Budget Amount SFY 2022	$81,248
Adjusted Budget Amount SFY 2022	$67,964
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	$43,709

TR202103 – Lightweight Deflectometer (LWD) for Acceptance of Unbound Materials

Project Type: Contract Research
MoDOT Contact: Brent Schulte
Total Contract Amount: $181,996
Contract Period: 10/1/2020 to 8/31/2022
Contract Investigator: Xiong Zhang

Funding: SPR 80%, State 20%

Project Description and Objectives:
There is a desire by MoDOT to move away from the Nuclear Density Gage (NDG) as the primary device for evaluating compacted materials. MoDOT recently participated in a pooled fund project with Maryland DOT and the University of Maryland that studied this issue and produced draft standards for use of the LWD. This project will develop a procedure and standards for using a LWD for acceptance of unbound materials. It is intended to build on the findings from the pooled fund study to tailor the results for Missouri; not duplicate the previous work.

Proposed Activities for SFY 2023:
The draft final report and research summary was due on May 31, 2022. The final report is due July 31, with the contract ending August 31, 2022. A follow-up project is being discussed to take advantage of the rebuilding of some sections of I-44 near Rolla. This would be a good opportunity to use some of the information learned in this research and build on it.

SFY 2022 Accomplishments:
The interim project presentation was held on July 14, 2021 for the research team to present the research progress and collect feedback from the advisory panel. The research team completed laboratory testing from the I-270 North project that was collected during State Fiscal Year 2021. The research plan was adjusted to include laboratory testing for soil collected from a Kansas City project. The research team did one trip on October 25, 2021 for collecting silty clayey soils from the Buck O' Neil Bridge project in Kansas, MO. In addition to two field trips for field testing: (1) on October 21, 2021 trip to the I-270-North project to test base course material (169 testing points), and (2) on November 15, 2021 trip to Buck O' Neil Bridge project to test silty clayey soils (213 testing points). Per discussion with the MoDOT Research Director and TAC, the scope of this study was expanded to include field and laboratory- testing data for the soil collected from the Buck O' Neil project in Kansas City. The researchers were granted a contract extension. The research team mainly focused on laboratory tests of soil from this project. The team completed all remaining lab tests along with preparing the guidelines for implementation and use of LWD testing specifically for projects in Missouri.

Financials	Amount
Projected Budget SFY 2023	$13,724
Budget Amount SFY 2022	$118,773
Adjusted Budget Amount SFY 2022	$142,048
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	$26,224

TR202104 – Pollinator Habitats Along Right of Way-Completed

Project Type: Contract Research
MoDOT Contact: Brent Schulte
Total Contract Amount: $60,000
Contract Period: 12/15/2020 to 8/16/2021
Contract Investigator: Kathleen Trauth
Funding: SPR 80%, State 20%

Project Description and Objectives:
Plant pollination by insects is one of the most well-known and important ecosystem services and is essential in both natural and agricultural landscapes. Research shows highway ROW could provide habitat for a diverse community of pollinators. ROW habitat could include forage for food and breeding or nesting opportunities. MoDOT ROW's extend across a variety of landscapes and can aid dispersal of pollinators by linking split habitats. By acting as protection for pollinators in otherwise inhospitable landscapes, ROW habitat can contribute to the maintenance of healthy ecosystems and provision of ecological services such as crop pollination services. In this project MoDOT would like an overall synthesis of previous studies on promoting pollinator habitats on highway ROW and the best practices by other transportation agencies that have pollinator programs.

Proposed Activities for SFY 2023:
This project was completed in SFY 2022.

SFY 2022 Accomplishments:
The final report was received in July and was posted to the Innovation Library in August. The project is completed.

Financials	Amount
Projected Budget SFY 2023	$0
Budget Amount SFY 2022	$2,839
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	$57,161

TR202105 – Airport Design-Build Bid Documents-Completed

Project Type: Contract Research
MoDOT Contact: Brent Schulte
Total Contract Amount: $243,986
Contract Period: 11/16/2020 to 8/30/2021
Contract Investigator: James R. Shaw
Funding: SPR 80%, State 20%

Project Description and Objectives:
The FAA recently gave the approval for local airports to do Design-Build projects. MoDOT's Aviation Section sees this as an opportunity to help smaller airports with the hanger projects that they occasionally do. Unfortunately, since these are small airports, they have little experience doing those types of bid documents. The first airport that has tried the Design-Build (D-B) process did not have a positive experience because their solicitation documents were not written well. This project will be to develop guidelines/ generic bid package for these airports so they can release bid documents that lead to successful Design/Build projects.

Proposed Activities for SFY 2023:
This project was completed in SFY 2022.

SFY 2022 Accomplishments:
S&H submitted the final report along with the summary in August. The contract ended August 31, 2021. The final report is waiting on FAA approval before being posted to the Innovation Library.   The final invoice was posted on September 28, 2021.

Financials	Amount
Projected Budget SFY 2023	$0
Budget Amount SFY 2022	$22,018
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	$221,968

TR202107 – TITANv2 – Interactive, Web-Based Platform for Transportation Data Integration, Visualization and Predictive Analytics – Phase 2

Project Type: Contract Research
MoDOT Contact: Jen Harper
Total Contract Amount: $449,932
Contract Period: 1/1/2021 to 12/31/2024
Contract Investigator: Dr. Yaw Adu - Gyamfi
Funding: SPR 80%, State 20%

Project Description and Objectives:
The rate of transportation data collection is poised to increase exponentially with mobile computing, community-based sensing and vehicle-to-vehicle and vehicle-to-infrastructure communications. Under TR201815 the research team designed a prototype interactive, web-based platform to assist decision makers at MoDOT by seamlessly integrating and analyzing transportation datasets. This phase 2 project will create a robust web platform that pulls together data from TMS and other sources to provide dashboards which help make sense of various data sets. The platforms are interactive and can provide real time information or longer duration information. This platform will also help the TMCs with real time travel information and performance measures.

Proposed Activities for SFY 2023:
Work will continue during State Fiscal Year 2023 on the predictive analytics portion of the site. More can be done once the statewide AADT data is able to be uploaded into the system. The research team will also continue to work with the TSMO team to find ways that the TITAN site can be utilized by staff to help with making data-based decisions. Many of the activities will focus on maintenance of the system and documentation.

SFY 2022 Accomplishments:
A dashboard for crash data has been completed. This dashboard will enable MoDOT to explore crash data from 2010 – 2019 in the web browser. They include; a statewide Waze incidents and jams dashboard, traffic incidents dashboard for KC, STL from Transcore and an AADT dashboard. These models will accomplish the following; predict network traffic speeds, predict queue lengths and jams, and predict likelihood of crashes. The research team has also received connected vehicle data for the entire state. This data includes vehicle accelerations and decelerations across the state. They are exploring this data for predictive analytics. The research team is currently working on the predictive analytics module using the probe data, connected vehicle data, incidents and traffic volume data. The initial models show there is promise although traffic volume data is crucial. The research team is working with Transportation Planning to get data for statewide AADT data. The manual for TiTAN was received in early June. Comments were sent to the researcher and a final document was sent and accepted.

Financials	Amount
Projected Budget SFY 2025	$76,761

Projected Budget SFY 2024	$100,000
Projected Budget SFY 2023	$100,000
Budget Amount SFY 2022	$100,000
Adjusted Budget Amount SFY 2022	$116,035
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	$57,136

TR202109 – Impact of Silt and Clay Particles on Freshwater Mussels

Project Type: Contract Research
MoDOT Contact: Scott Breeding
Total Contract Amount: $400,000
Contract Period: 1/1/2021 to 4/8/2024
Contract Investigator: Dr. Baolin Deng & Dr. Kathleen Trauth
Funding: SPR 80%, State 20%

Project Description and Objectives:
Threatened and endangered (T&E) species considerations for Missouri Department of Transportation (MoDOT) and Federal Highway Administration (FHWA) federally funded projects include potential impacts to rare plants, animals, critical habitat, and natural communities (e.g., streams, caves, prairies, karst). The objectives of this project are as follows: evaluate the impact of silt, clay and other mineral elements, particularly those particle types associated with transportation-sector construction activities, to freshwater mussels and study the mechanisms for such impacts; examine the effects of increased turbidity on mussel feeding and reproduction; investigate how different types of soils and minerals affect freshwater mussels, including identifying important thresholds of impact for each; and evaluate new and existing approaches that could mitigate the impact of various sediments from construction activities to mussels.

Proposed Activities for SFY 2023:
The research team will continue laboratory experiments consisting of determining the feeding and reproduction characteristics under increasing turbidity conditions and also evaluate impact of soils and minerals based on impact thresholds by determining turbidity in which impact is non-existent or minimal. This project is scheduled to spread various tasks and the related work across the State Fiscal Years 2023 and 2024.

SFY 2022 Accomplishments:
The survey of DOTs was completed with 42 states responding. Results were analyzed and shared with the TAC members on December 10, 2021. The research team completed experiments on impacts of silt and clay particles as well as mineral elements. These experiments included evaluation of suspended sediments with various exposure levels and burial experiments at various depths. Results showed good survival rates with sediment exposure after 4 days with the exception of one replicate due to possible toxicants in clay sample. Burial experiments of different depths were performed.

Financials	**Amount**
Projected Budget SFY 2024	$70,441
Projected Budget SFY 2023	$50,000
Budget Amount SFY 2022	$100,000
Adjusted Budget Amount SFY 2022	$233,782
Actual Cost SFY 2022	(See Addendum)

Prior to SFY 2022 Actual Cost $45,777

TR202110 – Industrial Internet-of-Things Asset Monitoring-Phase 2

Project Type: Contract Research
MoDOT Contact: Scott Breeding
Total Contract Amount: $232,210
Contract Period: 1/1/2021 to 12/31/2022
Contract Investigator: AECOM Technical Services, Inc.
Funding: SPR 80%, State 20%

Project Description and Objectives:
With MoDOT managed assets being so numerous and at different stages in their life-cycles, having a means of monitoring critical infrastructure assets would be highly valued. Being able to access life-cycle data for different types of construction (bridges or pavement) could aid in better understanding of proactive and cost saving maintenance schedules along with determining life-cycle cost analyses for various assets. The Industrial Internet-of-Things (IIoT) is the name given to interconnected computing devices, sensors, instruments and other technology that collects data or information at a prescribed interval of time and transmits that information over existing communications infrastructure. Phase 1 was completed in September 2020, and the Department decided to proceed with the second phase. Phase 2 will further explore the findings of Phase 1 and begin implementation through installation, monitoring of assets and analysis of data.

Proposed Activities for SFY 2023:
The drilling will be completed and sensors installed in the first quarter of the state fiscal year. The research team will monitor and collect data from the installed sensors. The project is currently scheduled to be completed at the end of December but it will be extended. The extension date will be determined once the sensors are installed.

SFY 2022 Accomplishments:
The project team has continued holding monthly meeting during the year. BDI was selected as the vendor to provide sensors. Procurement of sensors has been delayed due to supply chain issues and COVID. Due to staffing and workloads MoDOT was unable to perform drilling and Terracon (on-call drilling service) was contracted to perform drilling of bore holes. During a pre-installation meeting BDI proposed to spot weld strain gages to sign trusses, this raised concern to MoDOT and it was decided that spot welding would not be allowed. Other methods of attachment were discussed and it was decided to use an adhesive system.

Financials	**Amount**
Projected Budget SFY 2024	$35,937
Projected Budget SFY 2023	$40,000
Budget Amount SFY 2022	$100,000
Adjusted Budget Amount SFY 2022	$134,486
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	$21,787

TR202110a – Industrial Internet-of-Things Drilling

Project Type: Contract Research
MoDOT Contact: Scott Breeding
Total Contract Amount: $17,000
Contract Period: 1/1/2021 to 12/31/2022
Contract Investigator: Terracon
Funding: SPR 80%, State 20%

Project Description and Objectives:
TR202110 requires drilling behind the retaining walls and due to workload issues at MoDOT the Geotechnical group cannot get this work into their schedule. An on-call contract with Terracon was set up to complete the work.

Proposed Activities for SFY 2023:
The invoicing for the drilling will be completed in SFY 2023.

SFY 2022 Accomplishments:
Weather and drilling schedules delayed the project during second and third quarters. The drilling was completed at one of the locations in the fourth quarter. The contractor determined they did not have a drill rig capable of drilling on the slope at the second location. They attempted to use a hand auger but met resistance and could not get to depth. At the time of this submission there were still discussions about how to handle the contract.

Financials	Amount
Projected Budget SFY 2023	$17,000
Budget Amount SFY 2022	$0
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	$0

TR202111 – Deep Learning for Unmonitored Water Level Prediction and Risk Assessment

Project Type: Contract Research
MoDOT Contact: Brent Schulte
Total Contract Amount: $100,000
Contract Period: 2/8/2021 to 6/30/2022
Contract Investigator: Steve Corns and Suzanna Long
Funding: SPR 80%, State 20%

Project Description and Objectives:
This project uses deep learning and other computational intelligence methods to leverage public geospatial data and historical NOAA data to develop forecasting tools to create virtual water level monitors. These tools inform existing models developed in previous MATC/MoDOT projects for flood prediction and models developed by the USGS, FEMA, NOAA, and others and are used to reduce the errors from these models due to sparse data for prediction. The project scope includes a survey instrument to gather data from first responders who are required to travel during these hazardous events. These data are then used to determine the water levels and rate of change at unmonitored sites based on projected rainfall totals, based on drainage basin information, and based on recent weather patterns. The data from these virtual monitors is then used for flood event prediction to improve accuracy. The results of these

virtual monitors will be validated by manual testing at prediction locations. In addition, the data from the virtual monitors and the validation readings will be used to determine the sources of uncertainty in the predictions and recommend where physical monitors should be placed to improve future predictions. This provides the transportation safety or disaster planner increased accuracy to better plan for flooding events.

Proposed Activities for SFY 2023:
This project is scheduled to be completed in State Fiscal Year 2022 but the final billing might end up taking place in SFY 2023.

SFY 2022 Accomplishments:
The survey instrument to solicit information from first responders, state emergency officials and other stakeholders was sent out and the results indicated several areas of concern in Missouri. The area for a currently gauged location for training the model was enlarged to gather a better variety of potential locations to improve prediction accuracy. Twenty catchments were analyzed, and data extracted to be used as input to the deep learning algorithms. Two abstracts related to the project scope of work were accepted for presentation at the ASEM International Annual Conference. Deep learning algorithms were created to take into account the rainfall in the catchments, and how the associated streamflow's contribute to the water volume in the streams under consideration. In addition, upstream and downstream gauge heights have been introduced to determine if there is an increase in algorithm accuracy. Validation has been done using existing river gauges. A draft final report was sent to MoDOT. After a review and being accepted, the final was sent and posted to the Innovation Library.

Financials	**Amount**
Projected Budget SFY 2023	$37,564
Budget Amount SFY 2022	$50,000
Adjusted Budget Amount SFY 2022	$38,995
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	$23,441

TR202112 – GFRP Reinforced Barrier Curbs

Project Type: Contract Research
MoDOT Contact: Brent Schulte
Total Contract Amount: $ 74,997
Contract Period: 2/16/2021 to 8/1/2022
Contract Investigator: Chenglin Wu, John Myers
Funding: SPR 80%, State 20%

Project Description and Objectives:
GFRP reinforcement has recently drawn tremendous amount of interest in engineering practice. Years of research together with successful pilot implementation projects have provided confidence to engineers for field implementation of GFRP in bridge structures. Since the first steel-free deck used by MoDOT in 2007, both Carbon Fiber Reinforced Polymer (CFRP) and Glass Fiber Reinforced Polymer (GFRP) bars have been used in 4-5 bridge decks on the state bridge system. These previous efforts along with the reduced prices have promoted potential implementation of both steel-free deck and barrier. However, MoDOT currently does not have specifications for using GFRP reinforcement within barriers, which will be developed in this proposed project.

Proposed Activities for SFY 2023:
The final report is due on July 15th. The contract will end August 1, 2022.

SFY 2022 Accomplishments:
The team developed the preliminary design of the GFRP bars for a single slope barrier. The team revised the initial design, worked on the finite element modeling, and the modeling of the designs. The research team conducted two rounds of modeling. In the first modeling process, the assumed impact load from the previous publications was adopted. From the discussion with Dr. Faller and the team, the impact area was modified and a higher design strength was achieved. The team continued working on the dynamic impact finite element modeling of the designed reinforcement details. The draft final report was due June 1, 2022 but not received until June 10th to allow for comments from the TAC.

Financials	Amount
Projected Budget SFY 2023	$369
Budget Amount SFY 2022	$48,982
Adjusted Budget Amount SFY 2022	$48,613
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	$26,015

TR202113 – Fiber Reinforced Concrete for Bridge Decks and Overlays

Project Type: Contract Research
MoDOT Contact: Brent Schulte
Total Contract Amount: $150,000
Contract Period: 5/15/2021 to 11/15/2022
Contract Investigator: Richard Kaczkowski
Funding: SPR 80%, State 20%

Project Description and Objectives:
Overlay history suggests that cracking, curling, lack of ductility, and fatigue are common and collective failure modes of concrete overlays, all of which are positive contribution areas for fiber reinforcement. Improved resistance to crack propagation, controlled thermal and moisture stresses, increased elasticity, higher tensile, flexural, and fatigue strengths, and greater impact and abrasion resistance are some improvements in concrete performance that are generally achieved with the use of FRC compared to normal concrete overlays. Therefore, there is a need to (1) establish a systematic and functional process that can guarantee the success of the FRC overlay application, (2) develop performance criteria for acceptability, (3) establish defined protocols for agencies to be able to evaluate a product that is submitted for approval, and (4) identify methodologies that facilitate the decision-making process.

