ONE DOT
WORKING BETTER TOGETHER
U.S. Department of Transportation

Federal Transit Administration
901 Locust Street, Room 404 3
Kansas City, MO 64106
816-329-3920
816-329-3921 (fax)

Federal Highway Administration
220 W. Edgewood, Suite H
Jefferson City, MO 65109
573-636-7104
573-636-9283 (fax)

August 22, 2023

Mr. Patrick McKenna, Director Missouri
Department of Transportation
P.O. Box 270
Jefferson City, Missouri 65102

Re: SFY 2024 State Planning and Research Work Program Missouri Project SPR-PL-00 FY (24) Amendment #1 Request

Dear Mr. McKenna:

The Federal Highway Administration (FHWA) and the Federal Transit Administration (FTA) has jointly reviewed and approved the Missouri Department of Transportation's (MoDOT) request to amend state fiscal year (SFY) 2024 State Planning and Research (SPR) Work Program, as described in your letter dated August 16, 2023. This amendment includes additional activities for design work and consultant contracts, which have been included under the Part-I Planning section. The inclusion of these new activities does not change the Part-I Planning budget for District Transportation Planning.

If you have any questions or need additional information, please contact Daniel Nguyen of FTA at (816) 329-3938 and Cecelie Cochran or Dan Weitkamp of FHWA at (573) 638-2605.

Sincerely,

Mokhtee Ahmad
Regional Administrator
Federal Transit Administration

LENORE ARYN THOMPKINS
Digitally signed by LENORE ARYN THOMPKINS
Date: 2023.08.29 10:43:48 -05'00'

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

cc: Eric Curtit, MoDOT
Britni O'Connor, MoDOT
Jennifer Harper, MoDOT
Kelly Wilson, MoDOT
Dave Ahlvers, MoDOT
Dana Kaiser, MoDOT
Daniel Nguyen, FTA Region VII
Cathy Monroe, FTA Region VII
Aryn Thompkins, FHWA MO
Cecelie Cochran, FHWA MO
Dan Weitkamp, FHWA MO

ONE DOT
WORKING BETTER TOGETHER
U.S. Department of Transportation

Federal Transit Administration
901 Locust Street, Room 404 3
Kansas City, MO 64106
816-329-3920
816-329-3921 (fax)

Federal Highway Administration
220 W. Edgewood, Suite H
Jefferson City, MO 65109
573-636-7104
573-636-9283 (fax)

June 21, 2023

Mr. Patrick McKenna, Director Missouri
Department of Transportation
P.O. Box 270
Jefferson City, Missouri 65102

RE: SFY 2024 State Planning and Research Work Program
Missouri Project SPR-PL-00 FY (24) and
SFY FY2023 Annual Report
Missouri Project SPR-PL-00 FY (23)

Dear Mr. McKenna:

Per your letter dated June 20, 2023, the Federal Highway Administration (FHWA) and the Federal Transit Administration (FTA) has jointly reviewed and approved the final version of Missouri Department of Transportation's (MoDOT) state fiscal year (SFY) 2024 State Planning and Research (SPR) Work Program and SFY 2023 Annual Report. After prior discussion and review of provided draft copies, we find the SFY 2024 SPR Work Program satisfactory of the federal requirements and, therefore, approve it as requested for the effective period of July 1, 2023, through June 30, 2024.

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

The SFY 2024 SPR Work Program and SFY 2023 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 2023 SPR Work Program by August 31, 2023, and take steps to close out the SPR-PL-00 FY (23) project within 90 days of the close of the state fiscal year 2023 work program.

If you have any questions, please contact Cecelie Cochran and Dan Weitkamp (FHWA) at (573) 638-2605 or Eva Steinman (FTA) at (816) 329-3931.

Sincerely,

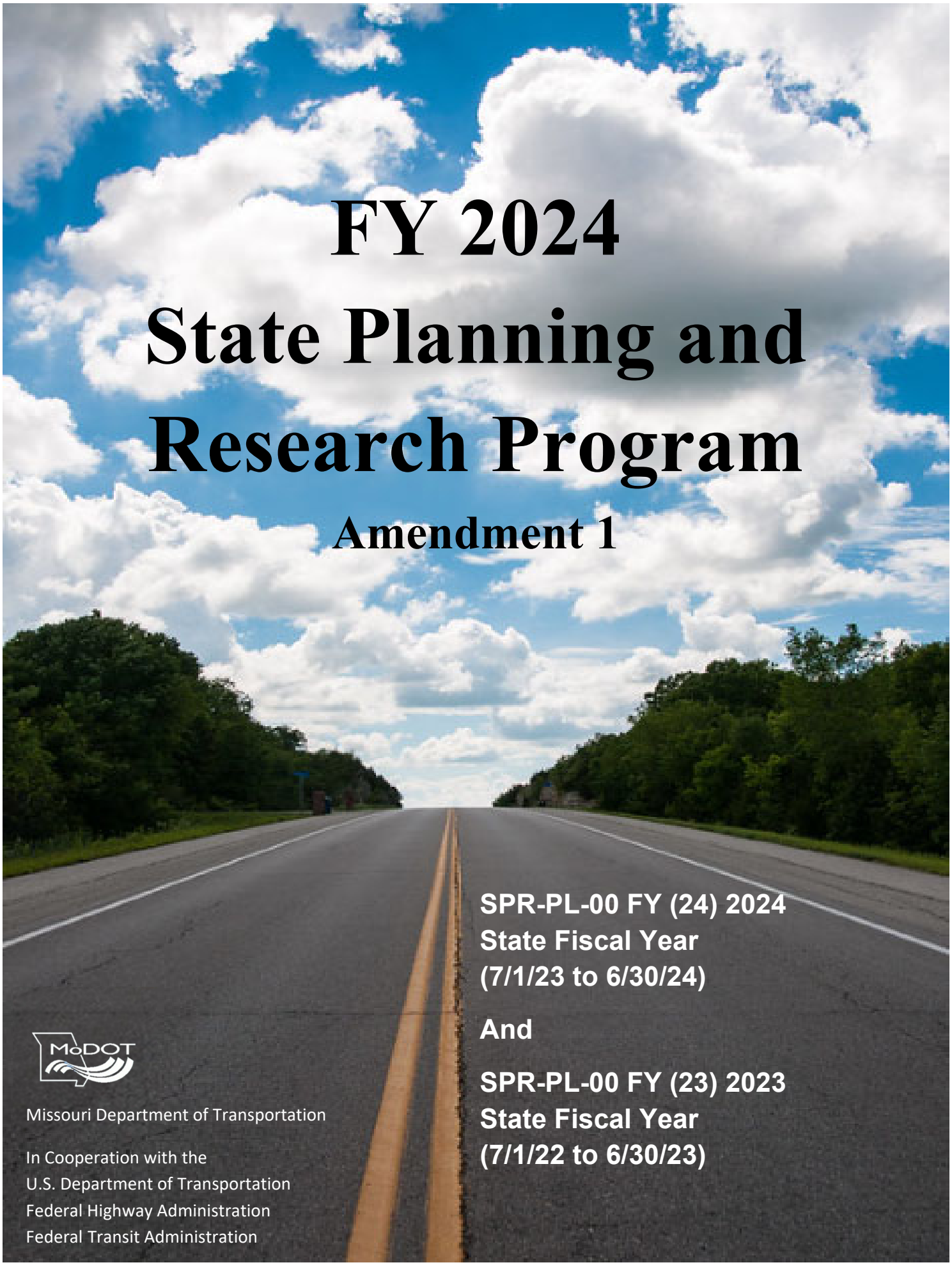
Mokhtee Ahmad

Mokhtee Ahmad
Regional Administrator
Federal Transit Administration

LENORE ARYN THOMPKINS
Digitally signed by LENORE ARYN THOMPKINS
Date: 2023.06.28 09:27:04 -05'00'

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

cc:
Eric Curtit, MoDOT
Britni O'Connor, MoDOT
Jennifer Harper, MoDOT
Aryn Thompkins, FHWA
Cecelie Cochran, FHWA
Eva Steinman, FTA



FY 2024
State Planning and Research Program
Amendment 1

SPR-PL-00 FY (24) 2024
State Fiscal Year
(7/1/23 to 6/30/24)

And

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

Missouri Department of Transportation

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

TABLE OF CONTENTS

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. MoDOT also considered the Planning Emphasis Areas (PEAs) in the development of the SPR Work Program.

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 2024 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 2023 work activities into the SFY 2024 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, 2023

A. Total Estimated Costs	SFY 2024	Amended SFY 2023
Part I – Planning	$26,067,673	$27,241,576
Part II – Metropolitan Planning	$14,062,190	$11,817,415
***Part III – Research, Development and Technology**	$5,601,557	$5,408,873
TOTAL ESTIMATED COST	**$45,731,420**	**$44,467,864**

B. Available Federal Funds	SFY 2024	SFY 2023
Part I - State Planning		
Obligated but Not Spent	$6,820,847	$5,890,750
Unobligated Funds	$19,071,122	$26,666,800
Estimated Annual Apportionment	$17,995,878	$17,642,929
Less: Pooled Funds		
- ITTS TPF-5(390)…….$39,800 estimated	($39,800)	($39,800)
- MAFC Phase 4 TPF-5(509)….$52,000 estimated	($52,000)	($0)
SUBTOTAL – STATE PLANNING	**$43,796,047**	**$50,160,679**
Part II - Metropolitan Planning		
Obligated but Not Spent	$10,509,792	$8,001,787
Unobligated Funds	$10,738,341	$12,077,735
Estimated FHWA PL Annual Allocation	$6,994,139	$6,856,999
Estimated FTA 5303 Annual Allocation	$2,411,336	$2,365,250
SUBTOTAL – METRO PLANNING	**$30,653,608**	**$29,301,771**
Part III – Research		.
Obligated but not spent	$3,031,638	$3,678,473
Unobligated Funds	$10,823,362	$12,335,947
Estimated Annual Apportionment	$5,998,626	$5,880,976
Less:	($2,381,000)	($2,351,000)
- NCHRP…….$1,320,000 estimated		
- TRB Core……...$211,000 estimated		
- Pooled Funds…..….$850,000 estimated		
SUBTOTAL – RESEARCH	**$17,472,626**	**$19,544,396**
TOTAL FEDERAL FUNDS AVAILABLE	**$91,922,281**	**$99,006,846**

C. Proposed Budget Estimates for SFY 2024

Proposed Budget Estimates for SFY 2024	Federal Funds	Percent	Matching Funds	Total
State Planning	$20,904,138	80%	$5,163,535	$26,067,673
Metropolitan Planning (PL and 5303) (Estimated)	$11,249,752	80%	$2,812,438	$14,062,190
*** Research**	$3,988,446	80%	$997,111	$4,985,557
	$616,000	100%	$0.00	$616,000
TOTAL	**$36,758,336**		**$8,973,084**	**$45,731,420**

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

Research Calculation--Items that are 100% funded

AASHTO TSP	$196,000	SPR24RDS
LTAP	$420,000	SPR24TTS
MoDOT Lead Pooled Funds	$0	SPR24RDS
Total 100% Funded	$616,000	

Itemized Cost Budget Estimates

Part I – Planning

Transportation Planning Activities	SPR Federal Portion FY2024	Match FY 2024	Total
80% Federal	$6,140,134	$1,535,033	$7,675,167
• **Transportation Planning Division (SPR2440S)**			
SUBTOTAL	**$6,140,134**	**$1,535,033**	**$7,675,167**
District Transportation Planning			
• **CD (SPR24CDS)**	$2,113,794	$528,449	$2,642,243
• **KC (SPR24KCS)**	$1,806,763	$451,691	$2,258,454
• **NE (SPR24NES)**	$727,282	$181,821	$909,103
• **NW (SPR24NWS)**	$839,153	$209,788	$1,048,941
• **SE (SPR24SES)**	$1,059,036	$264,759	$1,323,795
• **SL (SPR24SLS)**	1,285,819	$321,455	$1,607,274
• **SW (SPR24SWS)**	$687,347	$171,837	$859,184
SUBTOTAL	**$8,519,195**	**$2,129,799**	**$10,648,994**
Other Activities			
100% Federal - 2.5% Set-Aside funding			
• **Safe & Accessible Transportation Options (SPR24SAS)**	$250,000	$0	$250,000
80% Federal			
• **Multimodal Operations (SPR24MOS)**	$203,122	$50,781	$253,903
• **Information Systems (SPR24ISS)**	$1,931,286	$482,821	$2,414,107
• **Regional Planning Commission (SPR2427S)**	$1,326,000	$331,500	$1,657,500
• **Financial Services (SPR2493S)**	$1,079,314	$269,829	$1,349,143
• **Bridge Division (SPR24BRS)**	$851,866	$212,967	$1,064,833
• **Design Division (SPR2495S)**	$283,221	$70,805	$354,026
• **Consultant Contracts (SPR24DBS)**	$320,000	$80,000	$400,000
SUBTOTAL	**$6,244,810**	**$1,498,702**	**$7,743,512**
TOTAL PART I	**$20,904,138**	**$5,163,535**	**$26,067,673**

Part II – Urban (MPO)

Metropolitan Areas	Current CPG Contract Amount	Estimated FFY 2024 Local Match	Estimated Total FFY 2024 CPG Funds with Match
NW Arkansas	$5,000	$1,250	$6,250
Kansas City	$3,200,000	$800,000	$4,000,000
St. Louis	$4,383,275	$1,095,819	$5,479,094
Springfield	$1,037,729	$259,432	$1,297,161
Columbia	$949,146	$237,287	$1,186,433
Jefferson City	$233,951	$58,488	$292,439
Joplin	$828,862	$207,216	$1,036,078
St. Joseph	$390,614	$97,654	$488,268
Cape Girardeau	$221,175	$55,294	$276,469
TOTAL PART II	**$11,249,752**	**$2,812,438**	**$14,062,190**

Note:

- The estimated total of MPO contracts (CPG agreements) in place for the SFY 2024 SPR work program is $11,249,752
- The estimated PL amount is before post-apportionment set-asides; before penalties; before sequestration.
- For SFY 2023 SPR, estimated total apportioned PL Funds = $6,854,256 and Obligation limitation applied at 98%.

Part III – Research – SPR

Activity	SPR Federal Portion FY 2024	Match FY 2024	Total
• **Administration (SPR24ADS)**	$480,446	$120,111	$600,557
• **Research (SPR24RDS)**	$3,476,000	$820,000	$4,296,000
• **Technology Transfer (SPR24TTS)**	$648,000	$57,000	$705,000
***TOTAL PART III**	**$4,604,446**	**$997,111**	**$5,601,557**

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

Total MoDOT SPR Work Program

	SPR Federal Portion FY 2024	Match FY 2024	Total
• **Part I – Planning**	$20,904,138	$5,163,535	$26,067,673
• **Part II – Metropolitan Planning**	$11,249,752	$2,812,438	$14,062,190
• *** Part III – Research**	$4,604,446	$997,111	$5,601,557
TOTAL MoDOT SPR WORK PROGRAM	**$36,758,336**	**$8,973,084**	**$45,731,420**

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

CFR 420.107(c) Summary

FY 2023 FHWA Research Apportionment (25%)	**$5,998,626**
FY 2024 Research Budget	**$6,985,446**
Pooled Funds	*$850,000*
NCHRP	*$1,320,000*
TRB Core	*$211,000*
Part III Research (Federal Portion Only)	*$4,604,446*

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, conducting MoDOT's satisfaction survey and Innovative Partnerships and Alternative Funding activities.

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
- Electric Vehicle (EV) Infrastructure Development Plan Updates
- 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

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

- Began work on MoDOT's report card survey
- Developed applications for competitive discretionary grant programs

PLANNING AND PERFORMANCE GROUP

Purpose and Scope: Planning and Performance Group (PPG) includes the Planning and Policy, Strategic Planning, and Organization Performance 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 planning 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, State Planning and Research Work Program administration, Tracker production, and asset management plan development.

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
    - metropolitan 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
- Development of Carbon Reduction Strategy
- Produce and maintain Unfunded Needs List
- Updating MoDOT's Long Range Transportation Plan
- Assessment of 2020 census impacts

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 Metropolitan Planning Handbook
- 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)
- Calculate project Award and Completed Adjustments for the districts
- Provide data to legislators regarding projects in their districts
- Participant and review of the lettings as part of the letting review group
- Participant and reviewer of agreements (cost share/cost participation) as part of the agreements review group

Prior Year Accomplishments:
- Updated STIP through the amendment process as needed.
- Developed STIP reports
- Posted Program vs. Award report on the STIP web site

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
    - Annual fee to StreetLight Data for collecting transportation 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 2024	**$7,675,167**	SPR2440S
Budget Amount SFY 2023	$7,881,256	SPR2340S

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. It also includes training on engineering standards and training on evaluation and accreditation of inspection and testing materials for highway, public transportation, and intermodal transportation systems.