Proposed Activities for SFY 2023:
At this current time the contract extension has been sent for signatures. The researchers got behind schedule after having issues procuring materials for concrete mixes. The original draft final report due date was May 1, 2022. The new due date for the draft report is August 15, 2022.

SFY 2022 Accomplishments:
The researchers have completed a comprehensive review of the available literature. More than 100 fiber products were identified through contacting manufacturers, the characteristics of each fiber and their availability in the U.S. were identified for use by MoDOT. A survey of previous and ongoing related projects was also performed. Among all the contacted agencies only 15 responded. Tasks 1, 2, and 3

outlined in the proposal were completed and concluded. The researchers worked on collecting the required materials, upon receiving all the materials needed, they started Task 4 which included batching and testing concrete mixtures. Batching and testing FRC mixtures was started, however; the researchers encountered some major delays in procuring the materials and consequently the due date for completion of the task needed to be extended.

Financials	Amount
Projected Budget SFY 2023	$40,707
Budget Amount SFY 2022	$100,000
Adjusted Budget Amount SFY 2022	$109,293
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	$0

TR202114 – Accessing Standards and Specifications

Project Type: Contract Research
MoDOT Contact: Lauren Bielecki
Total Contract Amount: $33,259 annually
Contract Period: 6/1/2021 to 6/1/2023 estimated
Contract Investigator: Joe Stevens
Funding: SPR 80%, State 20%

Project Description and Objectives:
MoDOT currently has a decentralized approach for many specifications. In surveying divisions and districts, it was found some specifications were purchased by multiple areas. MoDOT worked with General Services to find an online service that provides access to needed specifications with the flexibility to add and delete our subscription.

Proposed Activities for SFY 2023:
The vendor has the ability to run reports to determine utilization of each of the specifications. Quarterly these will be checked and determined if they are being utilized. Each year they can be modified. Before the end of the first-year contract it will be decided if we need to retain all of the current specifications or make adjustments for the following year.

SFY 2022 Accomplishments:
The contract was signed in October. The specifications were made available to MoDOT staff and they have begun accessing them. The MoDOT librarian reached out first to the contacts that originally requested documents to add them and get feedback and has started adding more users to the system. Feedback has been positive so far, and a marketing plan has been implemented.

Financials	Amount
Projected Budget SFY 2023	$33,259
Budget Amount SFY 2022	$31,653
Adjusted Budget Amount SFY 2022	$33,259
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	$0

TR202115 – Effectiveness of Speed Management Methods in Work Zones

Project Type: Contract Research
MoDOT Contact: Brent Schulte
Total Contract Amount: $200,000
Contract Period: 3/17/2021 to 10/25/2022
Contract Investigator: Henry Brown and Carlos Sun
Funding: SPR 80%, State 20%

Project Description and Objectives:
As MoDOT shifts its focus to preservation and maintenance of the existing transportation system, the amount of road work being performed under traffic continues to increase. According to Section 616.12 of the MoDOT Engineering Policy Guide (EPG), speed reductions of 10 mph are recommended when workers are within 10 feet of the traffic lane or when there is head-to-head traffic on multilane highways. To manage work zone speeds, MoDOT utilizes various tools such as signage, speed trailers, red/blue lights for contractors, and law enforcement presence. MoDOT would like to learn more about the effectiveness of these tools and about the practices of other DOTs for managing speeds in work zones.

Proposed Activities for SFY 2023:
The researchers continue to conduct analysis of speed data collected along with driver simulation data. A survey will be developed and sent to drivers through social media. Researchers are wanting to get the perspective of drivers who travel through work zones. The draft final report and research summary are due July 25, 2022.

SFY 2022 Accomplishments:
A review of existing literature regarding work zone speed countermeasures and driver speed behavior was conducted. Development of the simulator scenarios, including modeling of the various countermeasures (speed trailer, speed trailer with red and blue lights, contractor vehicle with red and blue lights, and law enforcement) was completed. Field work was conducted at the I-270 work zone in St. Louis from August 3, 2021 to August 26, 2021. Approximately 325 hours of speed data were collected using two SpeedLane Pro sensors located upstream and downstream of the lane shift at the Lindberg Road interchange. Approximately 778,050 individual vehicle speed data points were collected. The following countermeasures were studied: no treatment, speed trailer, speed trailer with flashing speed feedback, speed trailer with red and blue lights, active law enforcement, passive law enforcement, and contractor vehicle with red and blue lights. Preliminary results indicate that law enforcement appears to be the most effective speed countermeasure and that the speed trailer with red/blue lights appears to be the most effective type of speed trailer in work zones. An interim presentation was held online on January 18, 2022. The development of daytime/nighttime scenarios, including modeling and programming all of the countermeasures, has been completed. Background traffic in the experiments was programmed based on the field data. In order to increase its display quality and realism, screen warping and blending techniques were applied to the multi-screen driving simulator. The internal tests of the daytime/nighttime scenarios were completed.

Financials	Amount
Projected Budget SFY 2023	$79,786
Budget Amount SFY 2022	$103,762
Adjusted Budget Amount SFY 2022	$103,976
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	$16,238

TR202117 – Asset Management for Mobility and Intelligent Transportation Systems

Project Type: Contract Research
MoDOT Contact: Jenni Hosey
Total Contract Amount: $74,999
Contract Period: 4/15/2021 to 6/15/2022
Contract Investigator: Jay Bledsoe and Jason Bittner
Funding: SPR 80%, State 20%

Project Description and Objectives:
Moving Ahead for Progress in the 21st Century, better known as MAP-21, introduced "asset management" into the lexicon of state Departments of Transportation (DOTs), or at least made it more widely known in understanding and practice. While encouraged, the inclusion of all infrastructure assets, including mobility and intelligent transportation systems (ITS), was not required in MAP-21. These assets include, but are not limited to, Dynamic Message Sign (DMS) boards, cameras, wireless radios, sensors/detectors, ramp meters, advanced traffic controls, and Road Weather Information Systems (RWIS) stations. The primary objectives of this project are to do a synthesis of how other state DOTs and related organizations do asset management of these types of assets and to develop a spreadsheet or tool to aid MODOT in managing mobility and ITS assets.

Proposed Activities for SFY 2023:
ARA will be reviewing the draft ITS tool with the TAC on July 11 and submitting the draft report to MoDOT on July 29, 2022. The final report is due September 30 and the final invoice by November.

SFY 2022 Accomplishments:
The consultant completed a literature review and survey of state DOTs regarding their use of ITS in asset management. TAC meetings were held to determine items to include in the development of the ITS tool. A meeting took place on Friday June 10th to discuss the upcoming tasks and due dates. A time-extension is in the process.

Financials	Amount
Projected Budget SFY 2023	$19,816
Budget Amount SFY 2022	$68,044
Adjusted Budget Amount SFY 2022	$39,802
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	$15,381

TR202121 – Performance of Cost-Effective Non-Proprietary UHPC in Thin Bonded Bridge Overlay

Project Type: Contract Research
MoDOT Contact: Brent Schulte
Total Contract Amount: $149,997
Contract Period: 4/15/2021 to 4/15/2023
Contract Investigator: Kamal Khayat, John Myers
Funding: SPR 80%, State 20%

Project Description and Objectives:

The use of Ultra High-Performance Concrete (UHPC) for thin bonded overlays for bridge deck rehabilitation has been successfully used in some pilot studies in Iowa, Delaware, New York, and more extensively in Europe. Such innovative material can enable the construction of thin bonded overlays of 1 to 2 inch in thickness for the rehabilitation of bridge decks and restoration of the structural capacity of bridges. Despite encouraging results with some field applications, the high material unit cost of proprietary materials limits the wide acceptance of UHPC for bridge deck rehabilitation. The PI has developed a new class of cost-effective, non-proprietary UHPC mixtures that are self-consolidating to facilitate placement and finishing. The main objective of the proposed project is to evaluate the constructability and performance of non-proprietary thixotropic UHPC for thin bonded bridge deck overlay construction.

Proposed Activities for SFY 2023:

The research team will work with MoDOT to plan field implementation to construct two thin bonded bridge deck overlays prepared with optimized UHPC developed in task two. Activities planned for the next reporting period include: (1) fine tuning of the selected UHPC mixture at the concrete batching plant; (2) carrying out a mock-up test; and (3) casting and evaluation material performance used during the bridge deck overlay construction. The selected bridge will have the selected mix applied as an overlay with an evaluation of the performance to follow. After all testing and performance evaluations, a performance-based specification will be developed. This project is expected to end in SFY 2023.

SFY 2022 Accomplishments:

The work in progress during this period included task 2.1 aiming at enhancing thixotropy of UHPC and Task 2.2 aiming at optimizing curing protocol of UHPC. The researchers worked on finalizing recommendations and guidelines for the use of non-proprietary thixotropic UHPC overlay materials for bridge deck rehabilitation. This includes; field-oriented test methods and acceptance criteria to evaluate workability, performance-based specifications, guidelines for mixture design and material selection of thixotropic UHPC and recommendations for batching sequence, mixing, placement, consolidation, and curing of UHPC for bridge deck overlays. Researchers worked on Task 2.3 aiming at selecting fiber content and evaluating flexural performance of the 12 composite overlay slabs that were cast in MoDOT project TR201704. Researchers also investigated the influence of fiber content on key fresh and hardened properties, as well as autogenous, drying, and restrained shrinkage of UHPC. Two UHPC mixtures, one containing only 17% LWS and the other one containing a combination of 17% LWS and 1% SRA were studied. The investigated fiber contents ranged between 2% and 3.25%, by volume. Work was completed on evaluating the robustness of the optimized UHPC mixtures that are proportioned with 17% pre-saturated lightweight sand (LWS), 1% shrinkage-reducing admixtures (SRA), and 3.25% steel microfibers.

Financials	Amount
Projected Budget SFY 2023	$88,406
Budget Amount SFY 2022	$49,997
Adjusted Budget Amount SFY 2022	$61,591
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	$0

TR202122 – LRFR Methodology for Missouri Bridges

Project Type: Contract Research
MoDOT Contact: Jenni Hosey

Total Contract Amount: $186,000
Contract Period: 5/28/2021 to 2/28/2023
Contract Investigator: Ganesh Thiagarajan and John Myers
Funding: SPR 80%, State 20%

Project Description and Objectives:
Load and Resistance Factor Rating, also referred to as LRFR, is an American Association of State Highway and Transportation Officials (AASHTO)-adopted guide manual for the condition evaluation of bridge structures. MoDOT has recently updated our load rating policy to better reflect the wide range of heavier vehicles legally travelling along Missouri roads. These updated rating practices are predominately based on the Load Factor Rating (LFR) methodology, with the allowance for the allowable stress rating methodology in special situations (example is timber bridges). The research team will provide MoDOT with recommendations of LRFR adoption. The contract itself is for $175,000 and a license for the software for the research team is $11,000.

Proposed Activities for SFY 2023:
This project will be wrapping up in SFY 2023 with the draft report due November 30, 2022 and the final due January 31, 2023.

SFY 2022 Accomplishments:
The research team contacted various neighboring states for their policies regarding bridge rating. The license for the AASHTOWare Bridge Rating software was procured by MoDOT. The Research team developed and tested an LRFR analysis template and Excel format file for presenting analysis results. All of the bridges were run through the analysis template and preliminary results shared with MoDOT. Additionally, in collaboration with Jacobs, the team developed the final Excel files in order to run the analyses. The file was shown to MoDOT and approval was given to proceed with some input for improvements.

Financials	Amount
Projected Budget SFY 2023	$111,707
Budget Amount SFY 2022	$86,000
Adjusted Budget Amount SFY 2022	$74,293
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	$0

TR202123 – High Tension Guard Cable Inspection and Life Cycle

Project Type: Contract Research
MoDOT Contact: Jenni Hosey
Total Contract Amount: $300,000
Contract Period: 11/15/2021 to 1/15/2024
Contract Investigator: Glenn Washer and John Myers
Funding: SPR 80%, State 20%

Project Description and Objectives:
The Missouri Department of Transportation (MoDOT) began utilizing guard cable along interstate routes in the early 2000s, and since that time has installed more than 800 miles of guard cable on divided highways. For this project, MoDOT aims to take a deeper dive on the life of these systems to better understand this type of asset as it has been utilized by the Department for almost 20 years. Some of the

objectives include analyzing the material properties after multiple impacts, reviewing installation and repair procedures, reviewing installation inspection and maintenance records along with available crash reports, conducting field inspections of a representative sample of locations, and conducting a life cycle assessment.

Proposed Activities for SFY 2023:
MCTI will continue doing field inspections and testing of the guard cable during the summer of 2022. Inspections will consist of a visual inspection and survey of the guard cable tension. Once enough information has been gathered regarding the in-situ conditions the full modeling of the system will begin. Laboratory analysis will begin in late fall and continue throughout the rest of the state fiscal year. Reporting will occur during State Fiscal Year 2024.

SFY 2022 Accomplishments:
A kick-off meeting was held on January 14, 2022. The literature review has started, and the Research Team (RT) has started going through previous works that have been done that may have a correlation with impact modeling and guard cable system behavior. The RT started to establish a base line for the FEM Modeling by creating simple models and assessing their behavior. The RT has also started doing field inspections. A progress meeting was held on May 5th to update the Technical Advisory Committee.

<u>Financials</u>	<u>Amount</u>
Projected Budget SFY 2024	$130,000
Projected Budget SFY 2023	$150,000
Budget Amount SFY 2022	$75,000
Adjusted Budget Amount SFY 2022	$20,000
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	$0

TR202124 – Implementation of Data QA for Innovative Technology at MoDOT

Project Type: Contract Research
MoDOT Contact: Scott Breeding and Jen Harper
Total Contract Amount: $85,895
Contract Period: 4/1/2021 to 11/1/2022
Contract Investigator: George Chang
Funding: SPR 80%, State 20%

Project Description and Objectives:
Meeting the 23 CFR Part 637 codes for quality assurance (QA) procedures for intelligent construction technologies (ICT) for construction acceptance is a national hurdle. The ICT currently includes intelligent compaction (IC), paver-mounted thermal profiler (PMTP), and other emerging technologies, such as dielectric profiling systems (DPS). Meeting the CFR codes is a worthwhile endeavor to ensure the technologies produce quality data for construction acceptance decisions. MoDOT is among the leading DOTs working towards satisfying the requirements so that intelligent construction technologies can be fully implemented. This study's main reason is to find solutions for IC and PMTP data QA issues encountered during the 2021 construction season. This study will identify the leading causes (both technical and institutional) for these issues and anticipate IC, PMTP, and DPS implementation issues. The results for this study will include solutions for these issues that can be implemented for the 2022 construction seasons and beyond to satisfy the related CFR code.

Proposed Activities for SFY 2023:
Most of the work during State Fiscal Year 2023 will be on the report. The draft report is due on August 1, 2022 and the final report is due on September 30, 2022.

SFY 2022 Accomplishments:
The Consultants submitted the draft Task 2 report to MODOT and FHWA-MO on August 6, 2021. The Consultants then conducted a project meeting with MODOT and FHWA-MO on September 16, 2021. The discussion included the project status and draft Task 2 report. The research team presented the detailed QA reviews for IC, PMTP, and DPS. The FHWA-MO comments were embedded in the PDF report sent before the meeting. The majority of the comments were discussed during the meeting. The consultants responded to the MoDOT/FHWA-MO comments embedded in the Task 2 report and finalized the tech memo on December 9, 2021. The progress for this project was presented at the Close-out meeting for the main IC/PMTP project as part of TR202021. The consultants updated the QA excel macro tools for both the FLIR camera and the Dirtmate. A quick reference guide and QR code were developed for each to facilitate field instruction. QA trainings for MoDOT staff were conducted in conjunction with the Just-In-Time trainings for Herzog and Capital in March and at other locations throughout the end of the State Fiscal Year 2022.

Financials	Amount
Projected Budget SFY 2023	$34,020
Budget Amount SFY 2022	$41,985
Adjusted Budget Amount SFY 2022	$47,965
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	$3,910

TR202125 – Lab and Field Evaluation of Asphalt Mixtures with Post-Consumer Recycled Plastic Waste, Phase II

Project Type: Contract Research
MoDOT Contact: Jen Harper
Total Contract Amount: $324,475
Contract Period: 4/15/2021 to 4/28/2023
Contract Investigator: Bill Buttlar
Funding: SPR 80%, State 20%

Project Description and Objectives:
Waste plastic has emerged as a global environmental crisis, with plastic debris adding to landfills and contaminating both land and aquatic environments with macro and micro plastics. Dry-process recycling of waste plastic into asphalt allows higher recycling amounts to be pursued, and greatly expands the number of contractors that can readily gear up for pilot projects and if successful, routine production. Because of the head start in waste plastic research with an ongoing project with Dow, this project starts with a comprehensive field demonstration project in the spring/summer of 2021, followed by subsequent lab testing, additional field demonstration projects, and long-term monitoring of field projects. A test section utilizing ground tire rubber (GTR) will be part of the 2021 project in Columbia.

Proposed Activities for SFY 2023:
The Pemiscot County project will be constructed in State Fiscal Year 2023. Most of the work will be geared towards this pilot project. The second half of the state fiscal year will be devoted towards

wrapping up the project. The draft final report is due on Febrary 28, 2023, and the final report on April 28, 2023.

SFY 2022 Accomplishments:
Over 40 trials were completed for mix designs taking over 3 months. The final mix designs were placed during August 2021 on the Stadium Blvd. project. The research team provided construction assistance and sampling during construction of the test sections in August including adjustments to Hi-Tec's feeder system to avoid overheating. The research team continues to monitor the Stadium Blvd. project. Some reflective cracking is noted. The research team continues to test samples from the plant and those taken from Stadium Blvd. Significant media coverage followed the demonstration project. The researchers began working on the mix designs for the NRRA reflective cracking challenge study - demonstration sections to be constructed in Pemiscot County (I-150). The researchers received samples of mixed waste plastic streams from EMC which is currently under consideration for use as the second waste plastic source. The plastic seems stiffer than the LLDPE pellets from Stadium Blvd, but the research team was able to make gyratory specimens with it.

Financials	Amount
Projected Budget SFY 2023	$23,938
Budget Amount SFY 2022	$75,000
Adjusted Budget Amount SFY 2022	$256,007
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	$44,530

5102402C Post-Consumer Recycled Plastic Waste, Phase II—Columbia Stadium Blvd Implementation Project

Project Type: Contract Research
MoDOT Contact: Jen Harper
Total Contract Amount: $86,122
Contract Period: 7/1/2021 to 6/30/22
Contract Investigator: Bill Buttlar
Funding: SPR 80%, State 20%

Project Description and Objectives:
This project was set up to provide the "delta costs" for the test sections on the Stadium Blvd. project in Columbia, MO that used the post-consumer recycled plastic waste.

Proposed Activities for SFY 2023:
Construction of the project and billing took place in State Fiscal Year 2022.

SFY 2022 Accomplishments:
This project took place in August 2021. The "delta costs" were billed to SPR funding to pay for the extra costs of doing trial sections on the project.

Financials	Amount
Projected Budget SFY 2023	$0
Budget Amount SFY 2022	$0
Adjusted Budget Amount SFY 2022	$86,122
Actual Cost SFY 2022	(See Addendum)

Prior to SFY 2022 Actual Cost $0

TR202201 – Library Support Contract (2022-2023)

Project Type: Contract Research
MoDOT Contact: Jen Harper
Total Contract Amount: $200,918
Contract Period: 7/1/2021 to 6/30/2023
Contract Investigator: Henry Brown
Funding: SPR 80%, State 20%

Project Description and Objectives:
The demand for information services has increased as more MoDOT users are realizing the timely, diverse and high-quality information they receive using the services of the current librarian. The major objective of this project is to provide library, research and reference support services for MoDOT. University of Missouri-Columbia will provide the services of a Master of Library Science (MLS) librarian who will work 40 hours per week and will be located at the Secretary of State's State Library and MoDOT in Jefferson City.

Proposed Activities for SFY 2023:
The librarian will continue to provide reference and research support services to MoDOT employees. Other services include circulation, cataloging, collection management (which includes digital repositories) & maintenance, marketing & outreach in addition to website content creation. Ongoing activities include coordinating and collaborating with the Missouri State Library.

SFY 2022 Accomplishments:
So far in SFY 2022, the librarian answered sixty-nine reference questions, fourteen of which were literature searches. A total of 8,652 print and electronic library items were circulated or accessed. Twenty-seven new items were added to the collection. Twelve reports were added to Innovation Library.

Financials	Amount
Projected Budget SFY 2023	$115,276
Budget Amount SFY 2022	$100,000
Adjusted Budget Amount SFY 2022	$85,642
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	$0

TR202202 – Deep Learning Models and Tools for Disaster Evacuation and Routing

Project Type: Contract Research
MoDOT Contact: Brent Schulte
Total Contract Amount: $329,110
Contract Period: 8/1/2021 to 1/31/2023
Contract Investigator: Steve Corns, Suzi Long, Praveen Edara
Funding: SPR 80%, State 20%

Project Description and Objectives:
This project details tools, processes, and protocols that can proactively manage disaster response, routing, and communications. The project will use the New Madrid Seismic Zone in SE Missouri as a testbed for modeling the response to an earthquake and aftershocks at Magnitude 8+. This area was chosen as it allows solutions to consider regions with inadequate road networks, limited communications protocols, and high likelihood of destruction for the proposed scenario. Research tasks will use deep learning techniques combined with traffic simulation models and crowdsourcing models for communication during the event, emergency response, and network restoration.

Proposed Activities for SFY 2023:
A time and cost extension was executed at the end of SFY 2022. The amount of data from the second survey took more time to analyze than anticipated. The draft final report will be November 1, 2022 with the final report due on December 19, 2022.

SFY 2022 Accomplishments:
A historical data analysis for the New Madrid Seismic Zone was conducted to determine any available data or approaches that would be relevant to the current work. Two survey instruments were prepared. One to solicit information from first responders, state emergency officials and the other to gather information about residents in the area being analyzed. MoDOT Research worked with the district to determine who is best to serve on the technical committee. The survey instrument to solicit information from first responders, state emergency officials and other stakeholders was sent out and the results have indicated several areas of concern in the New Madrid area of Missouri. A survey instrument was also implemented to determine the likelihood of residents to evacuate during an extreme event and their planned routes. An assessment of the GIS data for the area was conducted to identify soil types that could lead to loss of transportation infrastructure. This will enable the creation of network scenarios to determine evacuation routes with a higher likelihood of success. An ArcGIS model has been created to predict the probability that an infrastructure element will be lost. Planning for publication of the results is ongoing. A prototype of the phone app was developed and was shown to MoDOT personnel at the beginning of April. The amount of data in the second survey required a cost and time extension. This was done at the end of the fourth quarter.

Financials	Amount
Projected Budget SFY 2023	$174,874
Budget Amount SFY 2022	$200,000
Adjusted Budget Amount SFY 2022	$154,236
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	$0

TR202203 – Intermediate Bents-Calculation of Restraint Factor

Project Type: Contract Research
MoDOT Contact: TBD
Total Contract Amount: $150,000 max
Contract Period: 18-months estimated
Contract Investigator: TBD
Funding: SPR 80%, State 20%

Project Description and Objectives:
Currently MoDOT designs intermediate bents with prestressed concrete superstructures as a cantilever for longitudinal forces. In reality they are at least partially restrained and not able to rotate significantly. MoDOT wishes to examine if this results in a significant overdesign. The research will result in a recommendation for design factors.

Proposed Activities for SFY 2023:
The proposals are due July 12, 2022 and the selection meeting is scheduled for late July 20, 2022. It is anticipated this project will start in mid-late August.

SFY 2022 Accomplishments:
Due to staffing changes within the Research Section this project RFP did not get released until late SFY 2022. The RFP was posted on May 31, 2022. The proposals are due July 12, 2022.

Financials	Amount
Projected Budget SFY 2024	$75,000
Projected Budget SFY 2023	$75,000
Budget Amount SFY 2022	$15,000
Adjusted Budget Amount SFY 2022	$0
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	$0

TR202204 – Type N PTFE Bearing Designs

Project Type: Contract Research
MoDOT Contact: TBD
Total Contract Amount: $200,000 max
Contract Period: 18 months estimated
Contract Investigator: TBD
Funding: SPR 80%, State 20%

Project Description and Objectives:
MODOT currently specifies filled or unfilled flat PTFE bearings per section 1038.4.4 for expansion bearings. The design friction coefficients are in EPG section 751.50. MoDOT believes that if designers follow our specifications then the filled PTFE and/or cold values may be conservatively used but that it leads to friction forces that are sizable. The dynamic friction force is often larger than the forces that would be applied to a fixed bent due to temperature, wind or braking. This nullifies the benefits of using the expansion bearing. This research will look at what design coefficients of friction should be used when distributing forces for substructure design. The research will also determine if dimpled lubricated pads are an effective alternate and if so, what should be added to the specs to address maintenance issues with this type of bearing.

Proposed Activities for SFY 2023:
The RFP will be released in July or August of State Fiscal Year 2023 and the project team selected early fall.

SFY 2022 Accomplishments:
Due to staffing changes within the Research Section this project RFP did not get released in SFY 2022. Work on the RFP will begin in late SFY 2022 and it is expected to be released in early SFY 2023.

Financials	Amount
Projected Budget SFY 2024	$150,000
Projected Budget SFY 2023	$50,000
Budget Amount SFY 2022	$15,000
Adjusted Budget Amount SFY 2022	$0
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	$0

TR202205 – Analysis of Asphalt Mixtures Using Alternative Aggregate in SMA or SuperPave

Project Type: Contract Research
MoDOT Contact: Brent Schulte
Total Contract Amount: $199,999
Contract Period: 5/2/2022 to 5/1/2024
Contract Investigator: Jenny Liu
Funding: SPR 80%, State 20%

Project Description and Objectives:
The objective of this study is to identify and compare alternatives to Traprock through testing and laboratory evaluation along with conducting a literature review of current practices of neighboring DOTs. MoDOT is interested in finding other locally available, durable crushed aggregates for use in SMA and higher level Superpave mixes that could handle interstate traffic and are less expensive than Traprock.

Proposed Activities for SFY 2023:
Activities to be performed in SFY 2023 include: conducting a literature review of current neighboring DOTs' practices and other research studies in selecting, evaluating, and using other available hard and durable aggregates for SMA and higher level Superpave mixtures; an evaluation of durability from a list of candidate aggregates and identification of alternative aggregates meeting MoDOT specification requirements; development of SMA and Superpave mix designs for mixtures with alternative aggregates in accordance with MoDOT's current practices and specifications; and, performance evaluation of SMA and Superpave mixtures with alternative aggregates through a comprehensive laboratory testing and data analysis program.

SFY 2022 Accomplishments:
This project has been awarded and started May 2, 2022. The kick-off meeting was held May 11, 2022.

Financials	Amount
Projected Budget SFY 2024	$99,999
Projected Budget SFY 2023	$100,000
Budget Amount SFY 2022	$15,000
Adjusted Budget Amount SFY 2022	$0
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	$0

TR202206 – Friction Enhancements to Asphalt Pavement Surfaces

Project Type: Contract Research

MoDOT Contact: Brent Schulte
Total Contract Amount: $175,000 max
Contract Period: 2/1/2022 to 3/1/2024
Contract Investigator: Magdy Abdelrahman and John Meyers
Funding: SPR 80%, State 20%

Project Description and Objectives:
The relatively high cost of constructing, and removing, HFST with polymer resins along with the durability concerns due to existing pavement conditions, has led state agency to consider high friction surface treatment with asphalt-based binders as an alternative. This project will evaluate alternative binders for use in surface friction treatments. The main objective of this research study is to evaluate, assess, and identify the use of high friction alternative aggregate sources in asphalt-based surface treatment applications.

Proposed Activities for SFY 2023:
Activities to be performed in SFY 2023 include a literature review of the main findings of previous research focusing on asphalt-based binders in high friction surface treatment. The research team will finalize the selection of binders and aggregates that will be examined in this study following the outcomes of MoDOT project TR202005. Two polymer resin binders and three asphalt-based binders will be selected for this research. Laboratory evaluation of basic material properties of binders and aggregates will be conducted along with measuring the friction properties of the different aggregate and binder combinations.

SFY 2022 Accomplishments:
This project has been awarded and started February 1, 2022. After a kickoff meeting was held February 17, 2022, the research team completed ordering the new Friction testing equipment, DF Tester, and CT Meter. They continued to review literature on HFST, HFSC, materials and testing. Aggregate sources were identified and ordered. They received one source "Rhyolite-Trap Rock". The researchers finalized the S&T testing team and hired students to conduct testing. Testing on the received materials will continue into the next fiscal year.

Financials	Amount
Projected Budget SFY 2024	$67,916
Projected Budget SFY 2023	$100,000
Budget Amount SFY 2022	$15,000
Adjusted Budget Amount SFY 2022	$7,084
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	$0

TR202207 – Pile Set-up and Restrike Procedures

Project Type: Contract Research
MoDOT Contact: Brent Schulte
Total Contract Amount: $150,000
Contract Period: 2/25/2022 to 8/25/2023
Contract Investigator: Brent Rosenblad
Funding: SPR 80%, State 20%

Project Description and Objectives:
The objective of this research is to provide MoDOT with a better understanding of pile set-up in Missouri soils and provide the department with a pile restrike procedure for different types of piles. The department would like a more detailed pile restrike and set-up procedure that also considers contractor's tight timelines. A typical 7 or 14 day restrike procedure is not advantageous to a contractor's schedule.

Proposed Activities for SFY 2023:
Activities to be performed in SFY 2023 include completion of the research and literature review. Topics to be researched include Missouri soil types, magnitude of pile set up in various soils, reliability of pile set and sources of pile driving data. A summary document on "pile set up in Missouri soils" will be developed. The team will then develop pile set up and restrike procedures along with guidelines for the department. A draft final report and research summary is due in SFY 2023 also, with the final report due in SFY 2024.

SFY 2022 Accomplishments:
After a kickoff meeting was held March 10, 2022 the research team started working on the "Research and Literature Review" task along with identifying a graduate student who will be working on this project. Researchers have also started a shared folder with MoDOT to share past project data that has been gathered. The team worked on identifying, compiling, and reviewing relevant literature on pile set-up which will eventually be used to develop the Summary Document along with pile driving reports from around the state.

<u>Financials</u>	<u>Amount</u>
Projected Budget SFY 2024	$44,887
Projected Budget SFY 2023	$80,000
Budget Amount SFY 2022	$10,000
Adjusted Budget Amount SFY 2022	$25,113
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	$0

TR202208 – Bats and Bridges-Best Practices

Project Type: Contract Research
MoDOT Contact: Brent Schulte
Total Contract Amount: $85,170
Contract Period: 4/15/2022 to 4/15/2023
Contract Investigator: Piper Roby
Funding: SPR 80%, State 20%

Project Description and Objectives:
MoDOT's Environmental Section works with the Design and Construction Divisions to ensure that our operations and systems do not impact endangered species. One of the risk areas in Missouri is endangered bats and their propensity to use bridges as nesting areas. This project will look at best practices for reducing or eliminating impacts to bats. Some of the items that could be addressed is if there are specific designs and materials that attract bats, are there effective ways to temporarily keep bats off bridges, is there technology that can be used for detecting bats on bridges, what is the effect of roadway lighting on bats and are there types of lighting that present lesser adverse effects on bats. Another item of interest is what species use bridges on a regular basis in Missouri and how do they use them, for example foraging, resting, transient roosts, etc.

Proposed Activities for SFY 2023:
Activities to be performed in SFY 2023 include completion of the research and literature review. The researchers will then respond to questions and concerns from the TAC on this project that were listed in the RFP. After the research and literature review is completed along with responding to all questions, the team will develop a draft final report that is due January 16, 2023. The team will give a final presentation to MoDOT along with a final report which is due March 15, 2023. The contract will end April 15, 2023.

SFY 2022 Accomplishments:
This project was awarded, and a kick-off meeting was held on April 27, 2022. The researchers started the research and literature review at the end of SFY 2022.

<u>Financials</u>	<u>Amount</u>
Projected Budget SFY 2023	$81,465
Budget Amount SFY 2022	$10,000
Adjusted Budget Amount SFY 2022	$3,705
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	$0

TR202209 – Safety Effectiveness of Temporary Rumble Strips in Work Zones-Completed

Project Type: Contract Research
MoDOT Contact: Jenni Hosey
Total Contract Amount: $156,326
Contract Period: 8/1/2021 to 2/28/2022
Contract Investigator: Henry Brown
Funding: SPR 80%, State 20%

Project Description and Objectives:
Getting drivers attention prior to a work zone is vital for the safety of the workers and the traveling public. In recent years MoDOT has begun deploying rumble strips ahead of some work zones to catch the attention of drivers. There are multiple types of rumble strips including those meant for short term use and those for longer projects. This project will look for best practices with rumble strips and the effectiveness of use. It is anticipated the research team will gather data from other states as well as Missouri's use. The deliverables of the project will include recommendations on what type of rumble strip is most effective in different situations.

Proposed Activities for SFY 2023:
This project was completed in State Fiscal Year 2022.

SFY 2022 Accomplishments:
The MCTI research team coordinated with MoDOT districts regarding the collection of speed data in work zones using the temporary rumble strips. A literature review, state DOT interviews and surveys, traffic collection (speed and count), and economic feasibility of temporary rumble strips has been completed. MCTI submitted the draft report on December 15, 2021 and the final report on February 8, 2022. The final report was published in the Innovations Library.

<u>Financials</u>	<u>Amount</u>
Projected Budget SFY 2023	$0

Budget Amount SFY 2022	$20,000
Adjusted Budget Amount SFY 2022	$156,326
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	$0

TR202210 – Increasing Revenue from Amtrak

Project Type: Contract Research
MoDOT Contact: Jenni Hosey
Total Contract Amount: $99,799
Contract Period: 3/4/2022 to 3/31/2023
Contract Investigator: Peter Waldt
Funding: SPR 80%, State 20%

Project Description and Objectives:
Revenue is a critical component in providing passenger rail service in Missouri. Funding is always at risk of being cut so a steady stream of income would be helpful for planning purposes. This project would look at what other Amtrak services have done to increase revenue as well as other similar industries. It is anticipated this would be mostly a literature search to develop options to explore outside this project.