District Transportation Planning	***SPR Number***	***SPR Federal Portion FY 2024***	***Match FY 2024***	***Total***	***Amended FY 2023 Budget***
• **CD**	SPR24CDS	2,113,794.40	528,448.60	2,642,243.00	2,216,000.00
• **KC**	SPR24KCS	1,806,763.20	451,690.80	2,258,454.00	2,490,367.00
• **NE**	SPR24NES	727,282.40	181,820.60	909,103.00	775,187.00
• **NW**	SPR24NWS	839,152.80	209,788.20	1,048,941.00	849,534.00
• **SE**	SPR24SES	1,059,036.00	264,759.00	1,323,795.00	1,276,962.00
• **SL**	SPR24SLS	1,285,819.20	321,454.80	1,607,274.00	1,936,935.00
• **SW**	SPR24SWS	687,347.20	171,836.80	859,184.00	1,186,971.00
SUBTOTAL		**8,519,195.20**	**2,129,798.80**	**10,648,994.00**	**10,731,956.00**

OTHER ACTIVITIES

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 2024	**$250,000**	SPR24SAS
Budget Amount SFY 2023	$200,000	SPR23SAS

MULTIMODAL OPERATIONS DIVISION

Purpose and Scope:
MoDOT is directing a portion of the SPR funds for freight planning efforts. Personal services and fringe benefits for two employees within this work unit are included in the budget amount.

Proposed Activities:
- Engage stakeholders in discussions about additional freight transportation investments and needs
- Continue coordination with USACE for planning analysis to support modal shift from roads and rail to marine highways
- Continue assisting MoDOT team and planning partners integrate truck parking into planning and project development activities.
- Provide technical assistance and coordination with public ports to increase freight flows on the marine highway system.
- Continue administering the port capital improvement program, the freight enhancement program, and other state funded freight programs.
- Continue assisting RPCs and MPOs professional development by identifying pertinent freight-focused virtual and in-person trainings offered.
- Attend Mid America Regional Council's Goods Movement Committee meetings.
- Engage with multistate freight coalitions to identify best practices and potential regional collaborations for efficient planning and movement of freight.
- Identify trends and best practices for freight planning through literature review, attending Talking Freight webinars, attending AASHTO Council on Water Transportation, Planning Freight Task Force, and Special Committee on Freight meetings.

Prior Year Accomplishments:

- Assisted multimodal stakeholders' development of high priority unfunded needs lists to share with the RPCs and MPOs
- Collaborated with USACE developing scope for planning analysis to support increasing freight flow on marine highway 70
- Provide technical assistance for extension of State Freight and Rail Plan Truck Parking Analysis to prioritize the truck parking needs.

- Collaborated with public ports and RPCs on discretionary grant applications for freight projects.
- Administered the port capital improvement program, the freight enhancement program, and other state funded freight programs.
- Assisted RPCs and MPOs professional development by identifying pertinent freight-focused virtual and in-person trainings offered.
- Attended Mid America Regional Council's Goods Movement Committee meetings.
- Attended AASHTO Council on Water Transportation, Council on Rail Transportation, Planning Freight Task Force, and Special Committee on Freight meetings to identify trends and best practices for freight.

Financials	**Amount**	**Work ID Code**
Projected Budget SFY 2024	**$253,903**	SPR24MOS
Budget Amount SFY 2023	$0	N/A

Note: New SPR number added for FY 2024

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, Intelligent Transportation System and Safety System.
- Maintain and modernize the MoDOT Management System (MMS)

Prior Year Accomplishments:
- Provided TMS Core Maintenance Support
- Implemented new Safety Module in MMS

Financials	**Amount**	**Work ID Code**
Projected Budget SFY 2024	**$2,414,107**	SPR24ISS
Budget Amount SFY 2023	$2,578,873	SPR23ISS

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

Financials	Amount	Work ID Code
Projected Budget SFY 2024	**$1,657,500**	SPR2427S
Budget Amount SFY 2023	$1,657,500	SPR2327S

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
    - Provide coordination of STIP and federal-aid projects
    - Prepare financial models to support department long-term plans and short-term cash needs
    - 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 2024	**$1,349,143**	SPR2493S
Budget Amount SFY 2023	$1,314,505	SPR2393S

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 2024	**$1,064,833**	SPR24BRS
Budget Amount SFY 2023	$791,954	SPR23BRS

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
- Join the Candidate Conservation Agreement with Assurances for Monarch butterfly for MoDOT to plan for the monarch butterfly to be listed and enable MoDOT to continue constructing and maintaining the roadway network

Prior Year Accomplishments:
- Prepared projects to be included in the STIP
- Enhanced data driven safety analysis for STIP projects

Financials	Amount	Work ID Code
Projected Budget SFY 2024	**$354,026**	SPR2495S
Budget Amount SFY 2023	$2,360,532	SPR2395S

CONSULTANT CONTRACTS UTILIZING DBC BUDGET

Purpose and Scope: MoDOT is directing a portion of the SPR funds for MoDOT safety initiatives utilizing consultant services.

Proposed Activities:

- Develop Intersection Control Evaluation (ICE) guidance and implementation ($200,000)
- Improve safety evaluation for projects through data driven approach ($200,000)

Prior Year Accomplishments:

- None to report. New SPR number

Financials	Amount	Work ID Code
Projected Budget SFY 2024	**$400,000**	SPR24DBS
Budget Amount SFY 2023	$0	

Note: New SPR number added for FY 2024. Previously these items were under Design Division.

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 2024 allocation estimate amount used 2020 census urbanized area populations.

Table 1: Total CPG Funds Available to MPOs for SFY 2024 UPWP Work Activities

Metropolitan Areas (Fiscal Year)	MPO Balances as of May 2023 (with FY 2023 allocation)	Estimated FFY24 PL Allocation	Estimated FFY24 5303 Allocation Amounts	Estimated Total CPG Funds	Current CPG Contract Amount
NW Arkansas 07/01 -06/30	$3,167	$5,000	$0	$8,167	$5,000
Kansas City 01/01 - 12/31	$3,777,726	$1,975,191	$701,821	$6,454,738	$3,200,000
St. Louis 07/01 - 06/30	$14,769,529	$3,323,156	$1,234,737	$19,327,422	$4,383,275
Springfield 07/01 - 06/30	$1,296,091	$590,247	$193,819	$2,080,157	$1,037,729
Columbia 10/01 - 09/30	$1,205,639	$296,000	$97,256	$1,598,895	$949,146
Jefferson City 11/01 - 10/31	$628,908	$138,067	$34,817	$801,792	$233,951
Joplin 11/01 - 10/31	$957,689	$200,341	$59,437	$1,217,467	$828,862
St. Joseph 01/01 - 12/31	$993,546	$180,189	$51,470	$1,225,205	$390,614
Cape Girardeau 07/01 - 6/30	$655,400	$146,065	$37,979	$839,444	$221,175
TOTAL PART II	**$24,287,695**	**$6,854,256**	**$2,411,336**	**$33,553,287**	**$11,249,752**

* The MPOs balance is adjusted to include the actual SFY 2024 CPG allocation and equals the unobligated prior year (SFY 2023 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 2024 SPR work program is $11,249,752.

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	$350,000
St. Louis MPO	$308,154
Springfield MPO	$97,670

Part III – Research

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 2024	**$600,557**	SPR24ADS
Budget Amount SFY 2023	$468,873	SPR23ADS
Actual Cost SFY 2023	(See Addendum)	SPR23ADS

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 2024	**$4,296,000**	SPR24RDS
Amended Budget Amount SFY 2023	$4,290,000	SPR23RDS
Actual Cost SFY 2023	(See Addendum)	SPR23RDS

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 2024	**$705,000**	SPR24TTS
Budget Amount SFY 2023	$650,000	SPR23TTS
Actual Cost SFY 2023	(See Addendum)	SPR23TTS

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.

Jen Harper

Research Director

6/20/2023

Date

Part III Research Summary

Project No.	Project Name	SFY 2024 Budget
TA206601	Research Administration	$600,557
TR22CONT	Research Contingencies	$239,129
TR201313	Secretary of State Library MOU	$5,392
TR201610	AASHTO Technical Service Program SFY 2023 & SFY 2024	$199,000
TR201813	Leader-Follower TMA System	$54,992
TR202013	The Effect of Rubber Fills on the Performance of Infrastructure Phase 1	$51,194
TR202020	Evaluation of Recycled Components in SMA Mixes	$19,283
TR202107	TITANv2 – Interactive, Web-Based Platform for Transportation Data Integration, Visualization and Predictive Analytics	$80,000
TR202109	Impact of Silt and Clay Particles on Freshwater Mussels	$130,000
TR202110	Industrial Internet-of-Things Asset Monitoring-Phase 2	$43,411
TR202114	Accessing Standards and Specifications	$37,490
TR202122	LRFR Methodology for Missouri Bridges	$18,995
TR202123	High Tension Guard Cable Inspection and Life Cycle	$185,393
TR202203	Intermediate Bents-Calculation of Restraint Factor	$122,132
TR202204	Type N PTFE Bearing Designs	$150,289
TR202205	Analysis of Asphalt Mix. Using Alternative Aggregate in SMA or SuperPave	$69,999
TR202206	Friction Enhancements to Asphalt Pavement Surfaces	$72,916
TR202207	Pile Set-up and Restrike Procedures	$39,692
TR202212	Mitigating and Preventing MoDOT Safety-Related Incidents through Root-Cause Elimination and Utilization of Leading Safety Indicators	$199,999
TR202213	Ingress and Egress in the St. Louis Region in the Aftermath of an Earthquake in the St. Louis Region	$108,464
TR202214	Devel. a Hazard Detection and Alert System to Prevent Worker Fatalities	$17,635
TR202215	MoDOT Data Acq.& Data Processing Utilizing AI and Machine Learning	$64,704
TR202219	HFST Review of Service Life	$100,000
TR202221	Consultant Support for Intelligent Compaction and Paver-Mounted Thermal Profiling Projects in 2022-2023	$88,483
TR202303	Consultant Estimating	$25,000
TR202304	Investigating the Expanded Use of Waste Plastic in Asphalt	$25,000
TR202306	TSR Replacement and Stripping Tests	$100,000
TR202309	Audible Alert and TMA Lighting	$125,405
TR202311	Asset Characterization Using Automated Methods	$115,000
TR202312	Methods for Monitoring the Movement of Wildlife Through Concrete Barrier Gaps	$90,000
TR202313	Truck Parking Investments for Missouri	$36,114
TR202316	TMA Truck Safety	$75,000
TR202319	Impact Test of GFRP Reinforced Bridge Barriers	$100,000
TR202320	Safety Evaluation of J-turn Intersections in Missouri	$180,000

TR202322	Vulnerable Road User (VRU) Safety Assessment	$157,547
TR202323	LWD Phase II	$70,342
TR202325	MCTI Administration	$85,000
TR202401	Library Support Contract (2024-2025)	$115,000
TR202402	Striping Program	$75,000
TR202403	Shear Wave Velocity and Seismic Analysis Procedures	$50,000
TR202405	New Testing Protocols and Mitigation Approaches for D-Cracking Susceptible Concrete	$20,000
TR202406	Using Rubber Powder to Improve Freeze and Thaw Resistance of Concrete	$25,000
TR202407	Missouri NBI Database Analysis-Phase II	$25,000
TR202408	MASH Simulation for Different Devices	$25,000
TR202409	Letting Optimization	$40,000
TR202410	Effective Methods to Safely Communicate with CMVs	$100,000
TR202412	First and Last Mile Connectivity for People	$50,000
TR202413	Silane Bridge Deck Ratings	$25,000
TR202414	Electric Vehicles and Impact on Motor Vehicles World	$25,000
TR202415	TSMO and Automation in Work Zones	$50,000
TR202416	Fluorescent Yellow-Green Signs	$75,000
TR202417	Comprehensive Data Analysis for AMPT Tests on MO 740 and HWY	$13,000
TR202419	GPR Analysis of I-70	$250,000
Potential PF	Missouri/Kansas 2022 Peer Exchange Pooled Fund	$50,000
TTAPT001	Local Technical Transfer Assistance Program (LTAP)	$420,000
TT200701	National Highway Institute (NHI)	$10,000
TTAPT001	BEAP and TEAP	$275,000
	Total	**$5,601,557**

Pooled Funds

TPF-5(357)	**Connecting the DOTs: Implementing ShakeCast**	**$15,000**
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(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(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(501)	Roadside Safety Pooled Fund - Phase 3	$65,000
TPF-5(504)	Cont. Bituminous Pvmnt Stripping Assesm. Through Non-dest. Testing	$25,000
TPF-5(507)	National Hydraulic Engineering Conference	$1,000
TPF-5(515)	Evaluation of Low-Cost Safety Improvements (ELCSI-PFS)	$10,000
TPF-5(516)	Highway Safety Manual 2nd Edition (HSM2) Implementation	$16,000
TPF-5(517)	Performance Centered Concrete Construction	$20,000
Solic. 1596	Pavement Structural Evaluation with Traffic Speed Deflection Devices (TSDDs)	$55,000
Solic. 1598	MAASTO Connected Automated Vehicle (CAV) Steering Committee	$30,000
N/A	Transportation Pooled Fund Contingency	$85,400
	Total Pooled Funds	$850,000
	TRB Core Subscription estimate	$211,000
	NCHRP FY 2024 estimate	$1,320,000
	Total	**$2,381,000**

Administration – SPR24ADS

Estimated Cost - $600,557

TAyy6601 – Research Administration

Project Type: Contracts Other
MoDOT Contact: Jen Harper
Total Contract Amount SFY 2024: $600,557
Contract Period: 7/1/1966 to 6/30/2024
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 2024:

The salary and expenses of the Research Director, Research Analysts, and other applicable MoDOT staff working on research projects will be charged against this item.

SFY 2023 Accomplishments:

The Research Section had 44 active contract research projects at the end of the third quarter. The Research Section completed a total of 13 projects and published 16 reports as of May 1, 2022.

Financials	Amount
Projected Budget SFY 2024	$600,557
Budget Amount SFY 2023	$468,873
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 Actual Cost	N/A

Research – SPR24RDS

Estimated Cost - $4,296,000

TRyyCONT – Research Contingencies

Project Type: Contracts Other
MoDOT Contact: Jen Harper
Total Contract Amount: $239,129
Contract Period: 7/1/2023 to 6/30/2024
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 eventually become contract expenditures.

Proposed Activities for SFY 2024:
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 2024. These include administrative and other eligible costs.

SFY 2023 Accomplishments:
7 new projects were approved for funding in State Fiscal Year 2023 and two budget increases. The new projects are:
TR202312 Methods for Monitoring the Movement of Wildlife Through Concrete Barrier Gaps
TR202313 Truck Parking Investments for Missouri

TR202319 Impact Test of GFRP Reinforced Bridge Barriers
TR202320 Safety Evaluation of J-turn Intersections in Missouri
TR202322 Vulnerable Road User (VRU) Safety Assessment
TR202323 LWD Phase II
TR202325 MCTI Administration

Financials	Amount
Projected Budget SFY 2024	$239,129
Budget Amount SFY 2023	$262,446
Adjusted Budget Amount SFY 2023	$0
Actual Cost SFY 2023	N/A
Prior to SFY 2023 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 6/30/2024
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 2024:
It is expected that the SFY 2024 invoice will be received and sent for payment during the first quarter.

SFY 2023 Accomplishments:
The invoice from the Secretary of State's Office was receive on October 17th and posted the same day. The MOU was drafted in March and signed in April.

Financials	Amount
Projected Budget SFY 2024	$5,392
Budget Amount SFY 2023	$5,210
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 Actual Cost	N/A

TR201610 – AASHTO Technical Service Program SFY 2023 & SFY 2024

Project Type: Contract Research
MoDOT Contact: Jen Harper

Total Contract Amount: $384,000
Contract Period: 7/1/2022 to 06/30/2024
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 2024:
MoDOT's Construction and Materials Division is expected to participate in the following AASHTO Technical Service Programs for State Fiscal Year 2024:
• National Transportation Product Evaluation Program (NTPEP), $25,000.
• 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.
• AASHTO STEM Outreach Solutions (formerly TRAC and RIDES), $14,000.
The total amount for SFY 2024 for Construction and Materials is $95,000. Other MoDOT Divisions are participating in various Technical Service Programs that total up to $104,000 making the total MoDOT TSP commitment $199,000. For State Fiscal Year 2025 SPR funding will be moved to EODD to pay for the STEM Outreach Solutions Pooled fund.

SFY 2023 Accomplishments:
The invoices for FY 2023 were received in July. Construction and Materials and the various divisions paid for their respective programs during the first quarter.

Financials	Amount
Projected Budget SFY 2024	$199,000
Budget Amount SFY 2023	$180,000
Adjusted Budget Amount SFY 2023	$185,000
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 Actual Cost	N/A

TR201813 – Leader-Follower TMA System

Project Type: Contract Research
MoDOT Contact: Jen Harper
Total Contract Amount: $549,921
Contract Period: 3/5/2018 to 12/31/2023
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 2024:
It was anticipated some of the 250-hour testing in a live mobile work zone will continue through the summer months and hopefully be completed in the first or second quarter of State Fiscal Year 2024.