Proposed Activities for SFY 2023:
WSP will meet with the MoRPAC group this year for stakeholder feedback. The team will also submit quarterly progress reports and invoices. The draft report is due January 16, 2023 and the final on February 28, 2023.

SFY 2022 Accomplishments:
This RFP was drafted, posted, and awarded during SFY 2022 with WSP having the winning proposal. The kick-off meeting for this project was held on March 16, 2022 between MoDOT Research and Multimodal Operations staff and the consultant. MoDOT provided WSP with information regarding ridership, financial funding, and the contract between the department and Amtrak in April. Monthly progress meetings were held in May and June.

Financials	**Amount**
Projected Budget SFY 2023	$63,871
Budget Amount SFY 2022	$10,000
Adjusted Budget Amount SFY 2022	$35,928
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	$0

TR202212 – Mitigating and Preventing MoDOT Safety-Related Incidents through Root-Cause Elimination and Utilization of Leading Safety Indicators

Project Type: Contract Research
MoDOT Contact: Scott Breeding
Total Contract Amount: $249,999
Contract Period: 9/1/2022 to 5/1/2024
Contract Investigator: Islam El-adaway
Funding: SPR 80%, State 20%

Project Description and Objectives:
A top priority for MoDOT is to prevent worker injury and fatalities. Part of preventing accidents is to get at the root causes of incidents and develop leading safety indicators. This project will analyze incident reports on Missouri highway projects and use statistical modeling to determine the root-causes of incidents that have occurred. The researchers will survey contractors to determine what leading safety indicators they utilize and evaluate if they match with the root-causes identified through the modeling. Deliverables will include new leading safety performance measurements, a plan for monitoring, and evaluation policies to be considered by MoDOT.

Proposed Activities for SFY 2023:
The researcher requested a project start date of September 1, 2022 so that a graduate student can be hired for the project. A kickoff meeting will take place after that date. The researcher will perform a literature search and review of safety incidents on Missouri roadways. A survey of the contractors and MoDOT will begin towards the end of State Fiscal Year 2023. This project will carry over into State Fiscal Year 2024.

SFY 2022 Accomplishments:
The RFP for this project was posted in February with proposals due March 29, 2022. Two proposals were submitted for the TAC to review on April 7, 2022. This project was awarded in the fourth quarter to Dr. El-adaway of Missouri Science and Technology. The task order was executed and signed in the fourth quarter.

Financials	Amount
Projected Budget SFY 2024	$124,999
Projected Budget SFY 2023	$125,000
Budget Amount SFY 2022	$10,000
Adjusted Budget Amount SFY 2022	$0
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	$0

TR202213 – Identification of a Response and Rescue Network for the St. Louis Region (renamed from last work program)

Project Type: Contract Research
MoDOT Contact: Jenni Hosey
Total Contract Amount: $124,999
Contract Period: 5/1/2022 to 6/10/2024
Contract Investigator: Praveen Edara
Funding: SPR 80%, State 20%

Project Description and Objectives:
In the event an earthquake hits the New Madrid Fault there could be significant damage in the St. Louis region. Not only is it important to plan for evacuation of the residents but you also need to have a plan for how to get workers into the city for emergency response activities. Compounding the issue is the fact that there could be damage to bridges with the potential of collapse and bottlenecked roadways. The objective of this project would be to develop a list or routes and details on how to evacuate affected individuals and routes and directions for emergency response workers. A list of bridges that would need to be blocked due to susceptibility of collapse would also be part of the deliverables.

Proposed Activities for SFY 2023:
The University of Missouri will work on this project throughout SFY 2023 and SFY 2024. The Literature Review and Historical Data Analysis will be completed during SFY 2023. The research team should also complete the task of "Identifying Roadway Network Deficiencies, Strategies for Increasing Evacuation Effectiveness, Populations Likely to Struggle in an Evacuation, and Propose Type of Traffic Model" during SFY 2023. The rest of the work will be completed in SFY 2024 including the draft report due on March 11, 2024 and the final due on May 20, 2024.

SFY 2022 Accomplishments:
An RFP was drafted, posted, and awarded in SFY 2022. The University of Missouri is the consultant for this project and a kickoff meeting was held on May 20, 2022.

Financials	**Amount**
Projected Budget SFY 2024	$49,999
Projected Budget SFY 2023	$75,000
Budget Amount SFY 2022	$10,000
Adjusted Budget Amount SFY 2022	$0
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	$0

TR202214 – Developing a Hazard Detection and Alert System to Prevent Worker Fatalities

Project Type: Contract Research
MoDOT Contact: Brent Schulte
Total Contract Amount: $200,000
Contract Period: 2/28/2022 to 8/28/2023
Contract Investigator: Sejun Song and John Kevern
Funding: SPR 80%, State 20%

Project Description and Objectives:
This project will focus on providing MoDOT with a reliable system that detects the proximity of backing heavy fleet vehicles or equipment in construction sites to workers or other objects. The system will be capable of alerting workers in close proximity to the backing vehicle along with the vehicles operator. The project is to: 1) conduct a critical review of existing commercial alert systems to prevent work/construction zone crashes, and 2) develop an affordable, easy-to-use, adaptable, prompt, accurate, and reliable hazard detection and alert system that connects heavy fleet vehicles and the work/construction zone crews using advance communication technologies that can overcome the limitations of existing commercial alert systems.

Proposed Activities for SFY 2023:
Activities to be performed in SFY 2023 include; completion of the research and literature review, and a presentation on the findings from the review which is due July 15, 2022. After the presentation on existing alert systems, MoDOT will decide whether to try an existing commercial alert system or have the research team proceed with developing a system. After a system is developed a draft final report and research summary will be due at the end of SFY 2023. The final report will be due at the start of SFY 2024.

SFY 2022 Accomplishments:
After a kickoff meeting was held on February 9, 2022 the project team received summary files of reported work/construction zone backing incidents from MoDOT for a deeper understanding of the trends and characteristics of the incidents. The project team is worked on a literature review of work/construction zone backing incidents along with an analysis of backing incident summary files that contain 1,156 incidents from 2012-2021. A review of five types of backing incident prevention systems was performed; radar-based systems, sonar-based systems, infrared sensors and thermal imaging systems, tag-based systems, and video cameras. The project team worked on building a team by interviewing new students and training students for technology development.

Financials	Amount
Projected Budget SFY 2024	$52,026
Projected Budget SFY 2023	$115,000
Budget Amount SFY 2022	$15,000
Adjusted Budget Amount SFY 2022	$32,974
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	$0

TR202215 – Missouri DOT Data Acquisition and Data Processing Utilizing Artificial Intelligence and Machine Learning

Project Type: Contract Research
MoDOT Contact: Jenni Hosey
Total Contract Amount: $249,965
Contract Period: 6/15/2022 to 6/30/2024
Contract Investigator: Kyle Schneweis
Funding: SPR 80%, State 20%

Project Description and Objectives:
The ability to collect data and imagery has changed dramatically in recent years and the limiting factor is now the ability to process the large quantities that can be collected quickly. Processing the data utilizing newer technologies such as artificial intelligence and machine learning may allow MoDOT to utilize these new technologies to do things such as inspections and conducting inventory in a more efficient manner. This project would explore what areas MoDOT could benefit from these technologies and perform a benefit cost analysis for each.

Proposed Activities for SFY 2023:
High Street Consultants will work on this project throughout SFY 2023, producing 4 quarterly reports and holding progress meetings as needed. The Research and Literature Review will be compiled in the first quarter of SFY 2023. Task 3A, "Data Acquisition, AI Training, and Analysis", will be completed in the first half of SFY 2023. At that time there will be a client review to determine which AI processes MoDOT wishes the research team to develop. Development of those processes along with B/C analysis will take place during the rest of SFY 2023 and into SFY 2024. The draft and final reports are due in SFY 2024.

SFY 2022 Accomplishments:
An RFP was drafted, posted, and awarded in SFY 2022. High Street Consultants is the consultant for this project and a kickoff meeting was held in June 2022.

Financials   **Amount**
Projected Budget SFY 2024 $124,965
Projected Budget SFY 2023 $125,000
Budget Amount SFY 2022 $15,000
Adjusted Budget Amount SFY 2022 $0
Actual Cost SFY 2022   (See Addendum)
Prior to SFY 2022 Actual Cost $0

TR202216 – I-155 Pemiscot County NRRA Test Sections for the Mobile Test Track

Project Type: Contract Research
MoDOT Contact: Scott Breeding
Total Contract Amount: $145,000
Contract Period: N/A
Contract Investigator: Apex Paving
Funding: SPR 80%, State 20%

Project Description and Objectives:
This project is the beginning of building our test track in Missouri with the help of the National Road Research Alliance Pooled Fund. The location on I-155 in Pemiscot County, J9I3597, is ideal in that it will provide a consistent base for up to 10 test sections to be constructed. MoDOT will work with NRRA closely to establish the test section mix details. The research project with NRRA will allow the research team to develop the mobile testing system for the test track. This request is for the delta costs for constructing the test sections. The following estimate is based on a LTPP test site in 2016.

Proposed Activities for SFY 2023:
It is anticipated the work will take place in the summer or fall of calendar year 2022 but it is possible it could be spring or summer of 2023.

SFY 2022 Accomplishments:
This project was let in December 2021 and awarded to Apex Paving Company. It is anticipated the "delta costs" will occur in the first half of next fiscal year. The bid cost for the delta on the project was $144,283.66.

Financials   **Amount**
Projected Budget SFY 2023 $145,000
Budget Amount SFY 2022 $0
Actual Cost SFY 2022   (See Addendum)
Prior to SFY 2022 Actual Cost $0

TR202219 – HFST Review of Service Life

Project Type: Contract Research
MoDOT Contact: Scott Breeding
Total Contract Amount: $200,000 max
Contract Period: TBD
Contract Investigator: TBD
Funding: SPR 80%, State 20%

Project Description and Objectives:
MoDOT began using High Friction Surface Treatments in 2013. What begin as three initial placements has grown into a large program each year. While HFSTs can be an effective safety improvement they are costly and if applied incorrectly can begin to deteriorate quickly. This project will take a look at the large number of HFSTs currently in place over the years and see how long they are "holding up." It should be noted that past research has shown that even when HFSTs appear to be in poor condition they often are still providing good friction values. Since HFST is strictly a safety improvement and not a maintenance treatment; the condition of the pavement prior to treatment is also important and will be reviewed as part of the project. It is anticipated this project will be looking at a visual survey of the condition mostly through ARAN video.

Proposed Activities for SFY 2023:
It is anticipated we will write the RFP in the summer of 2022 and select a contractor in early fall.

SFY 2022 Accomplishments:
Work this fiscal year has been mostly taken place internally trying to track down the large number of HFSTs in currently in place along with their installation dates and contract information. This has proven to be time consuming but it is important to have an idea of what data is available before writing the RFP.

Financials	**Amount**
Projected Budget SFY 2024	$125,000
Projected Budget SFY 2023	$75,000
Budget Amount SFY 2022	$0
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	$0

TR202221 – Consultant Support for Intelligent Compaction and Paver-Mounted Thermal Profiling Projects in 2022-2023 – Active

Project Type: Contract
MoDOT Contact: Scott Breeding
Total Contract Amount: $418,073
Contract Period: 3/1/2022 to 4/30/2024
Contract Investigator: George Chang

Project Description and Objectives:
This project provides consultant support for MoDOT projects for the 2022 and 2023 construction seasons. The consultant has developed and lead contractor Intelligent Compaction (IC) and Paver-Mounted Thermal Profiling (PMTP) training and project support for MoDOT projects in previous years. This current research project will provide training, data, and field support as needed for each of the IC-PMTP MoDOT Asphalt Projects constructed in 2022 and 2023. This project will also begin the process of addressing the Quality Assurance (QA) testing required by FHWA.

Proposed Activities for SFY 2023:
The research team will continue to provide Just-In-Time training for contractors and MoDOT employees for the upcoming construction season as needed. The plan would be to provide the training at most of the districts during the 2022 season if possible. The consultants will be on site at the beginning of paving for those contractors needing significant support and provide as needed support virtually for other

contractors. Another training will occur during the winter of 2023 prior to the following construction season. It is being discussed that it occur in conjunction with the Asphalt Back to Basics Conference that takes place in late February each year.

SFY 2022 Accomplishments:
The research team conducted training during month of March for contractors and MoDOT staff at Jefferson City and also provided Just-In-Time training at various locations for upcoming projects. Accomplishments and issues were discussed during the meeting in order to plan for the 2022/2023 contract. Focus was on how to provide additional support and "recharge" our efforts coming out of COVID-19.

Financials	Amount
Projected Budget SFY 2024	$128,334
Projected Budget SFY 2023	$200,000
Budget Amount SFY 2022	$0
Adjusted Budget Amount SFY 2022	$89,739
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	$0

TR202222 – Consultant Support for Intelligent Compaction and Paver-Mounted Thermal Profiling Projects in 2022-2023 Misc. Expenses– Active

Project Type: Contract
MoDOT Contact: Scott Breeding
Total Contract Amount: $10,000
Contract Period: 3/1/2022 to 4/30/2024
Contract Investigator: N/A

Project Description and Objectives:
This would cover the cost for miscellaneous expenses with the implementation of the Intelligent compaction and paver-mounted thermal profiling projects. We have found we need small items for the team that goes into the field such as small tools, nuts, bolts, drill bits, etc.

Proposed Activities for SFY 2023:
It is anticipated some additional items will periodically be needed throughout the project to help administer the fieldwork for the IC/PMTP project.

SFY 2022 Accomplishments:
A few items were purchased at the end of April for the C&M Field Office to begin their work on the IC/PMTP projects in the 2022 construction season.

Financials	Amount
Projected Budget SFY 2024	$4,333
Projected Budget SFY 2023	$5,000
Budget Amount SFY 2022	$0
Adjusted Budget Amount SFY 2022	$667
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	$0

TR202301 – GPR Analysis of I-44 Pavement Data

Project Type: Contract Research
MoDOT Contact: Jen Harper
Total Contract Amount: $7,000 max
Contract Period: TBD
Contract Investigator: Adam Carmichael
Funding: SPR 80%, State 20%

Project Description and Objectives:
As part of Pooled Fund TPF-5(385) Infrasense collected ground penetrating radar (GPR) on I-44 from mile marker 113 to 129 in both the eastbound and westbound directions. This data was collected to supplement continuous deflection testing performed along the I-44 corridor as part of the pooled fund study. Since the GPR data analysis was not part of the pooled fund study this project would provide the funding to analyze the data and compare it to the continuous deflection data. The deliverables from the analysis will include: pavement layer thickness, layer elastic moduli, required overlay thickness estimate, and remaining service life estimate.

Proposed Activities for SFY 2023:
Infrasense already collected the data when they were in Missouri for the Pooled Fund project. Once the contract is signed in SFY 2023 they will analyze the data and provide the report to MoDOT. It is anticipated the "report" will not be a full research report but closer to a technical brief.

SFY 2022 Accomplishments:
This project will begin in SFY 2023.

Financials	Amount
Projected Budget SFY 2023	$7,000
Budget Amount SFY 2022	$0
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	$0

TR202302 – Recent Developments and Technology Assessment of Automated Weather Observing Systems

Project Type: Contract Research
MoDOT Contact: TBD
Total Contract Amount: $100,000 estimated
Contract Period: 12 months estimated
Contract Investigator: TBD
Funding: SPR 80%, State 20%

Project Description and Objectives:
The proposed research project aims to provide a detailed technical analysis of automated weather observing system (AWOS) with the goal of enabling MoDOT to make informed data-driven decisions on strategic investments/upgrades of surface weather observation stations in Missouri airports. To this end, the objectives of this study are three-fold: 1. Conduct a comprehensive review of current advances in surface weather observation stations (both AWOS and Automated Surface

Observing System or ASOS). 2. Identify AWOS/ASOS adopted by airports in other states along with user-experience feedback. 3. Provide recommendations on best AWOS/ASOS based on technological assessment and economic analysis.

Proposed Activities for SFY 2023:
It is anticipated this project would be scoped in early State Fiscal Year 2023, an RFP released late summer, and an anticipated start date in the late fall.

SFY 2022 Accomplishments:
This project will begin in SFY 2023.

Financials	Amount
Projected Budget SFY 2024	$75,000
Projected Budget SFY 2023	$25,000
Budget Amount SFY 2022	$0
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	$0

TR202303 – Consultant Estimating

Project Type: Contract Research
MoDOT Contact: TBD
Total Contract Amount: $100,000 estimated
Contract Period: 12 months estimated
Contract Investigator: TBD
Funding: SPR 80%, State 20%

Project Description and Objectives:
Design is looking at how to better negotiate work tasks and hours with consultants. Consultant Services would like to have a better handle on a job, its work tasks, hours, etc. in an estimating tool. MoDOT believes Pennsylvania and Florida might have some kind of system. It would be great to be able to learn from them and see what data would be applicable for Missouri as well as what other states might have.

Proposed Activities for SFY 2023:
It is anticipated this project would be scoped in early State Fiscal Year 2023, an RFP released late summer, and an anticipated start date in the late fall.

SFY 2022 Accomplishments:
This project will begin in SFY 2023.

Financials	Amount
Projected Budget SFY 2024	$75,000
Projected Budget SFY 2023	$25,000
Budget Amount SFY 2022	$0
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	$0

TR202304 – Investigating the Expanded Use of Waste Plastic in Asphalt

Project Type: Contract Research
MoDOT Contact: TBD
Total Contract Amount: $500,000 estimated
Contract Period: 36 months estimated
Contract Investigator: TBD
Funding: SPR 80%, State 20%

Project Description and Objectives:
Now that the initial concept of using waste plastic in asphalt has been vetted in Missouri for a relatively pure, PE-rich source of recycled waste plastic, new research is needed to investigate and formalize the manner in which other mixed waste plastic streams can be properly handled in a construction materials specification. For instance, which waste plastic streams should be allowed? And in what relative proportions? What type of pellet, shred or ground particle size range should be allowed? Which streams should be expressly prohibited, and/or what trace amounts can be tolerated (if any)? Depending on the results of the research, it may be possible and advisable to create several named categories of purposefully-designed or designated, mixes of recycled plastic for use in road asphalt. The final product will be a comprehensive technical report, technical presentations, and a series of field demonstration projects. The report should formalize the manner in which mixed waste plastic streams can be properly handled in a construction materials specification. MoDOT can apply the research by implementing the recommendations in forthcoming special provisions and eventually in their standard specifications.

Proposed Activities for SFY 2023:
This project would be directly contracted with MCTI and MU researchers since it is a follow-up project to the current waste plastic project. This will most likely not be contracted until Dr. Buttlar's TR202020 project is completed. It is scheduled to be completed in November.

SFY 2022 Accomplishments:
This project will begin in SFY 2023.

Financials	Amount
Projected Budget SFY 2026	$75,000
Projected Budget SFY 2025	$150,000
Projected Budget SFY 2024	$200,000
Projected Budget SFY 2023	$75,000
Budget Amount SFY 2022	$0
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	$0

TR202305 – Asphalt Binder Replacement Performance

Project Type: Contract Research
MoDOT Contact: TBD
Total Contract Amount: $250,000 estimated
Contract Period: 18 months estimated
Contract Investigator: TBD
Funding: SPR 80%, State 20%

Project Description and Objectives:
This project will look at the performance of asphalt binder replacement with recyclables on low-volume roads and developing changes to the specifications. MoDOT has placed a number of overlays on low volume roads recently with a new specification that allows for high amounts of recyclables. It would be good to determine how these mixes are performing. This project will determine if MoDOT needs to set replacement limit on the asphalt binder. Both lab work and field work may be needed on the project. The research will run tests with the grade it is at with the recent specification to see if what the contractor is giving us is actually realistic.

Proposed Activities for SFY 2023:
It is anticipated this project would be scoped in early State Fiscal Year 2023, an RFP released in the fall, and an anticipated start date in the late fall or early winter.

SFY 2022 Accomplishments:
This project will begin in SFY 2023.

Financials	Amount
Projected Budget SFY 2025	$75,000
Projected Budget SFY 2024	$150,000
Projected Budget SFY 2023	$25,000
Budget Amount SFY 2022	$0
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	$0

TR202306 – River Gravel in Asphalt Mixes

Project Type: Contract Research
MoDOT Contact: TBD
Total Contract Amount: $200,000 estimated
Contract Period: 18 months estimated
Contract Investigator: TBD
Funding: SPR 80%, State 20%

Project Description and Objectives:
This project will look at the use of river gravel in asphalt mixes and the effectiveness of performance tests in measuring the quality and durability. A few mixes recently with Osage River Gravel have had issues with stripping when the River Gravel has been in the lower layers. They seem to be performing fine on the surface but in the lower layer where they sit near the bottom and may remain saturated for a period of time, they are causing stripping. We need to be able to correlate these mixes to the Balanced Mix Design tests so that they fail when we have a mix that is going to strip.

Proposed Activities for SFY 2023:
It is anticipated this project would be scoped in early State Fiscal Year 2023, an RFP released in the fall, and an anticipated start date in the late fall.

SFY 2022 Accomplishments:
This project will begin in SFY 2023.

Financials	**Amount**
Projected Budget SFY 2024	$175,000
Projected Budget SFY 2023	$25,000
Budget Amount SFY 2022	$0
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	$0

TR202307 – Investigation of the HVSR (Horizontal-to-Vertical Spectral Ratio) Method to Determine Site Class for Seismic Design

Project Type: Contract Research
MoDOT Contact: TBD
Total Contract Amount: $200,000 estimated
Contract Period: 18 months estimated
Contract Investigator: TBD
Funding: SPR 80%, State 20%

Project Description and Objectives:
The goal of this research is to facilitate the implementation of a simple, single-station geophysical measurement to rapidly and non-intrusively determine site classification for use in seismic design. Determination of the geotechnical site class is a critical step to determine and plan for the extent of seismic design of bridges. Sites with soft ground conditions (Site Class E for example) may require seismic design considerations that stiff ground sites (Site Class B, for example) would not require. This project will investigate the use of a simple, single-station measurement, called the Horizontal-to-Vertical-Spectral-Ratio (HVSR) method, to infer site class. The method requires only a single three-component vibration sensor to record ambient noise for several minutes and produces the simple output of a frequency peak.

Proposed Activities for SFY 2023:
It is anticipated this project would be scoped in early State Fiscal Year 2023, an RFP released in the fall, and an anticipated start date in the late fall or early winter.

SFY 2022 Accomplishments:
This project will begin in SFY 2023.

Financials	**Amount**
Projected Budget SFY 2024	$175,000
Projected Budget SFY 2023	$25,000
Budget Amount SFY 2022	$0
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	$0

TR202308 – LRFD seismic maps

Project Type: Contract Research
MoDOT Contact: TBD
Total Contract Amount: $150,000 estimated
Contract Period: 18 months estimated

Contract Investigator: TBD
Funding: SPR 80%, State 20%

Project Description and Objectives:
This project would update the LRFD seismic maps with boring data. Right now the map is conservative. It is used during the preliminary scoping so when designers are scoping the bridge it may appear that much more geotechnical work will need to be done and sooner than is actually required. Once the Geotechnical drillers actually go out to the site and start their testing, they find out the soil is at a lower seismic risk. So while no bridges are designed off of the overly conservative maps, estimation of workflow and timelines are. Having better maps will allow MoDOT to plan better and be more efficient in the planning and scoping process.

Proposed Activities for SFY 2023:
It is anticipated this project would be scoped in early State Fiscal Year 2023, an RFP released in the fall, and an anticipated start date in the late fall or early winter.

SFY 2022 Accomplishments:
This project will begin in SFY 2023.

Financials	Amount
Projected Budget SFY 2024	$125,000
Projected Budget SFY 2023	$25,000
Budget Amount SFY 2022	$0
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	$0

TR202309 – Audible Alert and TMA Lighting

Project Type: Contract Research
MoDOT Contact: TBD
Total Contract Amount: $200,000 estimated
Contract Period: 18 months estimated
Contract Investigator: TBD
Funding: SPR 80%, State 20%

Project Description and Objectives:
What is the correct lighting/TMA package we should be using on our TMAs? The Safety Focus Team has been sent multiple ideas from the Districts regarding possible TMA lighting ideas for consideration. The Team put out a formal call to the districts to submit ideas for possible research. This project would work with FHWA to develop the research necessary to determine if the lighting suggestions improve driver attention and awareness to the TMA and provide the data needed to FHWA for acceptance. This project will also explore an updated Audible Alert system. Information would also be pulled from NCHRP project 05-24 to determine the lighting that was found to be effective during that study.

Proposed Activities for SFY 2023:
This project would be a direct contract with MCTI and reserachers at MU since they did original research on TMA lighting and an audible alert system. The results from the NCHRP report are expected in June so a workplan could be developed this summer with a hopeful start date of late summer early fall.

SFY 2022 Accomplishments:
This project will begin in SFY 2023.

Financials	Amount
Projected Budget SFY 2024	$175,000
Projected Budget SFY 2023	$25,000
Budget Amount SFY 2022	$0
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	$0

TR202310 – Magnesium Chloride and Cement Paste

Project Type: Contract Research
MoDOT Contact: TBD
Total Contract Amount: $150,000 estimated
Contract Period: 18 months estimated
Contract Investigator: TBD
Funding: SPR 80%, State 20%

Project Description and Objectives:
Magnesium Chloride is starting to be used in winter operations for snow/ice removal. It works well for those purposes but there have been some concerns that there could be a chemical reaction between the Magnesium chloride and the cement paste in concrete pavements and bridge surfaces. This project will look at that chemical reaction to determine if there is a concern with the use of Mag Chloride.

Proposed Activities for SFY 2023:
It is anticipated this project would be scoped in early State Fiscal Year 2023, an RFP released in the fall, and an anticipated start date in the late fall.

SFY 2022 Accomplishments:
This project will begin in SFY 2023.

Financials	Amount
Projected Budget SFY 2024	$125,000
Projected Budget SFY 2023	$25,000
Budget Amount SFY 2022	$0
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	$0

TR202311 – Asset Characterization Using Automated Methods

Project Type: Contract Research
MoDOT Contact: TBD
Total Contract Amount: $150,000 estimated
Contract Period: 24 months estimated
Contract Investigator: TBD
Funding: SPR 80%, State 20%

Project Description and Objectives:
This project would explore the possible ways of using existing LiDAR and/or other third-party data to identify and catalog various assets such as bridges and culverts and some additional information about them. Possibly done in 2 phases. Phase I would look at the following: 1. Identify various data attributes that should be produced from the research (culvert dimensions, bridge span etc.). 2. Evaluate the minimal level of accuracy of the data required for it to be usable. 3. Identify first-party and third-party data that are available to produce the data. 4. Develop a machine learning algorithm to extract the relevant data. 5. Test the algorithm for select locations and evaluate if the results meets the need.

Proposed Activities for SFY 2023:
It is anticipated this project would be scoped in early State Fiscal Year 2023, an RFP released late summer, and an anticipated start date in the late fall.

SFY 2022 Accomplishments:
This project will begin in SFY 2023.

Financials	Amount
Projected Budget SFY 2025	$50,000
Projected Budget SFY 2024	$75,000
Projected Budget SFY 2023	$25,000
Budget Amount SFY 2022	$0
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	$0

MoDOT Lead Pooled Fund Studies

TR201910 / TPF-5(388) – Developing Implementation Strategies for Risk Based Inspection (RBI)

Project Type: Pooled Funds
MoDOT Contact: Jen Harper
MoDOT/Total Commitment: $100,000/$400,000
Contract Period: 11/1/2018 to 12/31/2021
Contract Investigator: Glenn Washer – University of Missouri-Columbia
Funding: SPR 100%

Project Description and Objectives:
The research envisions developing a handbook for implementation of RBI practices that will provide a resource to participating states, presenting examples and case studies that define suitable attributes and characteristic for RBI. Workshops and training will be provided to participating states to assist with implementation of RBI, and tools will be developed to assist with future implementation of the RBI technology. Analysis of the bridge inventory to evaluate risk-based strategies will provide data for better asset management.

Proposed Activities for SFY 2023:
This project will wrap up in State Fiscal Year 2023. The research team will commence the work on the risk models for Connecticut and continue working with Illinois, which is the only pending state for collecting inspection data on past bridge performance. In addition to this, the Research Team will complete the reports for each state that document the risk models developed through the RAP and

backcasting results that verify the models. The draft of the final report is due on March 31, 2023 and the final report May 31, 2023.

SFY 2022 Accomplishments:
The project extension was completed at the end of September. The time extension was due to COVID-19 and budget increase due to additional states joining the pooled fund since the original contract execution. The interim report was completed and sent to the participating states on July 27, 2021. Data analysis results for Pennsylvania and Wisconsin were updated after correction of the data fragmentation issue (NBI data quality). A risk model spreadsheet was completed for all six states. The updating of the initial back-casting from 1992 to 2020 using historical data provided by participating states and the development of risk models for corrosion is in progress. Risk models are being adjusted to reflect some missing damage modes and attributes that were not considered during the RAP meeting but were found important when looking at the inspection reports. The research team is developing a model based on statistical data retrieved from the NBI database with AADT and span length being incorporated. Moving forward, the team intends to include other parameters found in the NBI database to have unified criteria to assess the consequences of any bridge damage. A Reliability Assessment Panel (RAP) meeting with Connecticut was conducted on February 28, 2022 and March 4, 2022. This meeting was conducted virtually as requested by Connecticut DOT and focused on the steel multi-girder bridge family. The outcome of the RAP meeting was successful and provided new attributes to be considered for a state with a policy of membrane/asphalt wearing surfaces on bridge decks.

Financials	**Amount**
Projected Budget SFY 2023	$0
Budget Amount SFY 2022	$0
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	$100,000

TR202004 / TPF-5(395) – Traffic Disruption-free Bridge Inspection Initiative with Robotic Systems

Project Type: Pooled Funds
MoDOT Contact: Jen Harper
MoDOT/Total Commitment: $125,000/$575,000
Contract Period: 8/01/2019 to 7/31/2024
Contract Investigator: Dr. Genda Chen – Missouri University of Science and Technology
Funding: SPR 100%

Project Description and Objectives:
The INSPIRE University Transportation Center (https://inspire-utc.mst.edu) at Missouri University of Science and Technology was awarded in December of 2016 by the U.S. Department of Transportation. The center is focused on the development of advanced technologies to aid in bridge inspection and maintenance. Specifically, structural crawlers and unmanned aerial vehicles (UAVs) will provide a mobile platform for in-depth inspection of elevated bridges. Microwave and hyperspectral images will be developed to qualitatively or quantitatively assess concrete delamination and steel corrosion of reinforced concrete (RC) bridges.

The goals of this pooled-fund initiative are to engage closely with several state departments of transportation (DOTs) in the early stage of technology development at the INSPIRE University Transportation Center, and leverage the center resources to develop case studies, protocols, and guidelines that can be adopted by state DOTs for bridge inspection without adversely impacting traffic.

The initiative involves the integration, field demonstration and documentation of a robotic system of structural crawlers, UAVs, NDE devices, sensors, and data analytics. Depending on the interest of participating DOTs, the objectives of this initiative include, but are not limited to:

- Development of inspection protocols for various types of bridges with the robotic system integrated into current practice.
- Comparison and correlation of bridge deck inspections from above and underneath decks to understand the reliability of traffic disruption-free bridge inspection from underneath.
- Design and technical guidelines of measurement devices on a robotic platform for the detection of surface and internal damage/deterioration in structural members, and for the change in lateral support of foundations.
- Data fusion and analytics of measurements taken from various imaging and sensing systems for consistency and reliability.

Proposed Activities for SFY 2023:
State site visits were delayed due to COVID-19. It is anticipated they will take place in the summer of 2022. An operation checklist will be finalized and completed to facilitate field tests at bridge sites. The data curation and repository system will be populated with more bridge data. Both horizontal and vertical imaging from infrared and hyperspectral cameras will be characterized. The characterization data will be summarized in the QA/QC Guidelines.

SFY 2022 Accomplishments:
An annual meeting on this pooled-fund study was held virtually on August 11, 2021, to summarize and review the technologies that have been integrated for field tests. At two Missouri Bridge sites tested in June of 2021, concrete cracks and spalling areas were clearly seen from bridge decks from optical images. Construction joints and delamination areas were easy to identify from thermal images. Missing bridge drawings of all states were identified and requested from their owners. A small drone operation checklist was developed to ensure proper integration prior to field testing. Ground penetrating radar and impact echo test results were compared with visual inspections on a pedestrian reinforced concrete bridge with an 8-to-10-in thick solid deck. The second prototype of BIRDS II was repaired and further tested on automatic girder detection and flight control along the girder centerline. Six types of drones were tested to provide sufficient training and experience for an inspection team. Active thermal imaging was conducted on four full-scale reinforced concrete slabs to understand the heat transfer process and defect detectability using various setup parameters with infrared cameras. For example, an optimal range of the angle of camera views was developed.

Financials	Amount
Projected Budget SFY 2024 – SFY 2025	$0
Projected Budget SFY 2023	$0
Budget Amount SFY 2022	$0
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	$125,000

TR202011 / TPF-5(462) – Assessment and Repair of Prestressed Bridge Girders Subjected to Over-Height Truck Impacts (OHTI)

Project Type: Pooled Funds
MoDOT Contact: Jen Harper
MoDOT/Total Commitment: $135,000/$755,000

Contract Period: 1/1/2021 to 12/31/2023
Contract Investigator: Dr. Mohamed Elgawady – Missouri University of Science and Technology
Funding: SPR 100%

Project Description and Objectives:
Based on bridge failure incidents that occurred between 1967 and 2006, vessel and vehicle impacts are the second highest cause of bridge failure. This project will include a comprehensive experimental and analytical program to assess the damage to bridge girders due to over-height truck impact. The remaining carrying capacity of the damaged bridge girders will be determined, which will allow stakeholders (e.g., DOT engineers) to prioritize girder repairs. Then, different repair measures will be investigated. The carrying capacity of the repaired girders will be determined as well. The remaining carrying capacities of both the damaged and repaired girders will be determined using analytical and finite element models. The anticipated testing includes testing fourteen full-scale prestressed girders under impact load. Standard detailing and design provisions for the proposed repair techniques will be developed.