SFY 2023 Accomplishments:
Kratos worked with the Kansas City District to support the live work zone testing. Several remote sessions were done for downloading the log files Due to the significant delays caused by COVID and then staffing issues, the project was not completed in the fall. With approval from Executive Team, it was decided to pay out most of the contract instead of waiting until completion. All but the last 10% of the project budget has now been invoiced. The project was extended to December 31, 2023. The plan is to finish testing in spring and summer striping season.

Financials	Amount
Projected Budget SFY 2024	$54,992
Budget Amount SFY 2023	$357,449
Adjusted Budget Amount SFY 2023	$302,457
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 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 12/31/2023
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 2024:
It is not anticipated there will be any miscellanous expenses for State Fiscal Year 2024.

SFY 2023 Accomplishments:
There were no charges this fiscal year.

Financials	Amount
Projected Budget SFY 2024	$0
Budget Amount SFY 2023	$27,531
Adjusted Budget Amount SFY 2023	$0
Actual Cost SFY 2023	(See Addendum)

Prior to SFY 2023 Actual Cost	$42,469

TR202007 – Geotechnical Asset Management of NW and NE—Completed

Project Type: Contract Research
MoDOT Contact: Brent Schulte
Total Contract Amount: $114,864
Contract Period: 9/26/2019 to 2/28/2023
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 2024:
This project was completed in SFY 2023.

SFY 2023 Accomplishments:
Landslide Tech (LT) worked with the MoDOT IT group the first half of SFY 2023, they finished trouble-shooting on the application and scheduled field work for the end of October. They also sent the completed application to Lydia Brownell for her to test as well. After field work was scheduled, they started coordinating on an itinerary and list of sites to visit during the field inspections. LT didn't have access to the Portal or the TMS interface to trouble shoot problems with scraping data or displaying the final data in TMS. They relied on the Geotechnical Technical Committee to advocate for what they needed from IT for the TMS portion of this project. The project was extended a few more months. LT completed field work in the Northwest and Northeast districts and worked with the MoDOT IT group to troubleshoot data collection and incorporation issues. The field work inventoried and assessed 91 geotechnical assets along roughly 2200 miles of NHS routes. A final report and research summary was received and accepted in January 2023 and added to the Innovation Library. The final invoice was received March 9, 2023.

Financials	Amount
Projected Budget SFY 2024	$0 ($65 not expended)
Budget Amount SFY 2023	$60,905
Adjusted Budget Amount SFY 2023	$60,840
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 Actual Cost	$53,959

TR202010a – Missouri Systemic Countermeasures to Improve Pedestrian Safety—Completed

Project Type: Contract Research
MoDOT Contact: Jenni Hosey
Total Contract Amount: $120,063 (+11,820 of ASAP funds)
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 2024:
This project was completed in SFY 2023.

SFY 2023 Accomplishments:
Arora and Associates submitted a draft report for the TAC to review on September 6. The final report was published in November. The final invoice for this project was paid on November 17, 2022. It is now complete and closed.

Financials	Amount
Projected Budget SFY 2024	$0 ($1,009 left unspent)
Budget Amount SFY 2023	$126,139
Adjusted Budget Amount SFY 2023	$119,054
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 Actual Cost	$0

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

Project Type: Contract Research
MoDOT Contact: Jen Harper
Total Contract Amount: $220,066
Contract Period: 10/15/2019 to TBD
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 2024:
It is anticipated this project will be completed in early SFY 2024. A new timeline is expected shortly now that the student was able to get their visa. Additionally, funding will need to be added to the project for the new student to have funding throughout the extension of the project. The agreed upon increase is $50,000. This extension will be completed in early SFY 2024.

SFY 2023 Accomplishments:
This project was delayed. The grad-student left the country due to a family death and then left the university. The remaining research team worked to develop a plan to finish out the project. An extension was granted until the end of the fiscal year. A new student was identified and work was planned to start in the spring however he only recently received his visa. This project will need to continue into SFY 2024 but a timeline has not been established yet.

Financials	Amount
Projected Budget SFY 2024	$51,194
Budget Amount SFY 2023	$1,549
Adjusted Budget Amount SFY 2023	$355
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 Actual Cost	$168,517

TR202016 – Monitoring an Active Landslide on Route 465 Near Branson--Completed

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 2024:
This project was completed in SFY 2023.

SFY 2023 Accomplishments:
In SFY 2023 Landslide Tech. (LT) started change detection work using the final LiDAR data pass. LT continued monitoring IPI movement, groundwater data, and weather data. They arranged a time to conduct the final SI readings and give some training to the SW District Geologist, who will manually download data 2 to 3 times a year going forward, in case MoDOT ever has future research questions at

this site. LT conducted final SI readings and data collection at the site. The data subscriptions powering the remote data monitoring were shut down. The research team also completed their final analysis of the data collected onsite. A final report and research summary was received and accepted in January 2023 and added to the Innovation Library. The final invoice was received March 9, 2023. This project is complete.

Financials	Amount
Projected Budget SFY 2024	$0 ($46 left unspent)
Budget Amount SFY 2023	$43,158
Adjusted Budget Amount SFY 2023	$38,730
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 Actual Cost	$111,216

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 TBD
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 2024:
This project is scheduled to be completed in SFY 2023.

SFY 2023 Accomplishments:
Writing of the draft report began in the fall A progress presentation was given on December 12th. 1-D and 2-D models were completed; however, the research team found that there were errors in FHWA's Hydraulic Toolbox software. The research team submitted the draft report on June 14, 2023. There will be a quick turnaround so that the final can be submitted by the end of the fiscal year.

Financials	Amount
Projected Budget SFY 2024	$0
Budget Amount SFY 2023	$67,443
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 Actual Cost	$132,553

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 10/31/2023
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 2024:
The draft and final reports are due in first quarter of SFY 2024.

SFY 2023 Accomplishments:
A no-cost extension was determined to be necessary due to supply chain issues and delays getting equipment serviced. All delayed equipment was received by Missouri S&T. Additional test specimens were prepared by UMC and delivered to Missouri S&T. A presentation covering some of field and lab findings was made at the AGC conference. Testing will be completed by end of SFY 2023 or first part of SFY 2024.

Financials	Amount
Projected Budget SFY 2024	$19,283
Budget Amount SFY 2023	$82,625
Adjusted Budget Amount SFY 2023	$63,342
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 Actual Cost	$237,375

TR202025 – MCTI Administration—Completed

Project Type: Contract Research
MoDOT Contact: Jen Harper
Total Contract Amount: $225,000
Contract Period: 11/18/2019 to 11/18/2022
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 2024:
A new number was given for SFY 2023-SFY 2025. The new number is TR202325.

SFY 2023 Accomplishments:
The Technical Advisory Groups met during quarter one of SFY 2023 for the first time. Each of the four TAGs developed multiple research problem statements for the SFY 2024 program. The Technical Advisory Groups submitted 20 research statements. The third-year report was completed and the next Master Memorandum of Understanding was executed in December. MCTI presented to the MHTC on February 8, 2023.

Financials	Amount
Projected Budget SFY 2024	$0
Budget Amount SFY 2023	$0
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 Actual Cost	$225,000

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

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 2024:
This project was completed in SFY 2023.

SFY 2023 Accomplishments:
Leidos completed all date identification for FYA, submitted FYA installation dates to MoDOT for review and approval, completed initial before-after analysis, and benefit-cost analysis. The draft report was sent to MoDOT on January 5. The final report was submitted to MoDOT on February 8 with the final presentation given on March 8. The final invoice was paid in June.

Financials	Amount
Projected Budget SFY 2024	$0 ($11,532 left unspent)
Budget Amount SFY 2023	$87,763
Adjusted Budget Amount SFY 2023	$76,231
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 Actual Cost	$111,673

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

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 2024:
This project was completed in SFY 2023.

SFY 2023 Accomplishments:
The researchers were delayed in delivering the draft report. When the draft was received it was reviewed and sent back to the researchers with multiple comments and corrections. The revised final report was received and accepted. The project ended on 8/31/2022 and the final report was posted to the Innovation Library. The final invoice was received. This project is completed.

Financials	Amount
Projected Budget SFY 2024	$0 ($3,161 left unspent)
Budget Amount SFY 2023	$13,724
Adjusted Budget Amount SFY 2023	$10,563
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 Actual Cost	$168,272

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 2024:
Work will continue during State Fiscal Year 2024 to add functionality as requested by MoDOT when they are within the funding allowed. The rest of the time will be spent on cleaning up issues as they are found and addressing requests for minor changes such as clarifying language on the site.

SFY 2023 Accomplishments:
The research team completed work on new crash data provided by the TAC from 2012 - 2020. The team received new update requests and are currently working to fix them. The research team released an initial version of the crash risk prediction APP in the 2nd quarter of SFY 2023. The researchers continued to evaluate the APP for accuracy throughout the fiscal year. Additionally, update requests from MoDOT staff were completed: This included integration of CCTV feeds for Springfield, and updates on the APP CENTER user interface for user-friendliness. The team also deployed an APP for analyzing motorcycle crashes. Lastly, we have successfully integrated incident and detector data streams from Parsons into TITAN. A lunch and learn at MoDOT took place on March 28, 2023, and was well received.

Financials	Amount
Projected Budget SFY 2025	$139,331
Projected Budget SFY 2024	$80,000
Budget Amount SFY 2023	$100,000
Adjusted Budget Amount SFY 2023	$57,430
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 Actual Cost	$173,171

TR202109 – Impact of Silt and Clay Particles on Freshwater Mussels

Project Type: Contract Research
MoDOT Contact: Scott Breeding
Total Contract Amount: $600,000

Contract Period: 1/1/2021 to 8/31/2024
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 2024:
The research team will continue laboratory experiments. The project is scheduled to be completed by end of FY2024 and the final report will be submitted in early FY2025.

SFY 2023 Accomplishments:
The research team continued analysis and documentation of survey results. The impacts of suspended sediments were carried out through a chronic exposure study. No clear lethal effect was observed but impacts on mussel growth were noticed. Impacts of sediment deposition on mussel species were evaluated for 6 soil/sediment samples. The project has been extended to allow additional burial studies, a new apparatus for the burial study has been designed. The new design mimics the hyporheic flow to better observe mussel behavior once buried. A preliminary study was conducted using the new test apparatus design. The new design is working well, and water quality has also improved. Adult mussels of different species from the Kansas Zoo finished quarantine and are ready for the burial study. A manuscript reporting the impacts of suspended sediments on juveniles was prepared by the project team and is waiting for approval of CERC and MoDOT before submission.

Financials	Amount
Projected Budget SFY 2025	$68,618
Projected Budget SFY 2024	$130,000
Budget Amount SFY 2023	$50,000
Adjusted Budget Amount SFY 2023	$121,823
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 Actual Cost	$279,559

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

Project Type: Contract Research
MoDOT Contact: Scott Breeding
Total Contract Amount: $266,850
Contract Period: 1/1/2021 to 12/31/2023
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 2024:
Project is scheduled to be completed in the 2nd quarter of SFY 2024.

SFY 2023 Accomplishments:
All instrumentation has been acquired. BDI and AECOM completed installations of sensors at 4 locations during 10/4/22-10/6/22: 1 retaining wall, 1 sign structure and 2 end terminals. BDI repaired damaged instrumentation and returned it to MoDOT. The dashboard went live and access has been shared with MoDOT.

Financials	Amount
Projected Budget SFY 2024	$43,411
Budget Amount SFY 2023	$40,000
Adjusted Budget Amount SFY 2023	$68,117
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 Actual Cost	$155,322

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 12/31/2023
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 2024:
The invoicing for the drilling was completed in SFY 2023. It is not anticipated there will be any additional expenses.

SFY 2023 Accomplishments:
This phase of the project is complete. The invoice coding was sent to the St. Louis district for payment to Terracon. The payment posted on November 4, 2022. This concludes the contract with Terracon. Additional miscellaneous expenses may occur when the rest of the field deployment occurs.

Financials	Amount
Projected Budget SFY 2024	$0
Budget Amount SFY 2023	$17,000
Adjusted Budget Amount SFY 2023	$4,656
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 Actual Cost	$0

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

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 2024:
This project was completed in SFY 2023.

SFY 2023 Accomplishments:
The final report was posted to the Innovations Library. The final invoice was posted on 9/7/22. This project is complete.

Financials	Amount
Projected Budget SFY 2024	$0 ($1 left unspent)
Budget Amount SFY 2023	$37,564
Adjusted Budget Amount SFY 2023	$11,151
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 Actual Cost	$88,848

TR202112 – GFRP Reinforced Barrier Curbs—Completed

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 2024:
This project was completed in SFY 2023.

SFY 2023 Accomplishments:
The final report was received and accepted. The final report was posted to the Innovation Library and the project ended 8/1/22. This project is completed. The university informed MoDOT that the June invoice was the final invoice.

Financials	Amount
Projected Budget SFY 2024	$0 ($370 left unspent)
Budget Amount SFY 2023	$370
Adjusted Budget Amount SFY 2023	$0
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 Actual Cost	$74,627

TR202113 – Fiber Reinforced Concrete for Bridge Decks and Overlays—Completed

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 2024:
This project was completed in SFY 2023.

SFY 2023 Accomplishments:
The draft final report was due August 15, 2022, with the final report due October 15th. The researchers encountered some major delays in procuring the materials, and testing. The final report was received in February after researchers had been contacted multiple times. The final report was posted to the Innovation Library and the final invoice was received. The contract ended 11/15/2022.This project is completed.

Financials	Amount
Projected Budget SFY 2024	$0
Budget Amount SFY 2023	$40,707
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 Actual Cost	$109,293

TR202114 – Accessing Standards and Specifications

Project Type: Contract Research
MoDOT Contact: Lauren Bielecki
Total Contract Amount: $37,490 annually
Contract Period: 6/1/2022 to 6/1/2023
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 2024:
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 next contract renewal, it will be decided if we need to retain all current specifications or make adjustments for the following year.

SFY 2023 Accomplishments:
In fall 2021, MoDOT implemented Techstreet, an online standards portal. The contract has been renewed through 2023. Feedback has been positive so far. A Techstreet flyer is now included in all new employee packets for all districts. A couple new specifications were added in SFY 2023 as requested by MoDOT staff. Invoicing took place and work continues with how to market.

Financials	Amount
Projected Budget SFY 2024	$37,490
Budget Amount SFY 2023	$33,259

Adjusted Budget Amount SFY 2023	$37,490
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 Actual Cost	$33,259

TR202115 – Effectiveness of Speed Management Methods in Work Zones—Completed

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 2024:
This project was completed in SFY 2023.

SFY 2023 Accomplishments:
The draft final report was received and after reviewing was accepted as the final version. The final report has been posted to the Innovation Library. The final invoice was posted on December 16, 2022. This project is completed.

Financials	Amount
Projected Budget SFY 2024	$0 ($36,819 left unspent)
Budget Amount SFY 2023	$79,786
Adjusted Budget Amount SFY 2023	$42,967
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 Actual Cost	$120,214

TR202117 – Asset Management for Mobility and Intelligent Transportation Systems—Completed

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 2024:
This project was completed in SFY 2023.

SFY 2023 Accomplishments:
The draft report was submitted to MoDOT and TAC for review on September 1, 2022, and the final, 508 compliant, version in December 2022. The final invoice was received in January and posted on January 18, 2023. This project is closed.

Financials	Amount
Projected Budget SFY 2024	$0 ($1,477 left unspent)
Budget Amount SFY 2023	$19,816
Adjusted Budget Amount SFY 2023	$18,339
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 Actual Cost	$55,183

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

Project Type: Contract Research
MoDOT Contact: Brent Schulte
Total Contract Amount: $149,997
Contract Period: 4/15/2021 to 6/15/2023
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 2024:
This project was completed in SFY 2023. The final invoice may be received in SFY 2024.

SFY 2023 Accomplishments:
The Missouri S&T research team together with the contractor conducted a demonstration on August 18, 2022, at the HyPoint lab facilities in Rolla. Due to issues in the first demonstration, the researchers conducted a mockup on the 10th of October 2022, before the field implementation of the Route Z and

Route M bridges. Two 12 x 12 ft slabs of different fluidity were cast for the mockup. The fresh properties of both mixtures were compared to a lab mixture of the same mixture design. The mixtures for the mockup slabs met the requirements for 7-day flexural strength and toughness. The UHPC overlays for Route Z and Route M bridges were cast on October 20th and November 4th, respectively. Control samples were taken at the middle and end locations of the bridges. The specification for 1-day, 7-day and 28-day compressive strength for Route Z and Route M UHPC overlays were met. A comprehensive instrumentation program involving the use of embedded strain gauges, thermocouples and humidity sensors was employed to monitor deformation, temperature, and internal relative humidity (IRH) in the UHPC overlay. Researchers requested a 2 month no-cost extension to collect more data from the embedded sensors. A bridge inspection of Route Z and Route M Bridges was carried out. The purpose of the inspection was to examine and document any signs of cracking or deterioration of the bridge overlays. A draft final report was received 3/20/23 and sent back with comments. The final report was received in May and posted to the Innovation Library. This project is complete.

Financials	Amount
Projected Budget SFY 2024	$0
Budget Amount SFY 2023	$88,406
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 Actual Cost	$61,591

TR202122 – LRFR Methodology for Missouri Bridges

Project Type: Contract Research
MoDOT Contact: Jenni Hosey
Total Contract Amount: $184,999
Contract Period: 5/28/2021 to 11/30/2023
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 2024:
This project will be wrapping up in SFY 2024 with the draft report due August 31, 2023, and the final due October 31, 2023.

SFY 2023 Accomplishments:
The research team identified steel bridges that had very low rating factors. When sent to MoDOT, it was suggested to check Service II LL factor of 1.0 instead of 1.3. The ten bridges were run, and two bridges were found to have increased ratings due to the reduction in LL. Ninety other bridges were run to test for validity. Research was done on the use of the various system factors and condition factors in LRFR, and correlations on how a good inspection program may influence their use. An NCHRP report was reviewed, and a summary report was drafted. Recommendations sought included when it is appropriate to use

system factors and condition factors since MoDOT is reluctant to use these factors. Additionally, the project team reviewed MoDOT's current practice for determining load posting needs on bridges and provided recommendations on how to utilize LRFR to produce similar outcomes with respect to the total number of bridges requiring posting for both methodologies. Due to staffing issues with graduate students and completing the work, the due dates for the draft and final reports were extended three months.

Financials	Amount
Projected Budget SFY 2024	$18,995
Budget Amount SFY 2023	$111,707
Adjusted Budget Amount SFY 2023	$96,378
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 Actual Cost	$69,626

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 2024:
The research team will continue to analyze crash data, finish crash modeling, and laboratory testing of guard cable samples. The draft report is due October 15, 2023, and final due December 15, 2023.

SFY 2023 Accomplishments:
During SFY 2023, the research team conducted field inspections of guard cable (GC), interviewed MoDOT district staff members, did mechanical tests of cable materials, and did FEM modeling of GC with passenger vehicles and a small truck. Using crash data records provided by MoDOT staff, the research team identified the most commonly impacted locations of GC across the state. MoDOT staff worked on providing data details regarding the maintenance specifics (number of feet of damaged cable, number of damaged components, etc.).

Financials	Amount
Projected Budget SFY 2024	$185,393
Budget Amount SFY 2023	$150,000
Adjusted Budget Amount SFY 2023	$99,117
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 Actual Cost	$15,490

TR202124 – Implementation of Data QA for Innovative Technology at MoDOT—Completed

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 2024:
This project was completed in SFY 2023.

SFY 2023 Accomplishments:
The final report posted on 11/17/22 and the final invoice was paid. This project is complete.

Financials	Amount
Projected Budget SFY 2024	$0 ($31 left unspent)
Budget Amount SFY 2023	$34,020
Adjusted Budget Amount SFY 2023	$33,989
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 Actual Cost	$51,875

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

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 2024:
This project was completed in SFY 2023.

SFY 2023 Accomplishments:
The research team wrapped up the initial performance monitoring of the Stadium Blvd resurfacing, using university pavement vision system hardware and machine learning pavement evaluation software. The team plans to continue to evaluate the section at least 4 times per year for long-term monitoring. The final report was received in March and was posted in the Innovation Library. The final invoice has been paid. This project is complete.

Financials	Amount
Projected Budget SFY 2024	$0
Budget Amount SFY 2023	$23,938
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 Actual Cost	$300,537

TR202201 – Library Support Contract (2022-2023)—Completed

Project Type: Contract Research
MoDOT Contact: Jen Harper
Total Contract Amount: $200,918
Contract Period: 7/1/2021 to 6/30/2024
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 2024:
This project was completed in SFY 2023 except possibly the final invoice. The new Library Contract number is TR202401

SFY 2023 Accomplishments:
For the period of July through September 2022, the librarian answered 27 reference questions, including five literature searches. A total of 1,485 print and electronic library items were circulated or accessed. For the period of October through December 2022, the librarian answered 18 reference questions, including one literature search. A total of 2,701 print and electronic library items were circulated or accessed. For the period of January through March 2023, the librarian answered 28 reference questions, including two literature searches. A total of 4,382 print and electronic library items were circulated or accessed. A total of 16 reports were published as of May 1, 2023.

Financials	Amount
Projected Budget SFY 2024	$0
Budget Amount SFY 2023	$115,276
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 Actual Cost	$85,642

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

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 2024:
This project was completed in SFY 2023.

SFY 2023 Accomplishments:
The initial project report and all experiments were completed. The final report was received in December and has been posted to the Innovation Library. The final invoice was received in May. This project is closed.

Financials	Amount
Projected Budget SFY 2024	$0 ($31,566 left unspent)
Budget Amount SFY 2023	$174,874
Adjusted Budget Amount SFY 2023	$143,308
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 Actual Cost	$154,236

TR202203 – Intermediate Bents-Calculation of Restraint Factor

Project Type: Contract Research
MoDOT Contact: Jen Harper
Total Contract Amount: $175,000
Contract Period: 9/8/2022 to 3/1/2024
Contract Investigator: Sarah Orton
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 2024:
The modeling will continue in SFY 2024 along with testing of an in-service bridge. The draft report is due December 1, 2023, and the final report February 1, 2024.

SFY 2023 Accomplishments:
The research team led by Dr. Sarah Orton was selected to perform the research project. The contract was signed on September 12, 2022. The research team is building a detailed numerical model using ANSYS finite element code for the analysis of the intermediate bend restraint. A model for bridge A8697 is running and showing good behavior. The results are being analyzed to determine if any changes to modeling assumptions are needed. A model is being built for bridge A7957, a previously tested bridge that could serve as the first round of validation for the computer models. A new DIC (digital image correlation system) has been purchased and work is underway to validate its use for determining bridge movements.

Financials	Amount
Projected Budget SFY 2024	$122,132
Budget Amount SFY 2023	$75,000
Adjusted Budget Amount SFY 2023	$52,868
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 Actual Cost	$0

TR202204 – Type N PTFE Bearing Designs

Project Type: Contract Research
MoDOT Contact: Jen Harper
Total Contract Amount: $200,000
Contract Period: 11/15/2022 to 5/31/2024
Contract Investigator: Jonathan C. McGormley
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 2024:
Phase 1 testing of bearing pads will take place in early SFY 2024. Upon the selection of specimen(s) from Phase 1, additional investigations will be conducted to measure the effects of bearing size, temperature, and contact pressure. The draft report is due October 27th and the final report on February 2, 2024.

SFY 2023 Accomplishments:
The request for proposal was posted on August 4, 2022. The contract was signed on November 21, 2022. A kick-off meeting was held on Friday December 2nd. Task 2 (Literature Review) was entirely completed. From Task 3 work items, the test plan as well as the bearing pad specimens' specifications required for Phase 1 experimentation were reviewed and approved by MoDOT. WJE placed the order for bearing pad specimens for Phase 1.

Financials	Amount
Projected Budget SFY 2024	$150,289
Budget Amount SFY 2023	$50,000
Adjusted Budget Amount SFY 2023	$49,711
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 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 2024:
Activities to be performed in SFY 2024 include: Sampling the rest of the aggregates from the sampling plan, along with testing for physical properties and durability. They will finish all Laboratory testing, including the performance evaluation of SMA and Superpave mixtures with alternative aggregates through a comprehensive laboratory testing and data analysis program. Researchers will draft a final report and research summary which is due 2/1/2024, with the final report, research summary, presentation and recommendations being due 4/1/2024. This project will be completed towards the end of SFY 2024.

SFY 2023 Accomplishments:
The research team conducted a comprehensive literature review of state-of-the-art and the state-of-the-practice on testing, evaluating methods, and requirements of aggregates used and associated mix design methods for SMA and higher level Superpave mixes. The team reviewed benefits and concerns of use of alternative materials in terms of cost, availability/reliability of the source of material, durability testing records of alternatives, and performance of mixtures. A list of quarries that include potential alternative aggregates was provided by MoDOT with different types of aggregates including chat, dolomite, gravel,

limestone, slag, trap rock, and granite. The S&T research team then studied the locations and distributions of the quarries to create a sampling plan. The research team also searched the average cost of different types of aggregates and considered the durability and historic usage. A sampling plan was generated. Three of the six aggregates for preliminary testing were sampled and collected, including the control traprock, limestone, and steel slag. Those materials were tested for physical properties and durability. The two research teams, i.e., S&T and UoI, had a virtual meeting in December. The UoI team has had the accelerated friction testing equipment ready and assigned a graduate research assistant to conduct the test. The S&T team worked with a mix design using the traprock and other control aggregates from the Rolla plant. Because of the inconsistency between the JMF and the obtained material, the S&T research team re-designed the SMA mixture following the AASHTO M 325, which took added extra work in addition to the original experimental plan.

Financials	Amount
Projected Budget SFY 2024	$69,999
Budget Amount SFY 2023	$100,000
Adjusted Budget Amount SFY 2023	$130,000
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 Actual Cost	$0

TR202206 – Friction Enhancements to Asphalt Pavement Surfaces

Project Type: Contract Research
MoDOT Contact: Brent Schulte
Total Contract Amount: $175,000
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 2024:
Activities to be performed in SFY 2024 include continuing the literature review of the main findings of previous research focusing on asphalt-based binders in high friction surface treatments. All laboratory testing will be completed along with measuring fiction properties of HFST systems. The research team will update the cost Analysis of applications. A draft final report and research summary are due 11/17/2023 with the final report, research summary and final presentation being due 2/1/2024. There may be a short no-cost time extension given on the project if additional testing is approved by MoDOT.

SFY 2023 Accomplishments:
The research team reviewed literature on HFST, HFSC, and materials and testing. The team worked on fractionating received aggregate sources to follow the finalized gradations along with laboratory evaluation of materials. The researchers also worked on the physical and chemical testing of aggregate sources. The research team completed the physical aggregate testing, completed the AIMS aggregate testing (conducted at Texas A&M), and completed the British Pendulum (BP) performance testing. The

delivery of the Dynamic Friction equipment was delayed but delivered. The team completed initial BP testing on coupons with different aggregate sizes, binder rates, and coated vs. non-coated aggregates. They also completed the "Terminal Presentation" and discussed the progress of current tasks and suggested additional testing with MoDOT. The research team is planning to submit a list of additional testing to include in this research project at no additional cost to MoDOT but will require more time. This will be reviewed by the TAC before being approved.

Financials	Amount
Projected Budget SFY 2024	$72,916
Budget Amount SFY 2023	$100,000
Adjusted Budget Amount SFY 2023	$95,000
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 Actual Cost	$7,084

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 2024:
Activities to be performed in SFY 2024 will include accepting and adding the final report to the Innovation Library. This project will be completed at the beginning of SFY 2024.

SFY 2023 Accomplishments:
The project literature review was completed along with the collection of pile load test data from Missouri. The research team reviewed pile load test reports and soil boring data to develop relationships between various factors affecting pile setup, such as pile size, soil strength, soil plasticity, etc. Researchers acquisitioned pile load test data from Iowa and developed relationships between soil properties and pile setup for the northern Missouri and Iowa data sets. A presentation of these results was given to MoDOT during the interim presentation in December. One of the more noteworthy findings from the data analysis to date was the importance of proper hammer warm-up when performing restrikes. This information will be included in the Procedures and Guidelines that will be developed as part of Task 4b. Researchers worked on the development of a robust approach to incorporate pile setup in MoDOT guidelines. The data they have acquired provided enough information to develop robust statistical models of setup and allowed them to run Monte Carlo simulations to calibrate resistance factors for pile setup. The team worked on finalizing the approach to include setup in the design guidelines, and writing up the guidelines, report, and example problems. A draft final report and summary was received in May and sent back with comments. The final report is due 7/24/23.

Financials	Amount
Projected Budget SFY 2024	$39,692
Budget Amount SFY 2023	$80,000
Adjusted Budget Amount SFY 2023	$85,195
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 Actual Cost	$25,113

TR202208 – Bats and Bridges-Best Practices—Completed

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 2024:
This project was completed in SFY 2023.

SFY 2023 Accomplishments:
Researchers wrapped up Task 2 including the bibliography, document library, and a summary of findings. 108 documents were obtained and reviewed. The research team received responses to the questionnaire and followed up as appropriate. Researchers completed the Interim Report which included responding to questions in the RFP. The team completed a draft final report, after a review from the TAC the report was returned with comments. A final report was received and accepted, and a final presentation was given. The final report was posted to the Innovation Library. A final invoice was received in May. This project is complete.

Financials	Amount
Projected Budget SFY 2024	$0 ($6,705 left unspent)
Budget Amount SFY 2023	$81,465
Adjusted Budget Amount SFY 2023	$74,760
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 Actual Cost	$3,705

TR202210 – Increasing Revenue for Passenger Rail—Completed

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 2024:
This project was completed in SFY 2023.

SFY 2023 Accomplishments:
The research team conducted 10 stakeholder interviews and met with the Multimodal Operations interns regarding a spreadsheet developed for identifying potential partnerships and outreach with colleges near the River Runner line. WSP also presented to MORPAC on August 10 to discuss the study and discuss thoughts and recommendations on increasing revenues for the River Runner service. The consultant submitted a draft report and research summary for MoDOT review on December 22, 2022. WSP developed story maps with ArcGIS to help visualize key opportunities and assets along the MO River Runner route and submitted an initial version for MODOT's review. The final report for this project was submitted to MoDOT Research on February 17, 2023, and a final presentation given to the TAC on March 1, 2023. The final report was published and the final invoice has been paid; this project is closed.

Financials	Amount
Projected Budget SFY 2024	$0
Budget Amount SFY 2023	$63,871
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 Actual Cost	$35,928

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 2024:
In SFY 2024 the research team will finish the two surveys, recommend an action plan from the research, and provide proposed changes to MoDOT's policies and procedures. The research team will give a presentation of findings to MoDOT. The final report is due April 1, 2024.

SFY 2023 Accomplishments:
A Kick-Off meeting was held on September 7, 2022. The data provided by MoDOT of internal incidents did not contain enough detailed information and the research team feels they will be unable to fully generate the root cause of incidents. With the lack of needed data, the study topic was changed from analyzing safety incidents on MoDOT projects to investigating the root causes of MoDOT work zone accidents. The research team has completed task 2 "Literature Search" and task 3 "Review of Safety Incidents." The team sent a draft survey for task 4 "Survey Contractors" to MoDOT for review.

Financials	Amount
Projected Budget SFY 2024	$199,999
Budget Amount SFY 2023	$125,000
Adjusted Budget Amount SFY 2023	$50,000
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 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: $224,999
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 2024:
The University of Missouri will finalize the traffic modelling scenarios and hold a tabletop exercise in St. Louis with the relevant stakeholders. The draft report is due March 11, 2024, and the final due on May 20, 2024.

SFY 2023 Accomplishments:
The project team developed and deployed an evacuee survey in the St. Louis region with the assistance of MoDOT staff. The survey was disseminated via various social media channels and local news media. A total of 198 responses were received over an eight-week period during which the online survey site was open. MoDOT staff presented the survey results at the TEAM Conference and the Earthquake Summit event in March. Additionally, the team worked with the East-West Gateway Council of Governments to

successfully run the travel demand model for the St. Louis region. Simulation of an evacuation scenario with hypothetical road network damage was also completed. The team worked with USGS in obtaining Shake Cast data for various earthquake magnitudes in the St. Louis region.

Financials	Amount
Projected Budget SFY 2024	$108,464
Budget Amount SFY 2023	$75,000
Adjusted Budget Amount SFY 2023	$116,535
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 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 2024:
Activities to be performed in SFY 2024 include completion of all system testing and development of a draft final report. The final report and research summary is due 7/28/2023. This project will be completed at the beginning of SFY 2024.

SFY 2023 Accomplishments:
The summary report of Task 2 was submitted. The report included a literature review of back-over incidents in work/construction zones along with a review of MoDOT's backing incidents in 2012-2021. The report also included an analysis of the survey results from state DOTs on the use of devices/equipment to prevent back-over incidents and a comparative review of various devices/equipment to prevent back-over incidents. The project team completed a presentation of Task 2 findings on Thursday, 08/4/2022 via Zoom. The Researchers built an in-Vehicle Portable Detection (iVPD) software system (Task 4A) on an Android App. The team designed and developed a BLE radar framework which is a new non-GPS-based and bidirectional object collision detection technology and also embedded a BLE beacon-based collision detection algorithm to a smart device (ESP32 and Android Phone).The team prepared feasibility testing scenarios between iVPD-to-iVPD communication. The project team prepared and submitted the PowerPoint presentation file and demoed working prototypes for the interim system presentation (Task 4B) at Jefferson City, on Tuesday, December 20th. The researchers built Wearable Proximity Sensors (WPS) with the ESP32-based small form-factor prototype. They did unit testing scenarios between iVPD-to-iVPD communication regarding alert accuracy, performance, and reliability

(Task 4C). The team designed simulation testing scenarios and built additional warning conditions (buzzer and sound) and filtering algorithms. They tested the weather (heat) resistance and concussion trials and performed integration scenario tests on a simulated environment (on an empty parking lot).