Proposed Activities for SFY 2023:
Impact testing has been delayed due to supply chain issues delaying delivery of the frame and girders but will begin in State Fiscal Year 2023. This will be followed by calculating the residual capacity of the beams. Work next fiscal year will begin on the repair methods for the beams and will continue into State Fiscal Year 2024. Development of numerical models will continue throughout the project.

SFY 2022 Accomplishments:
A draft literature review was completed. Two impact tests were designed. The research team validated the finite element (FE) model for the prestressed girders. An FE model of a full bridge was created. The design of the test setup for the experimental testing of the bridge girders subjected to lateral impacts was completed. A 3D model of the track system was created in SAP2000 to determine the forces on the system. Acquiring and manufacturing of the test setup was completed but several delays occurred due to the current supply chain issues. However, manufacturing the test setup has started. To prepare for testing, an experimental database of 140 reinforced concrete beams collected by Zhao et al 2019, was used to predict the peak impact force (PIF).

Financials	Amount
Projected Budget SFY 2024	$0
Projected Budget SFY 2023	$0
Budget Amount SFY 2022	$97,579
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	$37,421

Potential Pooled Fund Study—Quality Assurance Techniques for Innovative Construction Technologies

Project Type: Pooled Funds
MoDOT Contact: Jen Harper
MoDOT/Total Commitment: $100,000 est. MoDOT contribution
Contract Period: TBD
Contract Investigator: George Chang
Funding: SPR 100%

Project Description and Objectives:
Meeting the 23 CFR Part 637 codes for quality assurance (QA) procedures for intelligent construction technologies (ICT) for construction acceptance is a national hurdle. The ICT currently includes intelligent compaction (IC), paver-mounted thermal profiler (PMTP), and other emerging technologies, such as dielectric profiling systems (DPS). Meeting the CFR codes is a worthwhile endeavor to ensure the technologies produce quality data for construction acceptance decisions. MoDOT is among the leading DOTs working towards satisfying the requirements so that intelligent construction technologies can be fully implemented. This study would build upon TR202124 and open up the research to other states . It will identify the leading causes (both technical and institutional) for these issues and anticipate IC, PMTP, and DPS implementation issues. The results for this study will include discussions with FHWA for solutions for satisfying the CFR code requirements.

Proposed Activities for SFY 2023:
The project is in the conceptional stages at this time. In discussions for TR202124 it was determined that the issues raised in the QA process will need a nation-wide solution, it isn't just a MoDOT concern. It is hopeful this project could garner enough states to kick-off during the SFY 2023.

SFY 2022 Accomplishments:
This project is only in the conceptual stages during SFY 2022.

Financials	**Amount**
Projected Budget SFY 2025	$50,000
Projected Budget SFY 2024	$50,000
Projected Budget SFY 2023	$0
Budget Amount SFY 2022	$82,421
Adjusted Budget Amount SFY 2022	$0
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	$0

Potential Pooled Fund Study—Missouri/Kansas 2022 Peer Exchange Pooled Fund

Project Type: Pooled Funds
MoDOT Contact: Jen Harper
MoDOT/Total Commitment: $40,000 est. MoDOT contribution
Contract Period: TBD
Contract Investigator: TTI
Funding: SPR 100%

Project Description and Objectives:
State DOT Research Sections are required by FHWA to participate in peer exchanges of its Program Development and Program Management processes periodically (at least every five years) as described in 23 CFR 420.209(a). The objective of the peer exchange program is to give state DOT Research Programs a means to improve the quality and effectiveness of their research program. Most states will select two to three topics to focus on for their peer exchange and then invite other states to participate based on the topics. This pooled fund would be to hire a consultant to help facilitate and arrange the pooled fund for a combination MoDOT/Kansas meeting.

Proposed Activities for SFY 2023:
The peer exchange is tentatively scheduled for the second week in October. The entire Region 3 RAC states will be invited to attend.

SFY 2022 Accomplishments:
This project is only in the conceptual stages during SFY 2022.

Financials	Amount
Projected Budget SFY 2023	$40,000
Budget Amount SFY 2022	$0
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	$0

Potential Pooled Fund Study— CO2 Reduction in Concrete Pooled Fund (name will change)

Project Type: Pooled Funds
MoDOT Contact: Jen Harper
MoDOT/Total Commitment: $75,000 est. MoDOT contribution
Contract Period: TBD
Contract Investigator: John Kevern
Funding: SPR 100%

Project Description and Objectives:
The cement and concrete industry has pledged to be net carbon neutral by 2050. The suite of techniques being considered includes everything from simply lowering cementitious materials contents to the more complicated full elimination of Portland cement. Reality will require a diversity of solutions with lower cementitious materials contents and higher supplementary and alternative cementitious materials being the most straightforward and most easily adopted within the current design and construction process and supply chain. Techniques to reduce CO2 in concrete result in lowered initial pH, potentially shortening time to carbonation-induced corrosion. The fundamental research questions are 1) how do low CO2 cementitious chemistries impact durability and 2) can available mitigation strategies act to enable a wide variety of future environmentally concretes?

Proposed Activities for SFY 2023:
MoDOT and UMKC will start talking with states in July to garner interest in the pooled fund. We anticipate having enough initial support to post the pooled fund in late August or early September as a solicitation. It is hopefully we can get enough states to participate that we can start the project the second half of State Fiscal Year 2023.

SFY 2022 Accomplishments:
This project is only in the conceptual stages during SFY 2022.

Financials	Amount
Projected Budget SFY 2025	$15,000
Projected Budget SFY 2024	$50,000
Projected Budget SFY 2023	$10,000
Budget Amount SFY 2022	$0
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	$0

Pooled Fund Studies

(Pooled Fund Project contributions are not taken out of the RDS funding category)

TPF-5(317) / New solicitation will be posted soon – **Evaluation of Low-Cost Safety Improvements**

Project Type: Pooled Funds
MoDOT Contact: Jen Harper
MoDOT Total Commitment: $5,000 new solicitation
Contract Period: 2/10/2015 to ongoing
Contract Investigator: FHWA
Funding: SPR 100%

Project Description and Objectives:
The Evaluation of Low-Cost Safety Improvements Pooled Fund Study will encompass safety-effectiveness evaluations of priority strategies from the NCHRP Report 500 Guidebooks, Guidance for Implementation of the AASHTO Strategic Highway Safety Plan. A target of 24 strategies totaling $6M over three years is planned, but this will vary depending on the level of support. The data for the study will be gathered from those states that implement the strategies throughout the US. The data will be collected, and evaluation studies performed. This project is a continuation of TPF-5(099).

Financials	Amount
Committed Funds SFY 2023	$5,000
Committed Funds SFY 2022	$5,000
Transferred Funds SFY 2022	$5,000

TPF-5(343)/Solicitation 1567 – **Roadside Safety Research for MASH Implementation**

Project Type: Pooled Funds
MoDOT Contact: Jen Harper
MoDOT Total Commitment: $65,000 (new solicitation)
Contract Period: 1/1/2016 to 12/31/2023
Contract Investigator: Washington
Funding: SPR 100%

Project Description and Objectives:
The Roadside Safety Research for MASH Implementation program is designed to conduct research on roadside safety priorities for research projects aligned with the MASH implementation completion schedule. The compliance dates for MASH roadside safety hardware are:
- December 31, 2017: W-beam barriers and cast-in-place concrete barriers;
- June 30, 2018: W-beam terminals;
- December 31, 2018: Cable barriers, cable barrier terminals, crash cushions;
- December 31, 2019: Bridge rails, transitions, all other longitudinal barriers (including portable barriers installed permanently), all other terminals, sign supports, and other breakaway hardware;
- Also, temporary work zone devices, including portable barriers, manufactured after December 31, 2019, must have been successfully tested to the 2015 edition of MASH.

Financials	**Amount**
Committed Funds SFY 2023	$65,000
Committed Funds SFY 2022	$50,000
Transferred Funds SFY 2022	$50,000

TPF-5(357) – Connecting the DOTs: Implementing ShakeCast Across Multiple State Departments of Transportation for Rapid Post-Earthquake Response

Project Type: Pooled Funds
MoDOT Contact: Jen Harper
MoDOT Total Commitment: $105,000
Contract Period: 1/1/2017 to 9/30/2023
Contract Investigator: California DOT
Funding: SPR 100%

Project Description and Objectives:
When an earthquake occurs, the U. S. Geological Survey (USGS) ShakeMap portrays the extent of potentially damaging shaking. In turn, the ShakeCast system, a freely-available, post-earthquake situational awareness application, automatically retrieves earthquake shaking data from USGS ShakeMap, analyzes shaking intensity data against users' facilities (e.g., bridges, buildings, roads), sends notifications of potential impacts, and generates maps and other web-based products for emergency managers and responders. ShakeCast is particularly suitable for earthquake planning and response purposes by Departments of Transportation (DOTs), in part since it can utilize State's existing NBI databases to implement shaking-based inspection priority and impact assessments. This collaborative effort will bring participating DOTs into full ShakeCast operation for post-earthquake assessment of state and local bridge inventories. The project will provide a mechanism to actively engage representatives from state DOTs with the common interests in implementing and expanding the application of ShakeCast technologies to improve emergency response capabilities.

Financials	**Amount**
Committed Funds SFY 2023	$15,000
Committed Funds SFY 2022	$15,000
Transferred Funds SFY 2022	$15,000

TPF-5(385) – Pavement Structural Evaluation with Traffic Speed Deflection Devices (TSDDs)

Project Type: Pooled Funds
MoDOT Contact: Jen Harper
MoDOT Total Commitment: $135,000
Contract Period: 9/30/2021 to 10/31/2023
Contract Investigator: Virginia DOT
Funding: SPR 100%

Project Description and Objectives:
Research has shown that incorporating pavement structural condition along with pavement surface condition in a pavement management decision-making process leads to better-informed decisions, and more cost-effective pavement rehabilitation and preservation strategies. Recognizing this, some highway agencies have investigated the use of Falling Weight Deflectometer (FWD) for pavement management

applications. While FWDs are a common device for project level structural evaluation, they are inefficient at the network level. FWD measurements are made at discrete points along the pavement sections and the equipment has to remain stationary on the road during each testing point (typically 1-4 minutes, depending on the protocol). This requires lane closures that disrupt traffic and traffic control, which limits the productivity and the number of discrete points where measurements can be obtained. Over the last 15 years, traffic speed deflection devices (TSDDs) that can near-continuously measure pavement structural condition while traveling at traffic speed have been developed. The objective of the proposed pooled-fund project is to establish a research consortium focused on providing participating agencies guidelines on how to specify collection and use data collected with TSDDs for network- and project-level (if feasible) pavement management applications. Specific tasks within this multi-year program will be developed in cooperation with the consortium participants. In addition, the consortium will also provide participating agencies with a mechanism to conduct pilot demonstration testing in their respective networks.

Financials	Amount
Committed Funds SFY 2023	$45,000
Committed Funds SFY 2022	$45,000
Transferred Funds SFY 2022	$45,000

TPF-5(396)/new solicitation coming for FY23 – Mid-America Freight Coalition (MAFC) Phase 3

Project Type: Pooled Funds
MoDOT Contact: Jen Harper
MoDOT Total Commitment: FY23 $50,000 est.
Contract Period: 2/1/2019 to 3/31/2023
Contract Investigator: Wisconsin DOT
Funding: SPR 100%

Project Description and Objectives:
The industries and farms of the Mississippi Valley region can compete in the marketplace only if their products can move reliably, safely and at reasonable cost to market. Growing congestion threatens the sustainability of this freight movement. The people of the region are dependent upon farms and industries for their livelihoods and their economic quality of life depends on the flow of goods to our markets. The Mississippi Valley Freight Coalition (MVFC) was created to protect and support the economic wellbeing of the industries, farms and people of the region by keeping the products of those industries, farms and people flowing to markets reliably, safely, and efficiently. This project is a continuation of Pooled Fund TPF-5(156).

Financials	Amount
Committed Funds SFY 2023	$50,000 estimated
Committed Funds SFY 2022	$37,000
Transferred Funds SFY 2022	$37,000

TPF-5(421) – National Cooperative Highway Research Program (NCHRP) FY 2022 & TPF-5(422)-National Cooperative Highway Research Program (NCHRP) FY 2023

Project Type: Pooled Funds
MoDOT Contact: Jen Harper

MoDOT Total Commitment: $2,587,815
Contract Period: 7/1/2021 to 6/30/2023
Contract Investigator: NCHRP
Funding: SPR 100%

Project Description and Objectives:
FHWA has a longstanding association with the American Association of State Highway and Transportation Officials (AASHTO) and the National Academy of Sciences for conducting the National Cooperative Highway Research Program (NCHRP) under the Transportation Research Board (TRB). Each year contributions to the NCHRP are requested from the states. The NCHRP meets the criteria for use of federal-aid funds and is authorized to use 100% State Planning and Research Funds for the contribution.

Financials	Amount
Committed Funds SFY 2023 (estimated)	$1,294,000
Committed Funds SFY 2022	$1,127,239
Transferred Funds SFY 2022	$1,293,815

TPF-5(430) – Midwest Roadside Safety Pooled Fund Program

Project Type: Pooled Funds
MoDOT Contact: Jen Harper
MoDOT Total Commitment: $260,000
Contract Period: 1/21/2020 to 12/31/2022
Contract Investigator: Nebraska DOT
Funding: SPR 100%

Project Description and Objectives:
This project is continuation of work done under project SPR-3(017) and SPR-5(193), in which MoDOT has been a participant since 1991. The study has proved to be successful to this point and will remain active under the new project number. The purpose of the project is to crash test highway roadside appurtenances to assure they meet criteria established nationally. For more information, please refer to the Midwest Roadside Safety website: www.mwrsf.unl.edu

Financials	Amount
Committed Funds SFY 2023	$65,000
Committed Funds SFY 2022	$65,000
Transferred Funds SFY 2022	$65,000

TPF-5(435) – Aurora Program (FY20-FY24)

Project Type: Pooled Funds
MoDOT Contact: Jen Harper
MoDOT Total Commitment: $100,000
Contract Period: 1/1/2020 to 12/31/24
Contract Investigator: Iowa DOT
Funding: SPR 100%

Project Description and Objectives:
The Aurora Program is a consortium of public agencies focused on collaborative research, evaluation, and deployment of technologies for detailed road weather monitoring and forecasting. Members seek to implement advanced road weather information systems (RWIS) that fully integrate state-of-the-art roadway and weather forecasting technologies with coordinated, multi-agency weather monitoring infrastructures; ultimately lessening adverse impacts of inclement weather.

Financials	Amount
Committed Funds SFY 2023	$25,000
Committed Funds SFY 2022	$25,000
Transferred Funds SFY 2022	$25,000

TPF-5(437) – Technology Transfer Concrete Consortium (FY20-FY24)

Project Type: Pooled Funds
MoDOT Contact: Jen Harper
MoDOT Commitment: $32,000
Contract Period: 1/1/2020 to 12/31/2025
Contract Investigator: Iowa State
Funding: SPR 100%

Project Description and Objectives:
Increasingly, state DOTs are challenged to design and build longer life concrete pavements that result in higher levels of user satisfaction. In order to foster new technologies and practices, experts from state DOTs, FHWA, academia and industry must collaborate to identify and examine new concrete pavement research initiatives. The Technology Transfer Concrete Consortium (TTCC) is to establish a pooled fund for state representatives to continue collaborative efforts begun in TPF-5(066) Materials and Construction Optimization and then TPF-5(313) with the current project name. TTCC will provide new developments in concrete paving leading to implementation of new technologies and longer life pavements through the use of innovative testing, technology transfer, and construction optimization technologies and practices.

Financials	Amount
Committed Funds SFY 2023	$8,000
Committed Funds SFY 2022	$8,000
Transferred Funds SFY 2022	$8,000

TPF-5(438) – Smart Work Zone Deployment Initiatives (SWZDI)-FY20-FY24

Project Type: Pooled Funds
MoDOT Contact: Jen Harper
MoDOT Commitment: $200,000
Contract Period: 10/1/2019 to 9/30/2024
Contract Investigator: Iowa DOT
Funding: SPR 100%

Project Description and Objectives:
The Midwest Smart Work Zone Deployment Initiative (MwSWZDI) was initiated in 1999 as a Pooled Fund Study intended to coordinate and promote research related to safety and mobility in highway work

zones. The Iowa DOT has been the lead state since 2004. The previous pooled fund number was TPF-5(295). The program is an ongoing cooperative effort between State Departments of Transportation, universities, and industry. Commercial products are provided by private vendors for evaluation, although this is not the only focus of contracted projects. State DOTs provide funds, prioritize products with respect to the anticipated benefits to their construction and maintenance activities, and cooperate with researchers to identify test sites and conduct the evaluations.

Financials	Amount
Committed Funds SFY 2023	$50,000
Committed Funds SFY 2022	$50,000
Transferred Funds SFY 2022	$50,000

TPF-5(441) – No Boundaries Transportation Maintenance Innovations

Project Type: Pooled Funds
MoDOT Contact: Jen Harper
MoDOT Total Commitment: $40,000
Contract Period: 9/30/2020 to 10/26/2021
Contract Investigator: Colorado DOT
Funding: SPR 100%

Project Description and Objectives:
Through this pooled fund project, the Colorado Department of Transportation will work with other State Departments of Transportation (DOTs) to facilitate the implementation 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 the implementation of selected innovations. Resources will be provided for implementing the innovations that includes travel, training and other technology transfer activities. This project is a continuation of the previous project initiated and led by the Missouri DOT TPF-5(239) and then Ohio under TPF-5(330). 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. Workshops will continue to be provided for the states participating in the pooled fund project.