Financials	Amount
Projected Budget SFY 2024	$17,635
Budget Amount SFY 2023	$115,000
Adjusted Budget Amount SFY 2023	$149,391
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 Actual Cost	$32,974

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 2024:
High Street Consulting will finish the development of the 2 pilot projects (along with the required B/C analysis) and present the results to the TAC in SFY 2024. If there are remaining funds in the budget, High Street will conduct a small-scale identification of "hotspots" where frequency of maintenance requests may indicate the need for rehabilitation or reconstruction. High Street will provide a report of the peer exchange in early SFY 2024 and submit the draft report by April 1, 2024, and final by May 31, 2024.

SFY 2023 Accomplishments:
A kickoff meeting between High Street Consulting and MoDOT took place on July 7, 2022, to review the project workplan and schedule. High Street held a workshop with MoDOT staff on December 1 to discuss AI/ML technologies, their use in public agencies, and to brainstorm ideas to be considered as pilot projects. Of the 65 unique ideas generated, 7 ideas were presented to MoDOT. Project scopes were developed and voted on by the TAC. The pilot projects selected to move forward are 1) Automating and improving estimation of AADT counts from short-term traffic counts and 2) Creation of an inventory of roadway medians and mowable areas. High Street and MoDOT also held a peer exchange in St. Louis in June to explore how other state DOTs are approaching AI/ML technologies in their work efforts.

Financials	Amount
Projected Budget SFY 2024	$64,704
Budget Amount SFY 2023	$125,000
Adjusted Budget Amount SFY 2023	$185,261

Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 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 2024:
At the time of this report the project is scheduled to be completed and paid for in SFY 2024

SFY 2023 Accomplishments:
Construction is planned to be completed in May 2023.

Financials	Amount
Projected Budget SFY 2024	$0
Budget Amount SFY 2023	$145,000
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 Actual Cost	$0

TR202219 – HFST Review of Service Life

Project Type: Contract Research
MoDOT Contact: Scott Breeding
Total Contract Amount: $199,943
Contract Period: 6/1/2023 to 12/19/2024
Contract Investigator: Jay Bledsoe
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 2024:
A kick-off meeting is planned to be held in June or July of 2023 to get the project started.

SFY 2023 Accomplishments:
MoDOT has completed an inventory spreadsheet of HFST locations along with a kmz file of locations. The RFP was posted and a selection meeting was held on May 9, 2023. The selected research team was notified in May and the contract was completed in June.

Financials	Amount
Projected Budget SFY 2025	$94,943
Projected Budget SFY 2024	$100,000
Budget Amount SFY 2023	$75,000
Adjusted Budget Amount SFY 2023	$5,000
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 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 2024:
The research team will continue to provide support for contractors and MoDOT employees for the construction season as needed. The final report is due March 15, 2024.

SFY 2023 Accomplishments:
The consultant team provided support remotely and in the field. The team has also begun the differential range statistics (DRS) versus thermal segregation index (TSI) study on 2022 data, results were shared with the team. The project team completed the following training: Hybrid training for MoDOT projects staff (02/21/2023), Black to Basics advanced training (02/22/2023-02/23/2023), and remote contractor (03/08/2023). The research team completed and submitted the 2023 draft report for the 2022 construction season, comments were received, and the report was edited. The final version has been published.

Financials	Amount
Projected Budget SFY 2024	$88,483
Budget Amount SFY 2023	$200,000
Adjusted Budget Amount SFY 2023	$239,851
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 Actual Cost	$89,739

TR202222 – Consultant Support for Intelligent Compaction and Paver-Mounted Thermal Profiling Projects in 2022-2024 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 2024:
It is anticipated some additional items will periodically be needed throughout the project to help administer the fieldwork for the IC/PMTP project.

SFY 2023 Accomplishments:
No supplies were purchased this year.

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

TR202301 – GPR Analysis of I-44 Pavement Data—Completed

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 2024:
This project was completed in SFY 2023. A new phase is anticipated to do analysis on I-70 which is TR202419.

SFY 2023 Accomplishments:
The Consultant provided the analysis report of the section of I-44. The report was accepted by the technical contact. The final (and only) invoice was paid on October 27, 2022. This project is completed.

Financials	Amount
Projected Budget SFY 2024	$0
Budget Amount SFY 2023	$7,000
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 Actual Cost	$0

TR202303 – Consultant Estimating
Project Type: Contract Research
MoDOT Contact: Jenni Hosey
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 type 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 2024:
It is anticipated this project would be scoped in early State Fiscal Year 2024, an RFP released late summer, and an anticipated start date in the late fall.

SFY 2023 Accomplishments:
MoDOT Research worked with the Design Division on the details relating to this project. After further discussion, it was determined that more divisions needed to be involved, particularly in regard to data needs and program maintenance.

Financials	Amount
Projected Budget SFY 2025	$75,000
Projected Budget SFY 2024	$25,000
Budget Amount SFY 2023	$25,000
Adjusted Budget Amount SFY 2023	$0
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 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 2024:
This project will be directly contracted with MCTI and MU researchers since it is a follow-up project to the current waste plastic project. It was anticipated to start in SFY 2023 but has been pushed back to SFY 2024. Early in the fiscal year we will determine when the project will start based off on-going research on the topic.

SFY 2023 Accomplishments:
It was anticipated this project would start in SFY 2023 but delays in current research projects by the team has delayed scoping.

Financials	Amount
Projected Budget SFY 2027	$125,000
Projected Budget SFY 2026	$175,000
Projected Budget SFY 2025	$175,000
Projected Budget SFY 2024	$25,000
Budget Amount SFY 2023	$75,000
Adjusted Budget Amount SFY 2023	$0
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 Actual Cost	$0

TR202306 – TSR Replacement and Stripping Tests (renamed from last work program)

Project Type: Contract Research
MoDOT Contact: Jenni Hosey
Total Contract Amount: $250,000
Contract Period: 6/15/2023 to 1/1/2025
Contract Investigator: Bill Buttlar

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 2024:
Work for this project will take place during SFY 2024 and the first half of SFY 2025.

SFY 2023 Accomplishments:
This proposal was posted to the MoDOT Research site on February 1, 2023, with proposals due March 22, 2023. Bill Buttlar with the University of Missouri was the selected contractor. A kickoff meeting was held on May 23, 2023, to discuss the project workplan and schedule.

Financials	Amount
Projected Budget SFY 2025	$150,000
Projected Budget SFY 2024	$100,000
Budget Amount SFY 2023	$25,000
Adjusted Budget Amount SFY 2023	$0
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 Actual Cost	$0

TR202309 – Audible Alert and TMA Lighting

Project Type: Contract Research
MoDOT Contact: Scott Breeding
Total Contract Amount: $396,533
Contract Period: 12/1/2022 to 1/31/2025
Contract Investigator: Yaw Adu-Gymfi
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 2024:
Next fiscal year the research team will work on system development and design. The team will also perform field data collection and documentation along with field trials.

SFY 2023 Accomplishments:
The work plan was received September 16, 2022, and a kick-off meeting was held on February 2, 2023. The Research Team made significant progress on the Automated Truck Mounted Attenuators Warning System project during this fiscal year. The system conception design was improved to include a web-based interface for dynamic setting of trigger distances and lanes. Additionally, Lidar technology has been integrated into the warning system to enhance accuracy in distance measurements and speed detection. As a result, the project is well-positioned for continued advancement and success in the coming fiscal year.

Financials	Amount
Projected Budget SFY 2025	$200,000
Projected Budget SFY 2024	$125,405
Budget Amount SFY 2023	$25,000
Adjusted Budget Amount SFY 2023	$71,128
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 Actual Cost	$0

TR202311 – Asset Characterization Using Automated Methods

Project Type: Contract Research
MoDOT Contact: Brent Schulte
Total Contract Amount: $200,000
Contract Period: 6/1/2023 to 8/31/2024
Contract Investigator: Sungyop Kim and Donald Baker
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 meet the need.

Proposed Activities for SFY 2024:
Researchers will begin this project by performing a literature review on asset cataloging and characterization along with databases. The team will test and evaluate non-proprietary 3D LiDAR scanning programs. They will work on developing a machine learning (ML) model for asset cataloging along with identifying 15 assets for cataloging. Researchers will catalog and characterize 15 assets after developing an asset database. The team will develop a training and operation manual along with a draft final report and research summary.

SFY 2023 Accomplishments:
This RFP was posted, and proposals evaluated. The project was awarded and started in June.

Financials	Amount
Projected Budget SFY 2025	$75,000
Projected Budget SFY 2024	$115,000

Budget Amount SFY 2023	$25,000
Adjusted Budget Amount SFY 2023	$10,000
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 Actual Cost	$0

TR202312 – Methods for Monitoring the Movement of Wildlife Through Concrete Barrier Gaps

Project Type: Contract Research
MoDOT Contact: Jenni Hosey
Total Contract Amount: $245,500
Contract Period: 11/1/2022 to 12/1/2024
Contract Investigator: Brock Ortega
Funding: SPR 80%, State 20%

Project Description and Objectives:
Installation of concrete median barriers in divided highway settings has reduced the number of traffic fatalities in Missouri. However, their implementation has potentially caused an unintended negative effect on wildlife movement across the transportation system. Although little research exists on the effects of concrete median barriers, it is generally accepted that solid jersey barriers stop small animal passage on divided highways, effectively fragmenting habitat and eliminating connectivity. This fragmentation and behavioral adaptation can lead to reduced biological diversity, changes in animal communities and increase threat of extinctions. To combat these negative effects, the MoDOT Environmental Section has implemented the wildlife median barrier (WMB) innovation. The purpose of this research project is to develop ways to monitor the movement of small animals through the WMBs. This determination will show if the WMBs are or are not working. If successful, this practice can be implemented on other projects.

Proposed Activities for SFY 2024:
The project team will continue with monthly project status meetings, going to the site and collecting data, and doing most of the work during SFY 2024. The draft report is due on August 1, 2024, and the final report due October 1, 2024.

SFY 2023 Accomplishments:
The project team held a kick-off meeting with the TAC on November 2, 2022, and follow-up monthly meetings for the remainder of SFY 2023. Survey methodologies and a list of focal species was finalized. Due to internal MoDOT access and safety discussions and weather, the project team was finally able to visit the project site and install small animal tracking devices in May 2023. The subconsultant will be visiting the sites monthly to collect data. Due to the changes in MoDOT's typical applications for traffic control money was added to the project so that the contractor could provide the additional traffic control now required.

Financials	Amount
Projected Budget SFY 2025	$96,622
Projected Budget SFY 2024	$90,000
Budget Amount SFY 2023	$0
Adjusted Budget Amount SFY 2023	$58,878
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 Actual Cost	$0

TR202313 – Truck Parking Investments for Missouri

Project Type: Contract Research
MoDOT Contact: Jenni Hosey
Total Contract Amount: $199,486
Contract Period: 11/1/2022 to 8/1/2023
Contract Investigator: Katie Kirk
Funding: SPR 80%, State 20%

Project Description and Objectives:
In November 2021, Gov. Mike Parson created the Missouri Supply Chain Task Force (Task Force). This group held meetings across the state to identify supply chain problems facing Missouri businesses and citizens and develop potential solutions to address these challenges. Of the 32 recommendations in the Task Force's final report, two focus specifically on truck parking. The first, (#29), recommends the State and MoDOT develop a communication method that can safely and effectively relay critical information inside the truck without posing any safety risk to the driver. The second, (#30), recommends MoDOT and private operators of truck parking sites invest in increasing availability in areas that are known to have high demand and insufficient capacity, on both interstate and non-interstate roads. Using the information gathered by the SFRP and Task Force, this project seeks recommendations of where to expand truck parking in Missouri. Sites should be prioritized based on a cost-benefit analysis to ensure the greatest return on state investment.

Proposed Activities for SFY 2024:
The final report for this project is due July 1, 2023, with the final invoice due August 1, 2023.

SFY 2023 Accomplishments:
The project kickoff meeting was held November 18, 2022, with a data request submitted shortly thereafter. The Cambridge Systematics and WSP research team completed initial data analysis including the US-36 gap/prioritization estimate, assessment of CMV-involved crash data, and the initial demand prioritization map. MoDOT and the research team selected 17 sites. The researchers created draft layouts where to expand truck parking at those sites and submitted a draft report for MoDOT review in May.

Financials	Amount
Projected Budget SFY 2024	$36,114
Budget Amount SFY 2023	$0
Adjusted Budget Amount SFY 2023	$163,372
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 Actual Cost	$0

TR202316 – TMA Truck Safety

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

Project Description and Objectives:

MoDOT has had many TMA hits and the seat/seatbelt/cab area have had differing types of damage. This project would look to see if certain types of trucks, seats, and/or restraint combinations tend to keep the driver safer than others. This would most likely consist of computer modeling for at least the first phase since crash testing multiple configurations would be too costly. Efforts would be made to get information from manufacturers but likely that information would not be shared.

Proposed Activities for SFY 2024:
MoDOT will review and select a research team in the first quarter. A kick-off meeting will be held to get the project started.

SFY 2023 Accomplishments:
The RFP was posted on April 26, 2023, with proposals due on June 21, 2023.

Financials	Amount
Projected Budget SFY 2025	$175,000
Projected Budget SFY 2024	$75,000
Budget Amount SFY 2023	$0
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 Actual Cost	$0

TR202319 – Impact Test of GFRP Reinforced Bridge Barriers

Project Type: Contract Research
MoDOT Contact: Brent Schulte
Total Contract Amount: $160,000
Contract Period: 1/1/2023 to 1/31/2024
Contract Investigator: Chenglin Wu and John Myers
Funding: SPR 80%, State 20%

Project Description and Objectives:
This research will focus on the dynamic testing and analysis of GFRP reinforced concrete barrier walls. The pendulum impact test has been selected as the main approach due to its high cost-effectiveness. Researchers will construct segments of full-scale GFRP concrete barriers and test them under pendulum crush loading to evaluate the design. The impact energy coming from the kinetic motion and mass of the pendulum provides an efficient way of mimicking the vehicle impact loading exerted onto the concrete bridge barriers. From the test, the failure modes and details will be carefully examined and compared with the numerical modeling results building on Phase I activities to validate and improve the existing design. The expected outcome of this project will be a correlation between the GFRP reinforcement and impact resistance from the pendulum tests.

Proposed Activities for SFY 2024:
In SFY 2024 the team will pour barrier walls with the use of the new GFRP bars from Owens Corning. Pendulum impact testing will take place which will be followed by the analysis of test results. A draft final report and research summary is due 10/31/23 with the final report and summary due 12/31/23.

SFY 2023 Accomplishments:
A kick-off meeting was held 1/1/23 with MoDOT and Owens Corning, the manufacturer of the GFRP bars. The discussion yielded a preliminary design of the GFRP bars for the company to try to produce. The team has conducted the literature review and determined the preliminary design for the test setup. The team has hired two master's student and 1 post-doc partially to accelerate the project's progress.

Researchers are working on getting the GFRP bars produced and either building or purchasing forms to pour a barrier wall for testing.

Financials	Amount
Projected Budget SFY 2024	$100,000
Budget Amount SFY 2023	$0
Adjusted Budget Amount SFY 2023	$60,000
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 Actual Cost	$0

TR202320 – Safety Evaluation of J-turn Intersections in Missouri

Project Type: Contract Research
MoDOT Contact: Jenni Hosey
Total Contract Amount: $299,722
Contract Period: 1/1/2023 to 7/31/2024
Contract Investigator: Praveen Edara
Funding: SPR 80%, State 20%

Project Description and Objectives:
The project objective is to investigate the safety effectiveness of J-turn intersections in Missouri. The research methodology to meet this objective includes study design, data collection and analysis, and a review of existing literature. Attainment of the project objective will lead to greater understanding of the safety benefits of J-turns and the effect of site characteristics (e.g., geometrics, traffic volume) on crash frequency and severity.

Proposed Activities for SFY 2024:
Work will continue on this project through SFY 2024. The draft report is due April 30, 2024, and the final on June 30, 2024.

SFY 2023 Accomplishments:
The kick-off meeting was held with MoDOT staff on January 19, 2023. Crash data and design (or as-built) plans for the 47 sites (with J-turns) were provided to the MU research team. MU also completed the literature review, determined which statistical methods would be used in the data analysis, and requested crash reports for selected comparison sites with no treatment.

Financials	Amount
Projected Budget SFY 2025	$56,504
Projected Budget SFY 2024	$180,000
Budget Amount SFY 2023	$0
Adjusted Budget Amount SFY 2023	$63,218
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 Actual Cost	$0

TR202322 – Vulnerable Road User (VRU) Safety Assessment

Project Type: Contract Research
MoDOT Contact: Jenni Hosey
Total Contract Amount: $197,547
Contract Period: 1/1/2023 to 10/31/2023

Contract Investigator: MCTI-Missouri S&T
Funding: SPR 80%, State 20%

Project Description and Objectives:
The overall objective is to bring down VRU deaths and injuries as consistent with a vision towards zero fatalities by 2030. A data-driven approach helps to focus on the most vulnerable users and to target the most effective countermeasures. A related objective is to produce an initial Vulnerable Road User Safety Assessment for Missouri as described in 23 U.S.C. §148(1) as part of Missouri's Strategic Highway Safety Plan, currently named the Show-Me Zero Plan.