Financials	Amount
Committed Funds SFY 2023	$10,000
Committed Funds SFY 2022	$10,000
Transferred Funds SFY 2022	$10,000

TPF-5(442) – Transportation Research and Connectivity (librarian toolkit / knowledge networking / information condition / analysis of resources / digitization efforts / ADA support)

Project Type: Pooled Funds
MoDOT Contact: Jen Harper
MoDOT Total Commitment: $75,000
Contract Period: 4/27/2020 to 2/28/2023
Contract Investigator: Oklahoma DOT
Funding: anticipated SPR 100%

Project Description and Objectives:
With the number of transportation librarians shrinking nationwide and the number of complex issues facing transportation researchers only increasing, several solutions will be developed in the proposed study to remedy the aforementioned problems. To increase professionalism and standardization among non-library information managers, a toolkit will be developed that will offer guidance on best practices and be scalable to the research organization's size and abilities. Separately, a white paper on the changing nature of transportation libraries in the 21st century will be produced. This document will provide a roadmap for transportation organizations to follow with respect to current conditions of transportation information infrastructure. It will identify recurring problems, recommend solutions, and help organizations adapt to the rapid change that is occurring across the research landscape.

Financials	Amount
Committed Funds SFY 2023	$0
Committed Funds SFY 2022	$25,000
Transferred Funds SFY 2022	$25,000

TPF-5(443) – Continuous Asphalt Mixture Compaction Assessment using Density Profiling System (DPS)

Project Type: Pooled Funds
MoDOT Contact: Jen Harper
MoDOT Total Commitment: $75,000
Contract Period: 1/13/2020 to 1/10/2027
Contract Investigator: Minnesota DOT
Funding: SPR 100%

Project Description and Objectives:
The Aurora Program is a consortium of public agencies focused on collaborative research, evaluation, and deployment of technologies for detailed road weather monitoring and forecasting. Members seek to implement advanced road weather information systems (RWIS) that fully integrate state-of-the-art roadway and weather forecasting technologies with coordinated, multi-agency weather monitoring infrastructures; ultimately lessening adverse impacts of inclement weather.

Financials	Amount
Committed Funds SFY 2023	$0
Committed Funds SFY 2022	$25,000
Transferred Funds SFY 2022	$25,000

TPF-5(447) – Traffic Control Device (TCD) Consortium (3)

Project Type: Pooled Funds
MoDOT Contact: Jen Harper
MoDOT Total Commitment: $75,000
Contract Period: 10/1/2002 to ongoing
Contract Investigator: FHWA
Funding: SPR 100%

Project Description and Objectives:
The Traffic Control Device Consortium will focus on systematic evaluation of novel TCDs, employing a consistent process that addresses human factors and operations issues for each TCD idea and by providing local and state agencies a quicker response to new technologies with the right assessment skills and tools that 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 will aid in the compliance to the MUTCD rule-making process and incorporation of novel TCDs into the MUTCD. This project is a continuation of TPF-5(065) and TPF-5(316).

Financials	Amount
Committed Funds SFY 2023	$25,000
Committed Funds SFY 2022	$25,000
Transferred Funds SFY 2022	$25,000

TPF-5(448) – Integrating Construction Practices and Weather Into Freeze Thaw Specifications

Project Type: Pooled Funds
MoDOT Contact: Jen Harper
MoDOT Total Commitment: $60,000
Contract Period: 10/1/2019 to 9/30/2024
Contract Investigator: Oklahoma DOT
Funding: SPR 100%

Project Description and Objectives:
It has been suggested that the freeze-thaw behavior of concrete can be related to the rate at which the concrete absorbs water and reaches a critical degree of saturation. After the critical degree of saturation is reached and frozen the sample begins to crack and the stiffness degrades rapidly. This mechanism was suggested by Fagerlund and then expanded by research completed under pooled fund – TPF-5-297. Despite these advancements, there is still more work that is needed. The ultimate goal of this work is to build on previous research efforts to produce improved specifications and advance existing test methods; while, improve the underlying understanding of freeze thaw damage. This work will specifically focus on construction practices and the impact of weather.

Financials	Amount
Committed Funds SFY 2023	$0
Committed Funds SFY 2022	$20,000
Transferred Funds SFY 2022	$20,000

TPF-5(460) – Flood-frequency Analysis in the Midwest: Addressing Potential Nonstationary Annual Peak-flow Records

Project Type: Pooled Funds
MoDOT Contact: Jen Harper
MoDOT Total Commitment: $166,800
Contract Period: 11/2/2020 to 11/2/2024 (estimated)
Contract Investigator: South Dakota DOT
Funding: SPR 100%

Project Description and Objectives:
Peak-flow frequency analysis is essential for flood insurance studies, floodplain management, and the design of transportation infrastructure. In recent decades, better understanding of long-term hydroclimatic persistence, as well as concerns about potential climate change and land-use change have caused the stationarity assumption, underpinning for flood-frequency analysis, to be reexamined. The federal guidelines of Bulletin 17B (Interagency Advisory Committee on Water Data, 1982) and the recent updates in Bulletin 17C (England et al., 2018) recognize that the conventional assumptions for performing flood frequency analyses (e.g., the annual time series is a representative time sample of random homogeneous events and that the stochastic processes that generate floods are stationary or invariant in time) are violated in some cases. 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 commonly are conducted by the USGS in cooperation with state DOTs throughout the nation on an ongoing basis.

Financials	Amount
Committed Funds SFY 2023	$55,600
Committed Funds SFY 2022	$55,600
Transferred Funds SFY 2022	$55,600

TPF-5(463) – Pavement Surface Properties Consortium: Phase III - Managing the Pavement Properties for Improved Safety

Project Type: Pooled Funds
MoDOT Contact: Jen Harper
MoDOT Total Commitment: $20,000
Contract Period: 1/1/2021 to 9/30/2025
Contract Investigator: Virginia DOT
Funding: SPR 100%

Project Description and Objectives:
Functional pavement considerations are fundamental to the performance and management of pavements. In addition to structural and durability requirements, an optimum wearing surface should provide a combination of a good riding quality, adequate friction & water handling capability, and a low noise level. All these properties are highly influenced by the various components of the pavement surface texture. The mission of the Surface Properties Consortium has been to conduct applied research focused on enhancing the level of service provided by the roadway transportation system by optimizing pavement surface characteristics. The focus of Phase III will be on continuing to support the implementation of asset management approaches and tools that help improve the safety of our road networks by reducing the number of crashes and related fatalities. It will represent a concerted effort to bring pavement design and evaluation experts together with maintenance and safety professionals to maximize the contribution of the pavement community Towards Zero Deaths on US highways. It will also seek participation of industry through the pooled-fund or an industrial affiliate program.

Financials	Amount
Committed Funds SFY 2023	$20,000
Committed Funds SFY 2022	$0

Transferred Funds SFY 2022 $0

TPF-5(464) – Hydrologic and Hydraulic Software Enhancements (SMS, WMS, Hydraulic Toolbox, and HY-8)

Project Type: Pooled Funds
MoDOT Contact: Jen Harper
MoDOT Total Commitment: $30,000
Contract Period: 10/1/2020 to 12/31/2025
Contract Investigator: FHWA
Funding: SPR 100%

Project Description and Objectives:
The Federal Highway Administration (FHWA) sponsors ongoing development of four computer programs that perform both routine and complex hydrologic and hydraulic analyses of watersheds, river and stream systems, and transportation infrastructure. These programs incorporate procedures and equations documented in FHWA Hydraulic Design Series (HDS) documents, Hydraulic Engineering Circulars (HEC), technical briefs, and research reports.   The four software systems are: Surface-water Modeling System (SMS), Watershed Modeling System (WMS), Hydraulic Toolbox, and HY-8 Culvert Hydraulic Analysis Program. The continual evolution of the national hydraulic engineering state of practice necessitates ongoing development of and upgrades to these tools. This pooled fund will enhance the capabilities of the software programs, update the software user manual documentation, make new software versions publicly available, and do technology transfer activities.

Financials	**Amount**
Committed Funds SFY 2023	$10,000
Committed Funds SFY 2022	$10,000
Transferred Funds SFY 2022	$10,000

TPF-5(465) – Consortium for Asphalt Pavement Research and Implementation (CAPRI)

Project Type: Pooled Funds
MoDOT Contact: Jen Harper
MoDOT Total Commitment: $42,000
Contract Period: TBD
Contract Investigator: Alabama DOT
Funding: SPR 100%

Project Description and Objectives:
As owners and operators of the nation's surface transportation infrastructure, state departments of transportation (DOTs) are striving to design and build longer lasting and more cost-effective asphalt pavements that meet a higher level of sustainability, safety and user satisfaction for the public. To achieve this goal, state DOTs continue to adopt innovative technologies and optimized practices for designing, constructing, and preserving asphalt pavements. The adopted innovative technologies and practices are often developed from the collaborative research efforts supported by the state DOTs, Federal Highway Administration (FHWA), and industry. To continue fostering the development of new technologies and practices, this pooled fund study will identify and address national priority research and implementation needs for asphalt pavements that state DOTs face today and in the future. CAPRI will operate as a

voluntary consortium of flexible pavement stakeholders that is open to all state, local, and federal highway agencies, industry associations, individual companies, academic institutions and research organizations. The Alabama DOT will serve as the lead state and the National Center for Asphalt Technology (NCAT) at Auburn University will handle administrative duties for the project. Each participating entity may appoint one voting representative to CAPRI.

Financials	Amount
Committed Funds SFY 2023	$14,000
Committed Funds SFY 2022	$14,000
Transferred Funds SFY 2022	$14,000

TPF-5(466) – National Road Research Alliance - NRRA (Phase II)

Project Type: Pooled Funds
MoDOT Contact: Jen Harper
MoDOT Total Commitment: $850,000
Contract Period: 2/1/2021 to 1/31/2026
Contract Investigator: Minnesota
Funding: SPR 100%

Project Description and Objectives:
The need for the National Road Research Alliance (NRRA) has grown over the last several years. It is based on a number of successful efforts the Minnesota Department of Transportation (MnDOT) has achieved utilizing the MnROAD research facility. These efforts include a number of local and national research studies, pool fund research projects, local-national-international partnerships, academic and industry involvement, Transportation Engineering and Road Research Alliance (TERRA) pooled fund, and MnROAD's 2014 Peer exchange.

Primary objectives of the National Road Research Alliance (NRRA) are:
- Conduct structured construction, field testing and evaluation using the MnROAD cold weather facility;
- Evaluate pavement materials, equipment and methods under real-world conditions;
- Establish industry standards and develop performance measure 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

Financials	Amount
Committed Funds SFY 2023	$150,000
Committed Funds SFY 2022	$150,000
Transferred Funds SFY 2022	$150,000

TPF-5(467) – Research Project Tracking System

Project Type: Pooled Funds

MoDOT Contact: Jen Harper
MoDOT Total Commitment: $49,500
Contract Period: TBD
Contract Investigator: Kentucky
Funding: SPR 100%

Project Description and Objectives:
Each state in the U.S. has a transportation research program, typically managed by designated staff in the state DOT (or equivalent agency). While these programs vary substantially in size, complexity, staffing level, and resource availability, there are certain needs that are generally common to all programs. One of these needs is a tracking system for active and completed research projects. The tracking system can be used for numerous functions. The objective of the project is to develop common functional requirements, a software solution and maintenance of the software solution for a Research Program Tracking System to be used by multiple DOTs.

Financials	Amount
Committed Funds SFY 2023	$0
Committed Funds SFY 2022	$46,000
Transferred Funds SFY 2022	$46,000

TPF-5(471) – Real-time Monitoring of Concrete Strength to Determine Optimal Traffic Opening Time (note: the project name changed)

Project Type: Pooled Funds
MoDOT Contact: Jen Harper
MoDOT Total Commitment: $75,000
Contract Period: 5/17/2021 to 5/30/2024
Contract Investigator: Indiana DOT
Funding: SPR 100%

Project Description and Objectives:
Fast-paced construction schedules often expose concrete pavement and/or structures to undergo substantial loading conditions even at its early age, which causes pre-mature failure or a significant reduction in the life span of pavement and bridges. The current methods for determining traffic opening times can be inefficient and expensive, causing construction delays and cost overruns. To address this critical need an in-situ nondestructive sensing method was developed that enables an accurate and efficient understanding of early age properties of concrete using electromechanical impedance (EMI) method coupled with piezoelectric sensors.

Financials	Amount
Committed Funds SFY 2023	$25,000
Committed Funds SFY 2022	$25,000
Transferred Funds SFY 2022	$25,000

TPF-5(473) – TRB Research Subscription FY 2022 & TPF-5(496) – TRB Research Subscription FY 2023

Project Type: Pooled Funds
MoDOT Contact: Jen Harper

MoDOT Total Commitment: $413,870
Contract Period: 7/1/2021 to 6/30/2023
Contract Investigator: TRB
Funding: SPR 100%

Project Description and Objectives:
This is a subscription for support of core technical activities with the Transportation Research Board (TRB). The subscription is an agreement between MoDOT and the Transportation Research Board for the Research Correlation Service. The Research Correlation Service comprises a bundle of core services whose aim is to promote innovation through the coordination of research and dissemination of research results. The type of project is "Contract Other" because MoDOT purchases the services. The activities supported by this subscription include the collection of available information concerning past, current, and proposed research related to transportation. Sources including federal, state, and other governmental agencies, colleges and universities, research and planning organizations, transport operators and industry, as well as the TRB Annual Meeting and conference programs.

Financials	Amount
Committed Funds SFY 2023 (estimate)	$207,000
Committed Funds SFY 2022	$181,000
Transferred Funds SFY 2022	$206,870

TPF-5(479) – **Clear Roads Phase II**

Project Type: Pooled Funds
MoDOT Contact: Jen Harper
MoDOT Total Commitment: $50,000
Contract Period: 1/1/2017 to 12/30/2021
Contract Investigator: Minnesota DOT
Funding: SPR 100%

Project Description and Objectives:
The Clear Roads pooled fund project will maintain its focus on advancing winter highway operations nationally but 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.

Financials	Amount
Committed Funds SFY 2023	$25,000
Committed Funds SFY 2022	$25,000
Transferred Funds SFY 2022	$25,000

TPF-5(485) – Consequences-Based Analysis of Undrained Shear Behavior of Soils and Liquefaction Hazards, Phase 1: Filling the Data Gaps

Project Type: Pooled Funds

MoDOT Contact: Jen Harper
MoDOT Total Commitment: $40,000
Contract Period: 9/30/2021 to 9/30/2025
Contract Investigator: Utah DOT
Funding: SPR 100%

Project Description and Objectives:
Soils experience reductions in shear strength when pore pressures increase, which can happen under different types of loadings such as static loadings or earthquake-induced cyclic loadings. At present, widely used correlations for soil strength loss have inconsistencies, especially as it relates to some soil types and their amounts of soil strength loss and associated strains. For example, since the early 1970s, geotechnical engineers worldwide have largely relied upon empirical correlations to predict soil liquefaction susceptibility, triggering, and consequences/damage due to earthquakes. The overall objective of this multi-year, multi-phase effort is to create a true performance-based model to evaluate the consequences of undrained response in all soils, including consequences resulting from earthquake-induced liquefaction and cyclic softening. Through this overall project, a more robust method for estimating field performance of soils during undrained events (including earthquakes) will be developed and tested. Due to the ability of the CPT to collect nearly continuous profiles of data in most soil types, these studies will focus initially on using CPT data for analyzing undrained shear behavior and liquefaction hazards. The framework is intended to be adaptable to other methods such as Standard Penetration Test (SPT), laboratory testing and analysis, and shear wave velocity (Vs) data.

Financials	Amount
Committed Funds SFY 2023	$20,000
Committed Funds SFY 2022	$20,000
Transferred Funds SFY 2022	$20,000

TPF-5(319)/TPF-5(487) – Transportation Management Center Pooled Fund Study

Project Type: Pooled Funds
MoDOT Contact: Jen Harper
MoDOT Total Commitment: $50,000 (new Pooled Fund number)
Contract Period: 4/17/2015 to 4/16/2022
Contract Investigator: FHWA
Funding: SPR 100%

Project Description and Objectives:
The Transportation Management Center (TMC) Pooled Fund Study (PFS) serves as a forum to identify and address issues that are common among agencies that manage and operate TMCs and provides an opportunity for agencies to collectively take on those key issues and challenges. The goal of the TMC PFS is to assemble regional, state, and local transportation management agencies and the Federal Highway Administration (FHWA) to (1) identify human-centered and operational issues; (2) suggest approaches to addressing identified issues; (3) initiate and monitor projects intended to address identified issues; (4) provide guidance and recommendations and disseminate results; (5) provide leadership and coordinate with others with TMC interests; and (6) promote and facilitate technology transfer related to TMC issues nationally. This project is a continuation of TPF-2(207).