Proposed Activities for SFY 2024:
The draft report is due August 30, 2023, and the final due September 30, 2023. This project should be completed in SFY 2024.

SFY 2023 Accomplishments:
The project kickoff meeting was held on 1/19/23 and the project TAC was formed. A draft literature review was completed and is being integrated into the running report. This review consisted of relevant federal and state reports, and academic publications on VRU-safety research. Crash and related data was requested and received from MoDOT TMS. The team requested hospital data involving VRU admissions and diagnosis. Work continues on data analysis.

Financials	Amount
Projected Budget SFY 2024	$157,547
Budget Amount SFY 2023	$0
Adjusted Budget Amount SFY 2023	$40,000
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 Actual Cost	$0

TR202323 – LWD Phase II

Project Type: Contract Research
MoDOT Contact: Brent Schulte
Total Contract Amount: $75,342
Contract Period: 2/1/2023 to 3/15/2024
Contract Investigator: Xiong Zhang
Funding: SPR 80%, State 20%

Project Description and Objectives:
The principal objective of this Phase II project is to accumulate more field test data to improve the standards for the implementation of the Zorn LWD for the acceptance of unbound material layers.

Proposed Activities for SFY 2024:
Work will continue in SFY 2024, researchers and TAC members will continue to search for possible test sites. Testing will take place on some recommended sites along with any new construction sites the TAC may find followed by an analysis of all test results and findings. A draft final report and research summary is due 12/15/23 with the final being due 2/15/23. Due to the original sites being unavailable to test and searching for new sites, there may be a delay in the project.

SFY 2023 Accomplishments:
A kick-off meeting, involving the research team and TAC members, was held on March 10, 2023, to discuss the work plan and details of research tasks, the resources, and the schedule. There were changes to the project sites based upon the discussion with the TAC members. Some of the original project sites were not available for testing. The research team worked with the TAC to select new project sites. To make the moisture analyzer Ohaus MB120 work in the field, a vibration-free table to isolate vibration disturbance is needed. The research team is searching for vibration-free tables online. With project sites being unavailable or delayed and selections of new sites, there may be a delay of the overall project schedule.

Financials	Amount
Projected Budget SFY 2024	$70,342
Budget Amount SFY 2023	$0
Adjusted Budget Amount SFY 2023	$5,000
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 Actual Cost	$0

TR202325 – MCTI Administration

Project Type: Contract Research
MoDOT Contact: Jen Harper
Total Contract Amount: $255,000
Contract Period: 11/18/2022 to 11/30/2025
Contract Investigator: John Myers
Funding: SPR 80%, State 20%

Project Description and Objectives:
MCTI is a partnership between MoDOT and the 4 University Campuses: Columbia, Kansas City, 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 2024:
It is expected the TACs will meet again in August or September of 2023. The work to move some of the administration efforts to Rolla will be on-going. Coordination with the technical editor will continue as well.

SFY 2023 Accomplishments:
The Commission presentation took place on February 8th. As part of the Commission meeting a lab tour and lunch with MoDOT and MCTI staff took place on February 7th. Work continues on long range planning.

Financials	Amount
Projected Budget SFY 2025	$85,000
Projected Budget SFY 2024	$85,000
Budget Amount SFY 2023	$85,000
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 Actual Cost	$0

TR202401 – Library Support Contract (2024-2025)

Project Type: Contract Research
MoDOT Contact: Jen Harper
Total Contract Amount: $231,641
Contract Period: 7/1/2023 to 6/30/2025
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 2024:
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 2023 Accomplishments:
This project starts in SFY 2024.

Financials	Amount
Projected Budget SFY 2025	$116,641
Projected Budget SFY 2024	$115,000
Budget Amount SFY 2023	$0
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 Actual Cost	$0

TR202402 – Striping Program

Project Type: Contract Research
MoDOT Contact: Scott Breeding
Total Contract Amount: $125,000 estimated
Contract Period: 12 months estimated
Contract Investigator: TBD
Funding: SPR 80%, State 20%

Project Description and Objectives:
There is a potential the 11th edition of the MUTCD, when released, will require all edgeline markings to be a minimum of 6" which will be an increase from the current 4" minimum. This will significantly impact MoDOT given our pavement marking program far exceeds MUTCD requirements. With current staffing and equipment levels and a reduction of over 12,000 miles of striping production per year (due to increased refilling of paint, etc.), MoDOT would need to discontinue applying centerline markings on its 12,500 miles of low volume roadways in order to increase the width of the edgelines on the 15,500 miles of two-lane roadways which now get edgelines. Overall, we need information to help us determine what direction to take in response to the likely federal rule change that would result in no safety impact or a safety improvement.

Proposed Activities for SFY 2024:
MoDOT will notify submitters of the selected researcher and a kick-off meeting will be held to start the project in early SFY 2024.

SFY 2023 Accomplishments:
The RFP was posted on April 26, 2023, and proposals are due on June 14, 2023.

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

TR202403 – Shear Wave Velocity and Seismic Analysis Procedures

Project Type: Contract Research
MoDOT Contact: Jenni Hosey
Total Contract Amount: $200,000 estimated
Contract Period: 24 months estimated
Contract Investigator: TBD
Funding: SPR 80%, State 20%

Project Description and Objectives:
The American Association of State Highway and Transportation Officials (AASHTO) Load and Resistance Factor Design (LRFD) Bridge Design Specifications and AASHTO Guide Specifications for LRFD Seismic Bridge Design are being revised to include the direct use of the site class based on the time-average shear wave velocity (VS) in the upper 100 feet of a geologic profile, rather than average Standard Penetration Test (SPT) blow counts or other methods. Due to the greater emphasis on VS measurements in AASHTO procedures, MoDOT would like to explore methods to determine VS profiles at a project site that could be done in the preliminary stages without having to deploy a drill rig, Cone Penetration Test (CPT) rig, or crew to obtain the data. The goal of the proposed project is to update and refine seismic site investigation and analysis procedures in anticipation of upcoming changes to AASHTO specifications.

Proposed Activities for SFY 2024:
A kickoff meeting with the selected consultant will be held in early SFY 2024 with work starting shortly thereafter.

SFY 2023 Accomplishments:
This project was posted to the MoDOT Research website on March 29, 2023, with proposals due May 17, 2023. The TAC reviewed proposals on May 31, 2023, and notified the submitters of their selection status.

Financials	Amount
Projected Budget SFY 2026	$50,000
Projected Budget SFY 2025	$100,000
Projected Budget SFY 2024	$50,000
Budget Amount SFY 2023	$0
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 Actual Cost	$0

TR202405 – Testing and Use of D-Cracking Susceptible Concrete Aggregates

Project Type: Contract Research
MoDOT Contact: Brent Schulte
Total Contract Amount: $250,000 estimated
Contract Period: 24 months estimated
Contract Investigator: TBD
Funding: SPR 80%, State 20%

Project Description and Objectives:
A variety of new concrete sealant products are becoming commercially available which would aid in limiting the access of moisture to aggregates used in concrete that are prone to D-Cracking. This project will look at new approaches to the testing, management, and use of D-cracking susceptible concrete aggregates. A guide on the management of D-cracking susceptible aggregates will be produced along with testing protocols to identify and manage D-cracking susceptible aggregates. The outcome of this project may lead to a broader use of local aggregates as well as extend the service life of existing concrete pavement sections subject to D-cracking.

Proposed Activities for SFY 2024:
This project will be scoped, and an RFP created in early SFY 2024.

SFY 2023 Accomplishments:
This project is planned to start in SFY 2024.

Financials	Amount
Projected Budget SFY 2026	$55,000
Projected Budget SFY 2025	$100,000
Projected Budget SFY 2024	$130,000
Budget Amount SFY 2023	$20,000
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 Actual Cost	$0

TR202406 – Using Rubber Powder to Improve Freeze and Thaw Resistance of Concrete

Project Type: Contract Research
MoDOT Contact: Scott Breeding
Total Contract Amount: $180,000 estimated
Contract Period: 24 months estimated
Contract Investigator: TBD
Funding: SPR 80%, State 20%

Project Description and Objectives:
Preliminarily testing in MoDOT's Construction Material Laboratory showed that concrete incorporating rubber additive passed 300 cycles of the ASTM C666 with no weight losses. The main advantage of the rubber is that the rubber particles act as mechanical springs inside the concrete that can expand and compress to accommodate the water expansion and shrinkage. This research project will determine the optimum rubber powder particle size and powder percentage required for concrete mixtures to improve freeze-thaw resistance.

Proposed Activities for SFY 2024:
The project will be scoped in the first quarter of SFY 2024 with the hope the RFP will be posted in the second quarter.

SFY 2023 Accomplishments:
This project is planned to start in SFY 2024.

Financials	Amount
Projected Budget SFY 2026	$55,000
Projected Budget SFY 2025	$100,000
Projected Budget SFY 2024	$25,000
Budget Amount SFY 2023	$0
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 Actual Cost	$0

TR202407– Missouri NBI Database Analysis-Phase II

Project Type: Contract Research
MoDOT Contact: Scott Breeding
Total Contract Amount: $300,000 estimated
Contract Period: 24 months estimated
Contract Investigator: TBD
Funding: SPR 80%, State 20%

Project Description and Objectives:
This is Phase 2 of Missouri's NBI database analysis. The research is expected to identify gaps in data collection and result in a recommended combined data tracking system to include not only bridge condition ratings from bridge inspections, but also other key variables that are not well tracked or accurately tracked such as maintenance treatments, winter weather treatments, and intervention techniques. The research is anticipated to identify the impact of parameters studied for bridge type and geometry selection during preliminary design as well as identifying preservation strategies and optimal intervention timeframe. Economic cost benefit of system selection and life-cycle costs will also be

investigated. It will also develop a methodology for district staff to utilize the information generated from Phase 1.

Proposed Activities for SFY 2024:
This project will be scoped in early SFY 2024 and an RFP developed and posted.

SFY 2023 Accomplishments:
This project is planned to start in SFY 2024.

Financials	Amount
Projected Budget SFY 2026	$125,000
Projected Budget SFY 2025	$150,000
Projected Budget SFY 2024	$25,000
Budget Amount SFY 2023	$0
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 Actual Cost	$0

TR202408 – MASH Simulation for Different Devices

Project Type: Contract Research
MoDOT Contact: Scott Breeding
Total Contract Amount: $300,000
Contract Period: 24 months
Contract Investigator: TBD
Funding: SPR 80%, State 20%

Project Description and Objectives:
MoDOT's Innovation Challenge introduces new tools and equipment to be used statewide. If these innovations are used on our roadside, they need to be crash tested. Pooled fund crash testing facilities have a backlog of testing, resulting in the more urgent need for this research study to simulate crash testing. Two innovations from the Challenge that need to be MASH crash tested to be implemented are the Flagger Carts and the Mailbox Posts. In addition, requests to install License Plate Readers (LPRs) along our roadside have increased. No LPR device is currently MASH crash tested due to the fact there are so many varying design options. This research would perform a MASH simulation for MoDOT to evaluate and determine approval of installation along our roadside.

Proposed Activities for SFY 2024:
The project will be scoped in the first quarter of SFY 2024 with the hope the RFP will be posted in the second quarter.

SFY 2023 Accomplishments:
This project is planned to start in SFY 2024.

Financials	Amount
Projected Budget SFY 2026	$125,000
Projected Budget SFY 2025	$150,000
Projected Budget SFY 2024	$25,000
Budget Amount SFY 2023	$0
Actual Cost SFY 2023	(See Addendum)

Prior to SFY 2023 Actual Cost	$0

TR202409 – Letting Optimization

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

Project Description and Objectives:
Machine learning could be used to analyze historical trends of certain types of projects that were bid and then awarded to make a recommendation of when and how many projects should be bid at any certain time.

Proposed Activities for SFY 2024:
MoDOT Research will work with the Design division and put an RFP out in early SFY 2024. The project should be awarded in the fall/winter and work starting shortly afterwards.

SFY 2023 Accomplishments:
This project is planned to start in SFY 2024.

Financials	Amount
Projected Budget SFY 2025	$110,000
Projected Budget SFY 2024	$40,000
Budget Amount SFY 2023	$0
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 Actual Cost	$0

TR202410 – Effective Methods to Safely Communicate with CMVs

Project Type: Contract Research
MoDOT Contact: Jenni Hosey
Total Contract Amount: $200,000 estimated
Contract Period: 7/1/2023 to 1/2/2024
Contract Investigator: Praveen Edara
Funding: SPR 80%, State 20%

Project Description and Objectives:
Recommendation 29 in the Missouri Supply Chain Task Force's final report focuses on the development of a communication method to relay critical information safely and effectively inside commercial motor vehicles (CMV) without posing a safety risk to the driver and the traveling public. MoDOT has a need to communicate with drivers of CMVs about exceptions to the norm on their route. These exceptions can include stationary features, such as a low bridge clearance or steep grade, and variable road conditions such as a work zone, narrowed lanes, a crash ahead, or a weather impact. Many methods for notification involve sending notices through a phone application. However, federal law prohibits CMV drivers from touching a mobile phone or reading messages while in operation. Current applications do not distinguish between general text messages and critical route information. This research would identify effective ways (or a system) for timely notifications to drivers allowing them to make informed decisions on whether to

continue on the route, detour, or park at a safe location. This should also result in a more reliable highway freight delivery system.

Proposed Activities for SFY 2024:
A kickoff meeting with the consultant will be held in early SFY 2024 and work proceeding throughout the year.

SFY 2023 Accomplishments:
This project was posted to the MoDOT Research website on March 1, 2023, with proposals due April 19, 2023. The TAC met on May 11 to discuss proposals and select a consultant.

Financials	Amount
Projected Budget SFY 2025	$100,000
Projected Budget SFY 2024	$100,000
Budget Amount SFY 2023	$0
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 Actual Cost	$0

TR202412 – First and Last Mile Connectivity for People

Project Type: Contract Research
MoDOT Contact: Jenni Hosey
Total Contract Amount: $150,000 estimated
Contract Period: 15 months estimated
Contract Investigator: TBD
Funding: SPR 80%, State 20%

Project Description and Objectives:
In November 2021, Gov. Mike Parson created the Missouri Supply Chain Task Force. This group held meetings across the state to identify supply chain problems facing Missouri businesses and citizens and develop potential solutions to address these challenges. Recommendation 19 in the Task Force's **final report** focuses on the development of dedicated microtransit programs for employment centers. The goal of this research project is to: 1) understand how other state departments of transportation and metropolitan planning organizations (MPOs) support first and last mile mobility connections for their workforces; and 2) how MoDOT could utilize those best practices and tie them into the Supply Chain Task Force recommendation.

Proposed Activities for SFY 2024:
A kickoff meeting with the consultant will be held in late summer. Work will proceed through the year.

SFY 2023 Accomplishments:
The RFP was posted on April 26, 2023, with proposals due on June 14, 2023. The TAC met on June 20, 2023, to decide on a consultant. MoDOT will notify submitters about project selection shortly afterwards.

Financials	Amount
Projected Budget SFY 2025	$100,000
Projected Budget SFY 2024	$50,000
Budget Amount SFY 2023	$0
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 Actual Cost	$0

TR202413 – Silane Bridge Deck Ratings

Project Type: Contract Research
MoDOT Contact: Scott Breeding
Total Contract Amount: $200,000
Contract Period: 24 months estimated
Contract Investigator: TBD
Funding: SPR 80%, State 20%

Project Description and Objectives:
MoDOT has been very methodical and consistent with bridge deck ratings, it would be great to look at progression of silane bridge deck ratings since MoDOT moved to silane sealers 10-15 years ago. The research would determine if deterioration has slowed. MoDOT now uses 100% silane and have been told that decks with 100% silane only need to be sealed once and never again. This project will look at that claim to determine if it is accurate that we would never seal again, or if not if the frequency of reapplication can be reduced.

Proposed Activities for SFY 2024:
MoDOT Research will work with the technical staff and put an RFP out in early SFY 2024. The project should be awarded in the fall/winter with work starting shortly afterwards.

SFY 2023 Accomplishments:
This project is planned to start in SFY 2024.

Financials	Amount
Projected Budget SFY 2026	$75,000
Projected Budget SFY 2025	$100,000
Projected Budget SFY 2024	$25,000
Budget Amount SFY 2023	$0
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 Actual Cost	$0

TR202414 – Electric Vehicles and Impact on Motor Vehicles World

Project Type: Contract Research
MoDOT Contact: Scott Breeding
Total Contract Amount: $175,000 estimated
Contract Period: 18 months estimated
Contract Investigator: TBD
Funding: SPR 80%, State 20%

Project Description and Objectives:
A lot of the electric vehicle momentum is focused on long-haul trucking. In Missouri, commercial motor vehicle (CMV) carriers are charged fees based upon the number of gallons consumed, not the number of miles traveled. Missouri does not have a taxing mechanism in place for those using electric or hydrogen power technologies. If CMVs switch to these technologies, the Missouri road fund could lose up to $20 million per year. To mitigate the potential loss, Missouri needs to change the taxing mechanism on CMVs. One option, since it is already tracked by the International Fuel Tax Agreement, would be a fee on the vehicle miles travelled in a year. This research project will examine other DOT CMV taxing

structures, recommend to MoDOT which one(s) could work in Missouri, and demonstrate how those funds could be captured.

Proposed Activities for SFY 2024:
MoDOT Research will work with the technical staff and put an RFP out in early SFY 2024. The project should be awarded in the fall/winter and work starting shortly afterwards.

SFY 2023 Accomplishments:
This project is planned to start in SFY 2024.

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

TR202415 – TSMO and Automation in Work Zones

Project Type: Contract Research
MoDOT Contact: Jenni Hosey
Total Contract Amount: $250,000 estimated
Contract Period: 24 months estimated
Contract Investigator: TBD
Funding: SPR 80%, State 20%

Project Description and Objectives:
In a time when there is a workforce shortage in highway construction and an increase in distracted driving, speeding, and work zone crashes, there is a need to identify strategies that can benefit both areas. This research project is requested to identify implementable Transportation Systems Management and Operations (TSMO) strategies that benefit both areas of workforce shortage and safety to be incorporated into Missouri work zones on and off system. The goal of this research is to identify TSMO strategies available, examples of their use, demonstration in Missouri work zones, determination of their effectiveness, and a final list of recommended strategies with construction ready language to be incorporated into future projects.

Proposed Activities for SFY 2024:
A kickoff meeting with the consultant will held in late summer. Work will proceed through the year.

SFY 2023 Accomplishments:
This project RFP was posted to the MoDOT Research website on March 29, 2023, with proposals due May 17, 2023. MoDOT will notify submitters about project selection by June 16, 2023.

Financials	Amount
Projected Budget SFY 2026	$100,000
Projected Budget SFY 2025	$100,000
Projected Budget SFY 2024	$50,000
Budget Amount SFY 2023	$0
Actual Cost SFY 2023	(See Addendum)

Prior to SFY 2023 Actual Cost	$0

TR202416 – Fluorescent Yellow-Green Signs

Project Type: Contract Research
MoDOT Contact: Jenni Hosey
Total Contract Amount: $150,000 estimated
Contract Period: 15 months estimated
Contract Investigator: TBD
Funding: SPR 80%, State 20%

Project Description and Objectives:
In the MUTCD, fluorescent yellow-green (FYG) is the required color used for school signs and can be used as an option for bicycle and pedestrian (B/P) crossing signs. Due to the uniqueness of appearance, MoDOT reserved the FYG primarily for school signs. The only time MoDOT uses FYG for B/P crossing signs is if a state route and a city route crossed and the city used FYG at that location. MoDOT has been encouraged to change current pedestrian crossing signs from Fluorescent Yellow (FY) to FYG. This is based in the perception that FYG is safer than FY. However, MoDOT has a large inventory of FY signs on the state system with each sign lasting at least 15 years and would not consider switching to FYG signs in part (or whole) unless there is fact-based evidence that the color change would provide a significant safety benefit due to fiscal and logistical impacts. MoDOT is interested in discovering other state DOT policies and research regarding the use of FYG in pedestrian crossing signs. The department wants to know if current research indicates any significant safety impact to bicyclists and pedestrians if FYG signs are used instead of FY.

Proposed Activities for SFY 2024:
A consultant will be selected in early SFY 2024 and a kickoff meeting held in late summer. Work will proceed through the year.

SFY 2023 Accomplishments:
The RFP was posted to the Research website on April 26, 2023, with proposals due June 14, 2023.

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

TR202417 – Comprehensive Data Analysis for AMPT Tests on MO 740 and HWY

Project Type: Contract Research
MoDOT Contact: Jen Harper
Total Contract Amount: $19,291
Contract Period: 4/20/2023 to 11/30/2023
Contract Investigator: MCTI-Missouri S&T
Funding: SPR 80%, State 20%

Project Description and Objectives:
The S&T research team will process the AMPT testing data collected in the MO 740 and the HWY 54

projects. The data include the dynamic modulus test, the cyclic fatigue test, and the stress sweep rutting (SSR) test. The testing data on the MO 740 project were generated by the S&T team, and the tests for the HWY 54 project were performed by MoDOT. (Previously was approved by FHWA to utilize grant funding S073201C but it was closed out by MoDOT Financial Services.

Proposed Activities for SFY 2024:
The research team will perform analysis on the AMPT testing it completed in a previous project.

SFY 2023 Accomplishments:
This project was just getting started in SFY 2023.

Financials	Amount
Projected Budget SFY 2024	$13,000
Budget Amount SFY 2023	$0
Adjusted Budget Amount SFY 2023	$6,291
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 Actual Cost	$0

TR202419 – GPR Analysis of I-70

Project Type: Contract Research
MoDOT Contact: Scott Breeding
Total Contract Amount: $250,000 estimated
Contract Period: 10 months estimated
Contract Investigator: Infrasense
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 and the data was analyzed by Infrasense in project TR202301. MoDOT wishes to do further testing on the I-70 corridor that will be collected as part of the pooled fund project in the spring of 2023. 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. Having baseline data for the I-70 corridor is important for understanding the condition of the pavement and could be beneficial for any reconstruction activities in the future. 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 2024:
The GPR data collected during the spring of 2023 will be analyzed in early SFY 2024. A report will be provided to MoDOT. It is anticipated this would be provided during the second quarter.

SFY 2023 Accomplishments:
This project will get started in SFY 2024. The data collection that is part of Pooled Fund TPF-5(385) should be concluded at the end of SFY 2023.

Financials	Amount
Projected Budget SFY 2024	$250,000
Budget Amount SFY 2023	$0

Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 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/$850,000
Contract Period: 11/1/2018 to 4/1/2024
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 2024:
New FHWA requirements have slowed progress on the project. Initially the project was to be completed in SFY 2023. A revised schedule was approved by the committee so the new draft report date is September 30, 2023, and the final report is due November 30, 2023. A final meeting will be held with the TAC in early CY 2024 to address any implementation questions the states have.

SFY 2023 Accomplishments:
Risk models were updated to reflect recent changes in the SNBI to include additional element ratings where appropriate. The re-analysis of NBI data was completed during the first quarter of SFY 2023, and these data were used to estimate probability of failure to support the qualitative risk models. A more quantitative consequence analysis based on analysis of key NBI data fields was developed. Analysis of the NBI data for consequence factor attributes (ADT, feature under, detour length, etc.) The revised TICR data from the LTBP data update were documented for each participating state. A research update meeting with the states was conducted on January 23, 2023. The risk model spreadsheets have been updated for each state. The attributes for each state were finalized for distribution, which took longer than expected. An analysis of the intersection of the risk models (i.e., attributes for occurrence and consequence factor) with FHWA requirements was developed but has taken longer than expected to document. Additional analysis and updating was necessary to ensure the participating states could receive these attributes with a comprehensive view of how these interacted with the new FHWA requirements for RBI.

Financials	Amount
Projected Budget SFY 2024	$0
Budget Amount SFY 2023	$0
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 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 2024:
The last year of the project will focus on drafting the protocols, guidelines, and criteria. The draft report is due May 31, 2024, and the final report July 31, 2024.

SFY 2023 Accomplishments:
A ceiling drone was tested in a few application scenarios. It is equipped with RGB and thermal cameras featuring perch capability at the ceiling of a bridge deck for stable deck inspection and any follow-up inspection. In late fall, pilot training for six types of drones was completed. Case studies were conducted for representative bridges in the states of Missouri, Wisconsin, Virginia, Georgia, and Texas. The Geodetic drone with high-resolution images started operation in early 2023. The researchers collected images used to create 3D reconstruction of bridges for asset management. Work began on the draft beta version of protocols, guidelines, and performance criteria.

Financials	Amount
Projected Budget SFY 2025	$0
Projected Budget SFY 2024	$0

Budget Amount SFY 2023	$0
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 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: $185,000/$805,000
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 2024:
Testing and analysis will be completed during the beginning of SFY 2024. The draft report is due September 30, 2023, and the final on December 1, 2023.

SFY 2023 Accomplishments:
All parts of the test setup were completed and the test setup and data acquisition system finalized. Finite element models were developed for damaged girders and for the full bridge. These models were used to determine the residual capacity of the girders after being damaged. A cost increase was approved to cover the cost of the girders. Originally the girders were going to be donated but due to supply shortages that is no longer the case. Coreslab was added as a subcontractor to the project. Four of the girders were cast during the third quarter with strain gauges attached to the stirrups and the prestressing strands. Initial testing was done in the lab to confirm the gauges and data acquisition system were working. Fine tuning of the test setup was completed and the research team also began analyzing the first set of experimental data.

Financials	Amount
Projected Budget SFY 2024	$0
Projected Budget SFY 2024	$0
Budget Amount SFY 2023	$0
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 Actual Cost	$185,000

TR202317 / S079801S / TPF-5(502) —Missouri/Kansas 2023 Peer Exchange Pooled Fund

Project Type: Pooled Funds
MoDOT Contact: Jen Harper
MoDOT/Total Commitment: $50,000 est. MoDOT contribution
Contract Period: 8/18/2022 to 9/29/2023
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 2024:
The peer exchange took place in May 2023. The only thing that will continue in SFY 2024 is the final billing as expenses are submitted.

SFY 2023 Accomplishments:
There were multiple delays in getting the contract signed with TTI. By the time the contract was signed the hotel had backed out of providing space. After multiple attempts to find a hotel for the peer exchange it was postponed until the Spring. A request to update the estimated amount was sent to FS to increase the obligation amount on the project. An extension was sent to TTI on December 19, 2022. The pooled fund took place May 2nd through May 4th. All Region 3 states were able to attend except Indiana.

Financials	Amount
Projected Budget SFY 2024	$50,000
Budget Amount SFY 2023	$40,000
Adjusted Budget Amount SFY 2023	$0
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 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 have 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 sustainable concretes?

Proposed Activities for SFY 2024:
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 2024.

SFY 2023 Accomplishments:
This project has stalled in the development while MoDOT and the research team worked on the FHWA Climate Challenge application.

Financials	Amount
Projected Budget SFY 2026	$25,000
Projected Budget SFY 2025	$50,000
Projected Budget SFY 2024	$0
Budget Amount SFY 2023	$0
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 Actual Cost	$0

Pooled Fund Studies

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

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 2024	$15,000
Committed Funds SFY 2023	$15,000
Transferred Funds SFY 2023	$15,000

TPF-5(385)/ new phase Solicitation 1596 – Pavement Structural Evaluation with Traffic Speed Deflection Devices (TSDDs)

Project Type: Pooled Funds
MoDOT Contact: Jen Harper
MoDOT Total Commitment: $55,000 new solicitation
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 must 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 2024	$55,000
Committed Funds SFY 2023	$45,000
Transferred Funds SFY 2023	$45,000

TPF-5(422) – National Cooperative Highway Research Program (NCHRP) FY 2023 & TPF-5(423)- National Cooperative Highway Research Program (NCHRP) FY 2024

Project Type: Pooled Funds
MoDOT Contact: Jen Harper
MoDOT Total Commitment: $2,639,698
Contract Period: 7/1/2022 to 6/30/2024
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 2024	$1,320,000
Committed Funds SFY 2023	$1,294.000
Transferred Funds SFY 2023	$1,319,698

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

Project Type: Pooled Funds
MoDOT Contact: Jen Harper
MoDOT Total Commitment: $325,000
Contract Period: 1/21/2020 to 12/31/2023
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 2024	$65,000
Committed Funds SFY 2023	$65,000
Transferred Funds SFY 2023	$65,000

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

Project Type: Pooled Funds
MoDOT Contact: Jen Harper
MoDOT Total Commitment: $125,000
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 2024	$25,000
Committed Funds SFY 2023	$25,000
Transferred Funds SFY 2023	$25,000

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

Project Type: Pooled Funds
MoDOT Contact: Jen Harper
MoDOT Commitment: $40,000
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. 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 2024	$8,000
Committed Funds SFY 2023	$8,000
Transferred Funds SFY 2023	$8,000

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

Project Type: Pooled Funds
MoDOT Contact: Jen Harper
MoDOT Commitment: $250,000
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 2024	$50,000
Committed Funds SFY 2023	$50,000
Transferred Funds SFY 2023	$50,000

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

Project Type: Pooled Funds
MoDOT Contact: Jen Harper
MoDOT Total Commitment: $50,000
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 2024	$10,000
Committed Funds SFY 2023	$10,000
Transferred Funds SFY 2023	$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 2024	$0
Committed Funds SFY 2023	$0
Transferred Funds SFY 2023	$0

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 2024	$0
Committed Funds SFY 2023	$0
Transferred Funds SFY 2023	$0

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

Project Type: Pooled Funds
MoDOT Contact: Jen Harper
MoDOT Total Commitment: $100,000
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 2024	$25,000
Committed Funds SFY 2023	$25,000
Transferred Funds SFY 2023	$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 improving 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 2024	$0
Committed Funds SFY 2023	$0
Transferred Funds SFY 2023	$0

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: $222,400
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 2024	$55,600
Committed Funds SFY 2023	$55,600
Transferred Funds SFY 2023	$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: $40,000
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 2024	$20,000
Committed Funds SFY 2023	$20,000
Transferred Funds SFY 2023	$20,000

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: $40,000
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 2024	$10,000
Committed Funds SFY 2023	$10,000
Transferred Funds SFY 2023	$10,000

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

Project Type: Pooled Funds
MoDOT Contact: Jen Harper
MoDOT Total Commitment: $56,000
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 2024	$14,000
Committed Funds SFY 2023	$14,000

Transferred Funds SFY 2023	$14,000

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

Project Type: Pooled Funds
MoDOT Contact: Jen Harper
MoDOT Total Commitment: $1,000,000
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 2024	$150,000
Committed Funds SFY 2023	$150,000
Transferred Funds SFY 2023	$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 2024	$0
Committed Funds SFY 2023	$0
Transferred Funds SFY 2023	$0

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 2024	$0
Committed Funds SFY 2023	$25,000
Transferred Funds SFY 2023	$25,000

TPF-5(479) – Clear Roads Phase II

Project Type: Pooled Funds
MoDOT Contact: Jen Harper
MoDOT Total Commitment: $75,000
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 2024	$25,000
Committed Funds SFY 2023	$25,000
Transferred Funds SFY 2023	$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: $60,000
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 2024	$20,000
Committed Funds SFY 2023	$20,000
Transferred Funds SFY 2023	$20,000

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

Project Type: Pooled Funds
MoDOT Contact: Jen Harper
MoDOT Total Commitment: $100,000
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 2024	$50,000
Committed Funds SFY 2023	$50,000
Transferred Funds SFY 2023	$50,000

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

Project Type: Pooled Funds
MoDOT Contact: Jen Harper
MoDOT Total Commitment: $24,000
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 2024	$0
Committed Funds SFY 2023	$12,000
Transferred Funds SFY 2023	$24,000

TPF-5(501)– Roadside Safety Pooled Fund - Phase 3

Project Type: Pooled Funds
MoDOT Contact: Jen Harper
MoDOT Total Commitment: $130,000
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 2024	$65,000
Committed Funds SFY 2023	$65,000
Transferred Funds SFY 2023	$65,000

TPF-5(504) – Continuous Bituminous Pavement Stripping Assessment Through Non-destructive Testing

Project Type: Pooled Funds
MoDOT Contact: Jen Harper
MoDOT Total Commitment: $50,000
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 2024	$25,000
Committed Funds SFY 2023	$25,000
Transferred Funds SFY 2023	$25,000

TPF-5(507) – National Hydraulic Engineering Conference

Project Type: Pooled Funds
MoDOT Contact: Jen Harper
MoDOT Total Commitment: $2,000
Contract Period: TBD
Contract Investigator: FHWA
Funding: SPR 100%

Project Description and Objectives:
For more than 20 years, the FHWA has led the coordination of opportunities for collaboration, technology deployment, and best practice information sharing among transportation hydraulic engineers and practitioners. In recent years, FHWA has partnered with the AASHTO Technical Committee on Hydrology and Hydraulics and the TRB AFB60 Subcommittee to coordinate the opportunities. These coordinated opportunities have improved the state of the practice of transportation hydraulic engineers and practitioners. The objectives of this study are: 1. Provide opportunities for communication and information sharing among state hydraulic engineers, federal agencies, and national technical organizations (AASHTO TCHH and TRB AFB60) through the National Hydraulic Engineering Conference, and 2. Provide a technology and knowledge exchange forum to enhance the practical knowledge of member states concerning transportation hydraulic engineering, including advanced modeling technologies, FHWA initiatives, and best practices.