Financials	Amount
Committed Funds SFY 2023	$50,000

Committed Funds SFY 2022	$25,000
Transferred Funds SFY 2022	$25,000

TPF-5(495) – Technology Exchange on Low Volume Road Design, Construction and Maintenance

Project Type: Pooled Funds
MoDOT Contact: Jen Harper
MoDOT Total Commitment: $12,000
Contract Period: 1/1/2022 to 12/31/2023
Contract Investigator: Iowa DOT
Funding: SPR 100%

Project Description and Objectives:
The primary activities of this pooled fund project are technology exchange, information sharing, and the facilitation of partnering relationships among state agencies and participating members with FHWA, Local Public Agencies and other appropriate agencies and associations. Technology exchange activities in conjunction with the 13th International Conference on Low Volume Roads will be advantageous to participating members. Specifically, this pooled fund will: 1. Provide communication and information sharing among member participants: Discuss research, development and technology transfer needs in the areas of design, construction, maintenance, and safety on low volume roads and provide research ideas to TRB in the areas of Low Volume Roads. 2. Member workshop at the 13th International Conference on Low Volume Roads: Provide a technology and knowledge exchange forum to enhance the practical knowledge of pooled fund participants concerning low volume road management with a focus on encouraging State DOT and other agency participation in the pooled fund. 3. Pooled Fund Member Meeting on Low Volume Road Issues: Provide a technology and knowledge exchange forum focused on Low Volume Road issues. Topics may include agency collaboration, funding, asset management, shared ROW/utilities, safety programs, emergency response, training and certifications, maintenance of traffic, federal oversight, standards and specifications, contracting methods, environmental issues, energy development, maintenance, material sources and quality, and bonding. 4. Technology Transfer through paper publication, webinars, technology field demonstrations, and expanding access to solutions on issues selected by pooled fund member in areas of Low Volume Road Design, Construction and Management.

Financials	**Amount**
Committed Funds SFY 2023	$12,000
Committed Funds SFY 2022	$0
Transferred Funds SFY 2022	$0

Solicitation 1481 – Full-Scale Accelerated Load Testing of RCC Pavements-Solicitation Withdrawn

Project Type: Pooled Funds
MoDOT Contact: Jen Harper
MoDOT Total Commitment: $0
Contract Period: TBD
Contract Investigator: Louisiana DOT
Funding: SPR 100%

Project Description and Objectives:
There has been a resurgent interest in design and construction of RCC pavements because their rapid construction process, enhanced surface characteristics, ability to open to traffic early, improved RCC pavement construction equipment, and overall cost effectiveness of RCC. Given these benefits, the RCC Pavement Council in conjunction with LTRC has undertaken an initiative to explore specific aspects of Roller Compacted Concrete (RCC) pavement under load using the Pavement Research Facility (PRF) located in Port Allen, LA. For this research, the Accelerated Transportation Loading and Simulation (ATLaS) device can apply a maximum dual tire wheel load of 30,000 lb. with a tire pressure of 150 psi at a rate of up to 6 mph. The loading carriage applies the dual tire wheel load in two directions (bidirectional) with a productivity of approximately 15,000 load cycles/day. LTRC will set aside up to four test lanes for the RCC full-scale testing program. Each lane is capable of accommodating three test sites. The effective site length is approximately 50 feet. Within a typical lane, there are also three areas in each lane designated for material sampling of the constructed section.

Financials	Amount
Committed Funds SFY 2023	$0
Committed Funds SFY 2022	$0
Transferred Funds SFY 2022	$0

Solicitation 1569 – Continuous Bituminous Pavement Stripping Assessment Through Non-destructive Testing

Project Type: Pooled Funds
MoDOT Contact: Jen Harper
MoDOT Total Commitment: $25,000
Contract Period: TBD
Contract Investigator: Minnesota DOT
Funding: SPR 100%

Project Description and Objectives:
After the SHRP2 R06D study, several states (FL, TX, NM, CA, KY and MN) participated in an Implementation Assistance Program (IAP) sponsored by FHWA and AASHTO, aimed at determining if the 3D-GPR and the IE/SASW technologies met "proof of concept" and were ready for national implementation. The primary objective of the proposed pooled-fund project is to establish a research consortium focused on addressing the R06D and IAP recommendations. As per the IAP and R06D findings and recommendations, particular emphasis will be placed on using 3D-GPR along with Traffic Speed Deflectometer (TSD) and/or Falling Weight Deflectometer (FWD) to detect the location, distribution, and severity of stripping in full-depth and composite bituminous pavements. Recognizing that 3D-GPR and TSD may not be readily available to all participating states, the study will allocate a portion of the pool fund to hire consulting firms for 3D-GPR and TSD surveys on the projects considered in this study.

Financials	Amount
Committed Funds SFY 2023	$25,000
Committed Funds SFY 2022	$0
Transferred Funds SFY 2022	$0

Solicitation 1577 – Highway Safety Manual 2nd Edition (HSM2) Implementation

Project Type: Pooled Funds
MoDOT Contact: Jen Harper
MoDOT Total Commitment: $16,000
Contract Period: TBD
Contract Investigator: FHWA
Funding: SPR 100%

Project Description and Objectives:
The goal of this project is to 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 which is anticipated in 2025.

Financials	**Amount**
Committed Funds SFY 2023	$16,000
Committed Funds SFY 2022	$0
Transferred Funds SFY 2022	$0

N/A – Transportation Pooled Fund Contingency

Project Type: Pooled Funds
MoDOT Contact: Jen Harper
MoDOT Total Commitment SFY23: $64,400
Contract Period: TBD
Contract Investigator: N/A
Funding: anticipated SPR 100%

Project Description and Objectives:
At the time of this document, state DOTs are just now working on the upcoming 2023 pooled fund solicitations. It is anticipated that Missouri DOT staff will request to enter into several other pooled fund projects in State Fiscal Year 2023. This Contingency project is to account for those requests over the next 13 months.

Financials	**Amount**
Committed Funds SFY 2023	$64,400
Committed Funds SFY 2022	$0
Transferred Funds SFY 2022	$TBD

Technology Transfer – SPR23TTS

Estimated Cost - $650,000

    LTAP = $335,000
    NHI   = $40,000
    BEAP = $200,000
    TEAP = $75,000

TTAP – LTAP Program

Project Type: Contracts Other
MoDOT Contact: Jen Harper
Contract Investigator: Missouri S&T
Funding: SPR 100%

TTAP Number	Calendar Year/Switch to FFY in 2022	SPR Work Program Timeline	Contract $
TTAP-T001(36)	2021	7/1/21 through 9/30/21	$80,084
TTAP-T001(37)	FFY 2022	10/1/21 through 9/30/22	$300,000
TTAP-T001(38)	FFY 2023	10/1/22 through 6/30/23	$250,000

Project Description and Objectives:
The Local Technical Assistance Program (LTAP) was established by the Federal Highway Administration (FHWA) in 1982 in response to a recognized need for funding and technical support to the 38,000 communities that maintain local roads and bridges. The Missouri LTAP center is located at Missouri University of Science and Technology. The center enables local counties, parishes, townships, cities and towns to improve their roads and bridges by supplying them with a variety of training programs; new and existing technology updates; and personalized technical assistance. Through these core services, the LTAP center provides access to training and information that may not otherwise be accessible.

<u>Accomplishments</u>
CY 2021:
    With the change to Federal fiscal year there is only one quarter reported. The number of in person classes is still limited to single agencies that can provide a location that allows for social distancing and all CDC and local guidelines can be followed. LTAP has continued to work with MoDOT to provide online training classes. This quarter 14 trainings took place with a total of 707 attendees. The two highest attended classes were Work Zone Safety & Flagger training and LPA Basic – Responsible Person in Charge.

FFY 2022:

The development of a new learning management system (LMS) with an integrated website is being finalized. Implementation is expected in early SFY 2023. The development of an asset management system, Automated Smart Pavement Monitoring Tool, for use by local public agencies (LPAs) in Missouri was developed in collaboration between the Missouri Center for Transportation Innovation (MCTI) and Missouri's LTAP. The tool will be promoted to LPAs throughout the state in MO-LTAP's quarterly newsletter. MoDOT transferred the ownership and operation of the bike trailer to Missouri S&T. Missouri LTAP and MoDOT identified available funding to provide training to schools and communities throughout the state utilizing the bike trailer. MO-LTAP scheduled free bicycle-safety trainings throughout the year with schools and communities. Missouri's LTAP Director, Dr. Heath Pickerill, participated virtually in the National LTAP Association (NLTAPA) winter meeting on January 9, 2022. NLTAPA holds two annual meetings, one in January during TRB and the second in July during the annual conference, which is scheduled for July 18-21 in Seattle, WA. Dr. Pickerill attended the Transportation Engineers Association of Missouri (TEAM) Conference on March 23-25 at Margaritaville Conference Center in Osage Beach where he shared information and promoted Missouri's LTAP as an exhibitor. Dr. Pickerill also serves on the TEAM governing board.

Proposed Activities
FFY 2023

• Will be seeking to expand our LTAP contact list by developing partnerships with various organizations. Also continue to look for partnerships through the Local Public Agency LPA efforts with MoDOT.
• Provide technology transfer materials.
• Provide increased information services - Continue to review and update the webpage to increase the services provided online and the links available.
• Conduct and arrange seminars & workshop training sessions.
• Continue offering "Show Me" Roads Scholar Program Level I courses; will be offering more Level II classes.
• Develop more Level II courses.
• Pursue additional funding sources that will allow the program to be expanded. This would allow us to further promote LTAP and our training and services.
• Continue to assist the MoDOT Local Public Agency efforts through training and other administrative opportunities.
• Evaluate program effectiveness.
• Create efficiencies in providing tech transfer materials and training by sharing resources and cost sharing with the Rural Technical Assistance Program (RTAP) on such deliverables as e-newsletters, arranging training and providing materials.

Financials	Amount
Projected Budget SFY 2023	$335,000
Budget Amount SFY 2022	$300,000
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	N/A

S068202C – FY20 009 MoSTIC LTAP Safety Circuit Rider CY2020, CY2021 & CY2022

Project Type: Contract Research
MoDOT Contact: Jen Harper

Total Contract Amount: $120,000 (not SPR Funding)
Contract Period: 1/1/2020 to 12/31/2022
Contract Investigator: Gidget Koestner
Funding: SPR 80%, State 20%

Project Description and Objectives:
The Missouri Department of Transportation (MoDOT) and the Missouri Local Technical Assistance Program (LTAP) hired a Safety Circuit Rider on contract under the Missouri LTAP Center. This position will provide part-time engineering services and advice as a local field liaison. The target audience would include road and bridge agencies and street departments with limited or no in-house transportation safety engineering resources to conduct these activities on their own. The approach would include travel to local agencies, promoting and facilitating specific low-cost, easy to-implement strategies for safety and infrastructure improvements as well as providing guidance to apply for additional funding where warranted. The position will coordinate with other road safety activities provided by, or funded by, MoDOT and/or Missouri LTAP to benefit local agencies while avoiding duplication of effort.

Proposed Activities for SFY 2023:
Funding for the Safety Circuit Rider position will be taken over by the Highway Safety and Traffic Division for Fiscal Year 2023. It is possible an invoice will be received in SFY 2023.

SFY 2022 Accomplishments:
The SCR spent time in August preparing presentation materials for the American Public Works Association (APWA) – Public Works Expo (PWX) in St. Louis. The operation and maintenance session titled "Low-Cost Maintenance Countermeasures" was held on August 30, 2021. Missouri's LTAP Director, Dr. Heath Pickerill, and the Missouri Safety Circuit Rider (SCR) Ms. Gidget Koestner attended Missouri's Highway Safety & Traffic Conference on September 20-22 at the Holiday Inn Conference Center in Columbia where they shared information and promoted both Missouri's LTAP and the Safety Circuit Rider Program as exhibitors. The conference provided an opportunity to promote program efforts to increase roadway safety throughout the state. Pickerill and Koestner also attended the Missouri Municipal League's annual conference on September 26-28 at Union Station in St. Louis. They networked with cities and towns as well as shared resources and available training. During the first quarter of Calendar Year 2022, the SCR attended Technical Oversight Working Group meetings to participate in multiple reviews of FHWA Safety Circuit Rider Publication drafts on January 28, February 8, and March 25, 2022. The SCR also sent various emails for outreach to the Missouri Association of Council of Governments and regional planning commissions, updated various local agencies' data review information to include 2021, and created accurate maps.

Financials	Amount
Projected Budget SFY 2023	N/A
Budget Amount SFY 2022	N/A
Actual Cost SFY 2022	N/A
Prior to SFY 2022 Actual Cost	N/A

TT200701 – NHI National Highway Institute Training SFY 2022 & SFY 2023

Project Type: Contracts Other
MoDOT Contact: Jen Harper
Total Contract Amount: $80,000
Contract Period: 7/1/2021 to 6/30/2023
Contract Investigator: Sherron Motts

Funding: SPR 80%, State 20%

Project Description and Objectives:
The National Highway Institute (NHI) as part of FHWA is a source for training the transportation community. NHI provides a catalog of available courses that MODOT can purchase and host. Construction and Materials provides research funding in the amount up to $40,000. The type of project is "Contract Other" because MoDOT purchases the classes. NHI training courses provide direction and support to department personnel. Courses are scheduled and provided for department personnel to maintain an understanding of new methodologies and technologies. Training is also provided to meet employee needs and enhance their abilities to support the department's functions.

Proposed Activities for SFY 2023:
Provide opportunity for training of department personnel through NHI courses. Other training opportunities may be offered that support department functions, including on-site classes and workshops necessary to maintain our goal.

SFY 2022 Accomplishments:
There were no in person classes due to COVID-19 this fiscal year. There were no requests for online NHI classes.

Financials	Amount
Projected Budget SFY 2023	$40,000
Budget Amount SFY 2022	$40,000
Adjusted Amount SFY 2022	$0
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	N/A

BEAP Program 2022 and 2023

Project Type: Contracts Other
MoDOT Contact: Jen Harper
Total Contract Amount: $350,000
Contract Period: 7/1/2021 to 6/30/2023
Funding: SPR 80%, State 20%

Problem, Background, and Significance:
The BEAP program has been in existence for a number of years. It provides an avenue for local agencies without engineering expertise to get some engineering assistance, through approved consultants, to deal with problems on their bridges. The Bridge Division administers the BEAP program. The type of project is "Contract Other" because the project work will include contract management. The objective of this program is to provide engineering technical assistance to various local agencies to deal with operational problems on their bridges. This assistance results in reports that are provided to the local agencies providing them with options for addressing these issues. Implementation by the local agency of the recommendations from these reports will result in improvements to the functionality and safety of their bridges.

Proposed Activities for SFY 2023:
For State Fiscal Year 2023 and beyond an increase of $50,000 was approved to account for increases in costs for consultant fees. The hope is to prevent any reduction in the number of studies each year that

MoDOT can support due to inflation costs. BEAP will continue to provide opportunities for local agencies to get technical assistance for bridge engineering problems. It is estimated that the available funds will allow for around 45 BEAP projects. The total number of projects per year will vary depending on the scope and final cost of individual projects.

SFY 2022 Accomplishments:
As of April 27, 2022, the funding allocation for SFY 2022 (including additional funds allocated later in the fiscal year) has allowed for 44 BEAP studies to be completed. These studies involved 48 local agency bridges that had some type of operational problem. Currently, 37 of these studies have been completed. The remaining 7 projects have the reports and invoices pending. The reports and invoices for the remaining 7 projects will be received, approved and payments will be made to the consultants by July 1, 2022.

Financials	**Amount**
Projected Budget SFY 2023	$200,000
Budget Amount SFY 2022	$150,000
Adjusted Budget Amount SFY 2022	$180,000
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	N/A

TEAP Programs 2022 and 2023

Project Type: Contracts Other
MoDOT Contact: Jen Harper
Total Contract Amount SPR: $120,000
Total Contract Amount Local Agency Match: $30,000
Total Contract Amount: $122,500
Contract Period: 7/1/2021 to 6/30/2023
Funding: SPR 80%, State 20%

Problem, Background, and Significance:
The TEAP program has been in existence for a number of years. It provides an avenue for local agencies without engineering expertise to get some engineering assistance, through approved consultants, to deal with problems on their roadways. The Design Division administers the TEAP program. The type of project is "Contract Other" because the project work will include contract management. The objective of this program is to provide engineering technical assistance to various local agencies to deal with operational problems on their bridges and roadways. This assistance results in reports that are provided to the local agencies providing them with options for addressing these issues. Implementation by the local agency of the recommendations from these reports will result in improvements to the functionality and safety of their roadways.

Proposed Activities for SFY 2023:
For State Fiscal Year 2022 and beyond an increase of $30,000 was approved to account for increases in costs for consultant fees. The hope is to prevent any reduction in the number of studies each year that MoDOT can support due to inflation costs. TEAP will continue to provide opportunities for local agencies to get technical assistance for traffic engineering problems. The total number of projects per year will vary depending on the scope and final cost of individual projects. The TEAP program is managed by MoDOT's Design Division's LPA group

SFY 2022 Accomplishments:
The funding allocation for SFY 2022 allowed for 11 TEAP studies to provide technical assistance for local agency roadways. The eleven projects were from a combination of technical transfer funding and highway safety funding.

Financials	**Amount**
Projected Budget SFY 2023	$75,000
Budget Amount SFY 2022	$75,000
Actual Cost SFY 2022	(See Addendum)
Prior to SFY 2022 Actual Cost	N/A