Financials	Amount
Committed Funds SFY 2024	$1,000
Committed Funds SFY 2023	$0
Transferred Funds SFY 2023	$1,000

TPF-5(511) – TRB Research Subscription FY 2023 & TPF-5(?) – TRB Research Subscription FY 2024

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 2024 (estimate)	$211,000
Committed Funds SFY 2023	$207,000
Transferred Funds SFY 2023	$210,941

TPF-5(515) – Evaluation of Low-Cost Safety Improvements (ELCSI-PFS) previously TPF-5(317)

Project Type: Pooled Funds
MoDOT Contact: Jen Harper
MoDOT Total Commitment: $20,000
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 2024	$10,000
Committed Funds SFY 2023	$10,000
Transferred Funds SFY 2023	$10,000

TPF-5(516) – Highway Safety Manual 2nd Edition (HSM2) Implementation

Project Type: Pooled Funds
MoDOT Contact: Jen Harper
MoDOT Total Commitment: $32,000
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 2024	$16,000
Committed Funds SFY 2023	$16,000
Transferred Funds SFY 2023	$16,000

TPF-5(517) – Performance Centered Concrete Construction

Project Type: Pooled Funds
MoDOT Contact: Jen Harper
MoDOT Total Commitment: $40,000
Contract Period: TBD
Contract Investigator: FHWA
Funding: SPR 100%

Project Description and Objectives:
A Performance Centered Concrete Construction initiative will assure that any new concrete pavement or overlay will last for the intended period, with a minimum of distress, at a low life-cycle cost in an increasingly sustainable way. Reducing the need to replace or repair any concrete pavement will provide the direct benefits of saving money, decreasing CO2 footprint, and easing traffic delays – all of which are beneficial to sustainability. Fewer closures over the life of the pavement also enhances the safety of the traveling public and roadworkers. This is a continuation of TPF-5(368) with a slightly different focus.

Financials	Amount
Committed Funds SFY 2024	$20,000
Committed Funds SFY 2023	$0
Transferred Funds SFY 2023	$20,000

Solicitation 1598– MAASTO Connected Automated Vehicle (CAV) Steering Committee

Project Type: Pooled Funds
MoDOT Contact: Jen Harper
MoDOT Total Commitment: $30,000
Contract Period: TBD
Contract Investigator: Michigan
Funding: SPR 100%

Project Description and Objectives:
The Mid-America Association of State Transportation Officials (MAASTO) Board unanimously nominated MDOT to lead an initiative to coordinate and facilitate the creation of a pooled fund study project. The intended purpose of the proposed TPF study is to support a collaborative research and project consortium on the topic of CAV technology. There is a need for establishing a common strategic direction for advancing CAV's deployments amongst its member states. This proposed pooled fund project will focus on movement toward resolution of a common direction for the body of ten (10) states in the Region (Illinois, Indiana, Iowa, Kansas, Kentucky, Michigan, Minnesota, Missouri, Ohio, and Wisconsin). The objective of this TPF study is to provide; as needed, engineering and/or technical support services for the research, development, deployment, operations, and maintenance of CAV technology, along with advancing various CAV related initiatives.

Financials	Amount
Committed Funds SFY 2024	$30,000
Committed Funds SFY 2023	$0
Transferred Funds SFY 2023	$0

N/A – Transportation Pooled Fund Contingency

Project Type: Pooled Funds
MoDOT Contact: Jen Harper
MoDOT Total Commitment SFY 2024: $85,400
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 2024	$85,400
Committed Funds SFY 2023	$0
Transferred Funds SFY 2023	$0

Technology Transfer – SPR24TTS

Estimated Cost - $705,000

LTAP = $420,000
NHI = $10,000
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(37)	FFY 2022	10/1/21 through 9/30/22	$300,000
TTAP-T001(38)	FFY 2023	10/1/22 through 6/30/23	$315,000
LTAP-T001(040)	SFY 2024	7/1/23 – 6/30/24	$420,000

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.

Accomplishments
FFY 2022:
The project has been completed for Federal Fiscal Year 2022. The final invoice was paid on January 20, 2023. The 2022 year overspent because of pending payments from cities and counties for training. It was determined to overrun this project so that the dates of service are correct and then reduce the next contract by that same amount. This project is closed

FFY 2023:
The FHWA directive to require all LTAP centers to operate on the federal fiscal year has been rescinded. It was determined to move the timing of LTAP to coincide with the State Fiscal Year. Therefore, this year's task order was only for 9 months. For the first quarter of federal fiscal year (FFY) 2023, LTAP conducted 45 classes with 2,669 attendees. For the second quarter of FFY 2023, LTAP conducted 23 classes with 560 attendees. The annual in person Advisory Committee meeting took place in Rolla on Thursday, March 30, 2023. The RFP for the next contract with LTAP was posted on February 1, 2023, and proposals were due March 22, 2023. The selection meeting was held and Missouri S&T was selected. LTAP is still working with the vendor, ESX/xCatalyst on the website and registration system. An assistant director was hired by LTAP and they are coordinating this effort. The AD and vendor are in the process of developing an online payment system which is additional scope to the original project but will allow cities and counties to pay upfront and should alleviate some of the issues with late payments to LTAP. There is not a specific date identified to "go live" but will roll out in stages to speed up the process.

Proposed Activities
FFY 2024
- 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 further promotion of LTAP 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 2024	$420,000
Budget Amount SFY 2023	$335,000
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 Actual Cost	N/A

TT200701 – NHI National Highway Institute Training SFY 2023 & SFY 2024

Project Type: Contracts Other
MoDOT Contact: Jen Harper
Total Contract Amount: $50,000
Contract Period: 7/1/2021 to 6/30/2024
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 for department staff to attend training. 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 2024:
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 2023 Accomplishments:
The NHI Scour class for Bridge Division took place in October. The invoice was received in early November and paid on November 15, 2022. Several Right of Way trainings have been released through NHI and this funding will be used for some of the MoDOT R/W employees to attend virtually.

Financials	Amount
Projected Budget SFY 2024	$10,000
Budget Amount SFY 2023	$40,000
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 Actual Cost	N/A

BEAP Program 2023 and 2024

Project Type: Contracts Other
MoDOT Contact: Jen Harper
Total Contract Amount: $400,000
Contract Period: 7/1/2022 to 6/30/2024
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 2024:
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 35 BEAP projects. The total number of projects per year will vary depending on the scope and final cost of individual projects.

SFY 2023 Accomplishments:
The funding allocation for SFY 2023 was $200,000. As of April 21, 2023, $172,480 has allowed 28 BEAP studies to be completed. These studies involved, 27 local agency bridges, 5 non-NBI length structures (less than 20') and 9 low water crossing studies that had some type of operational problem. Currently, 18 of these studies have been completed. The remaining 10 projects have the reports and invoices pending. The reports and invoices for the remaining 10 projects will be received, approved and payments will be made to the consultants by July 1, 2023.

Financials	Amount
Projected Budget SFY 2024	$200,000
Budget Amount SFY 2023	$150,000
Adjusted Budget Amount SFY 2023	$200,000
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 Actual Cost	N/A

TEAP Programs 2023 and 2024

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: $150,000
Contract Period: 7/1/2022 to 6/30/2024
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 2024:
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 2023 Accomplishments:
The funding allocation for SFY 2023 allowed for 13 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 2024	$75,000
Budget Amount SFY 2023	$75,000
Actual Cost SFY 2023	(See Addendum)
Prior to SFY 2023 Actual Cost	N/A

ADDENDUM

State Planning and Research Program

Fiscal Year 2023 Annual Report - (07/01/2022 - 06/30/2023)

PART I - PLANNING

Transportation Planning Activities	SFY 2023 Amended Budget with Match	SFY 2023 Expenditures with Match
• Transportation Planning	$7,881,256	$8,173,383
• Safe and Accessible Transportation Options	$200,000	$0
SUBTOTAL	**$8,081,256**	**$8,173,383**
District Transportation Planning		
• CD	$2,216,000	$2,621,791
• KC	$2,490,367	$2,156,240
• NE	$775,187	$827,694
• NW	$849,534	$1,034,599
• SE	$1,276,962	$1,412,088
• SL	$1,936,935	$1,534,018
• SW	$1,186,971	$965,210
SUBTOTAL	**$10,731,956**	**$10,551,640**
Other Activities		
• Information Systems	$2,578,873	$2,899,809
• Regional Planning Commission	$1,657,500	$1,640,893
• Financial Services	$1,314,505	$1,574,056
• Bridge Division	$791,954	$1,103,001
• Design Division	$2,360,532	$357,415
• Commuications	$25,000	$8,179
SUBTOTAL	**$8,728,364**	**$7,583,353**
TOTAL PART I	**$27,541,576**	**$26,308,376**

Part II – Urban (MPO) – PL

Metropolitan Areas	FY 2023 CPG Funds	FY 2023 CPG Expenditures*
NW Arkansas	$5,000	$5,000
Kansas City	$3,200,000	$1,014,459
St. Louis	$4,585,004	$2,657,555
Springfield	$925,953	$750,766
Columbia	$949,146	$108,898
Jefferson City	$233,951	$107,249
Joplin	$828,862	$108,188
St. Joseph	$390,614	$49,483
Cape Girardeau	$177,627	$117,973
TOTAL PART II	**$11,296,157**	**$4,919,571**

* As of 9/18/2023 - For Information Only - Does not reflect complete fiscal year

Part III – Research – SPR

Activity	SFY 2023 Amended Budget with Match	SFY 2023 Expenditures with Match
• Administration (SPR23ADS)	$468,873	$541,283
• Research (SPR23RDS)	$4,290,000	$3,975,710
• Technology Transfer (SPR23TTS)	$705,000	$661,195
TOTAL PART III	**$5,463,873**	**$5,178,188**

TOTAL MoDOT SPR WORK PROGRAM

	SFY 2023 Amended Budget with Match	SFY 2023 Expenditures with Match
• Part I – Planning	$27,541,576	$26,308,376
• Part II – Metropolitan Planning	$11,296,157	$4,919,571
• Part III – Research	$5,463,873	$5,178,188
TOTAL MoDOT SPR WORK PROGRAM	**$44,301,606**	**$36,406,135**

Project Number	Project Description	SFY 2023 Budget	SFY 2023 Actual
Administration - SPR23ADS		**$468,873**	**$541,283**
TA216601	Research Administration	$468,873	$541,283
Research - SPR23RDS	Research	**$4,290,000**	**$3,975,710**
Research General			
TR23CONT	Research Contingencies	$262,446	N/A
Research Contracts			
TR201313	Secretary of State Library MOU	$5,210	$5,210
TR201610	AASHTO Technical Service Program	$190,000	$185,000
TR201813	Leader-Follower TMA System	$357,449	$302,457
TR201814	Leader-Follower TMA System misc items	$27,531	$0
TR202007	Geotechnical Asset Management (GAM) Collection App	$60,905	$60,840
TR202010a	Missouri Systemic Countermeasures to Improve Ped Safety-new contract	$126,139	$119,054
TR202013	Rubber Fill Phase 1	$1,549	$355
TR202016	Monitoring an Active Landslide	$43,158	$38,730
TR202017	Scour Analysis at Missouri Bridges	$67,443	$61,867
TR202020	Evaluation of Recycled Components in SMA Mixes	$82,625	$56,760
TR202025	MCTI Administrative Costs	$75,000	$0
TR202102	Safety Eval of FYA	$87,763	$76,231
TR202103	Lightweight Deflectometer (LWD) for Accep. of Unbound Materials	$13,724	$10,563
TR202107	TiTAN Phase 2	$100,000	$70,910
TR202109	Impact of Silt and Clay Particles on Freshwater Mussels	$50,000	$158,700
TR202110	Industrial Internet-of-Things Asset Monitoring-Phase 2	$40,000	$69,220
TR202110a	Industrial Internet-of-Things Asset Drilling	$17,000	$4,693
TR202111	Deep Learning for Water Level Prediction	$37,564	$11,151
TR202112	GFRP Reinforced Barrier Curbs	$369	$0
TR202113	Fiber Reinforced Concrete for Bridge Decks and Overlays	$40,707	$40,707
TR202114	Techstreet Specifications	$33,259	$37,490
TR202115	Workzone Speed Management Techniques	$79,786	$42,967
TR202117	Mobility and ITS Asset Management	$19,816	$18,339
TR202121	Perf. of Cost-Eff. Non-Prop.UHPC in Thin Bonded Bridge Overlay	$88,406	$88,406
TR202122	LRFR Methodology for Missouri Bridges	$111,707	$98,445
TR202123	High Tension Guard Cable Inspection and Life Cycle	$150,000	$133,074
TR202124	Implementation of Data QA for Innovative Tech. at MoDOT	$34,020	$33,989
TR202125	Lab and Field Eval for Post Consumer Recy Plastics phase 2	$23,938	$23,938
TR202201	Library Support Contract (July 2021- June 2023)	$115,276	$100,148
TR202202	Deep Learning Models and Tools for Disaster Evac and Routing	$174,874	$143,308
TR202203	Int. Bents-Calc. of Restraint Factor at Top of Int. Bent	$75,000	$62,072
TR202204	Type N PTFE Bearing Designs	$50,000	$59,784
TR202205	Analysis of Asphalt Mix. Using Alternative Agg in SMA or SuperPave	$100,000	$120,551
TR202206	Friction Enhancement to Asphhalt Pavement Surfaces	$100,000	$63,372
TR202207	Pile Set-up and Restrike Procedures	$80,000	$102,167
TR202208	Bats and Bridges-Best Practices	$81,465	$74,760
TR202210	Increasing Revenue from Amtrak	$63,871	$63,872
TR202212	Mitigating and Preventing MoDOT Safety Relating Incidents	$125,000	$36,200
TR202213	Ingress and Egress in the SL Region in the Aftermath of and EQ	$75,000	$111,784
TR202214	Dev a Hazard Det.and Alert System to Prevent Worker Fatalities	$115,000	$125,827
TR202215	MoDOT Data Acq & Data Processing Utilz. AI and Machine Learning	$125,000	$176,487
TR202216	I-155 Pemiscot County NRRA Test Sections for the Mobile Test Track	$145,000	$144,284
TR202219	HFST Review of Service Life	$75,000	$0
TR202221	Consultant Support for IC and PMTP Projects in 2022-2023	$200,000	$220,583
TR202222	IC/PMTP incidentals	$5,000	$0
TR202301	GPR Analysis of I-44 Pavement Data	$7,000	$5,280
TR202302	Recent Developments and Technology Assessment of Automated Weather Observing Systems	$25,000	$0
TR202303	Consultant Estimating	$25,000	$0
TR202304	Investigating the Expanded Use of Waste Plastic in Asphalt	$75,000	$0
TR202305	Asphalt Binder Replacement Performance	$25,000	$0
TR202306	River Gravel in Asphalt Mixes	$25,000	$0
TR202307	Investigation of the HVSR Method to Determine Site Class for Seismic Design	$25,000	$0
TR202308	LRFD Seismic Maps	$25,000	$0
TR202309	Audible Alert and TMA Lighting	$25,000	$109,440
TR202310	Magnesium Chloride and Cement Paste	$25,000	$0
TR202311	Asset Characterization Using Automated Methods	$25,000	$0
TR202312	Animal Crossings with Median Barriers	$0	$48,878

Project Number	Project Description	SFY 2023 Budget	SFY 2023 Actual
TR202313	Truck Parking Prioritization	$0	$129,110
TR202319	Impact Testing of GFRP Reinforced Barriers	$0	$31,240
TR202320	Safety Eval of J-turns	$0	$83,592
TR202322	Vulnerable Road Users	$0	$125,977
TR202323	LWD Phase II	$0	$2,900
TR202325	MCTI Administrative Costs (estimate part of TR202025)	$0	$85,000
		$4,240,000	$3,975,710
Technology Transfer - SPR23TTS		**$705,000**	**$661,195**
TTAPT001	Local Technical Transfer Assistance Program (LTAP)	$390,000	$394,764
TTAPT001	BEAP	$200,000	$188,377
TTAPT001	TEAP	$60,000	$61,944
TT200701	NHI National Highway Institute Training*	$40,000	$16,110
	Total SFY 2023 Part B Budget	**$5,503,873**	**$5,178,187**
MoDOT Led Pooled Fund Studies (including other states contributions)			
TR201910	Developing Implementation Strategies for Risk Based Inspection (RBI)	N/A	$159,876
TR202004	Traffic Disruption-free Bridge Inspection Initiative with Robotic Systems	N/A	$189,852
TR202011	Assess.and Repair of P/SBridge Girders Subjected to (OHTI)	N/A	$175,267
TR202317	Missouri/Kansas Peer Exchange Pooled Fund	N/A	$49,944
MoDOT Led Pooled Fund Studies (MoDOT Contribution only)			
TR201910	Developing Implementation Strategies for Risk Based Inspection (RBI)	$0	$0
TR202004	Traffic Disruption-free Bridge Inspection Initiative with Robotic Systems	$0	$0
TR202011	Assess.and Repair of P/SBridge Girders Subjected to (OHTI)	$0	$0
TR202317	Missouri/Kansas Peer Exchange Pooled Fund	$40,000	$0
		$40,000	$0
	Total SFY 2023 Part B Budget including MoDOT led Pooled Fund State Contributions		**$5,753,127**
Additional Part B Transfers			
	NCHRP Contribution	$1,294,000	$1,319,698
	TRB Core Contribution	$207,000	$210,941
	Pooled Funds led by others	$850,000	$761,600
		$2,351,000	**$2,292,239**
			$7,470,426