

2023
State
Planning and
Research
Program II

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Office of Transportation Planning

David Mohler, Executive Director	Steve Woelfel, Deputy Executive Director	Bob Frey, Director of Project-Oriented Planning	Ethan Britland, Manager of Multimodal Planning	Peter Sutton
				Makaela Niles
			Vacant TPP II (to be filled)	
			Vacant TPP II (to be filled)	
		Kevin Lopes, Director of GIS Services	Lionel Lucien, Manager of Public Private Development	Curtis Wiemann
				Vacant TPP II (to be filled)
				David Dinocco
				Michael McGill
				Jose Simo
				Argenis Sosa
				Manny Zotos
				Sudip Paudel
				Shruti Venkatesh
				Mary Molloy
				Florence Person
				Aanchal Gupta
				Charlotte Mays
		Charles Major		
			Derek Krevat, Manager of MPO Activities	Derek Shooster
				Christopher Klem
				Miranda Briseno
				Raissah A. Kouame
			Jules Williams, Manager of Sustainable Transportation	Max Natanagara
				Daisy Brown
			Hongyan (Lily) Oliver, Manager of Research	Nicholas Zavalas
				Patrick McMahon
				Michael Flanary
Drew Pflaumer				
Manager (Vacant)	Vacant TPP II (to be filled)			
	Patricia Cahill			
	Doug Johnson			
	Vacant TPP II (to be filled)			
	Vacant TPP II (to be filled)			
Liz Williams, Director of Data and Policy		Vacant TPP II (to be filled)		
		Vacant TPP II (to be filled)		
Michelle Ho, Director of Capital Planning		Andrew Wang		
		Vacant TPP II (to be filled)		
Maria Ramirez, Manager of Administration		Nathaniel Kerr		
		Vacant (to be filled)		
Susan Repucci				

Research

A. Research Program Development, Administration, and Implementation

Task Lead: Hongyan Oliver

Task Purpose: To provide oversight and administration of the research program; conduct internal and external outreach activities; and manage associated contracts. The Research Section's work includes conducting research problem statement (RPS) solicitations; organizing RPS evaluation and selection; procuring and administering research contracts; and tracking project performance and implementation efforts and impacts. Please see Appendix A for the FFY23 Problem Statement Solicitation Form, where implementation and potential benefits are emphasized.

Accomplishments in prior year:

- Engaged in scoping and contracting coordination efforts between research project principal investigators (PI) and project champions (PC).
- Procured and/or administered over 30 research agreements (and/or contracts) with research entities.
- Performed project development and management for 35 research projects.
- Conducted three research roundtables to connect MassDOT personnel with researchers and two internal information sessions during the 2023 problem statement solicitation period.
- Conducted a "Lunch & Learn" session to inform and engage MassDOT and MBTA staff on research activities.
- Received 22 new research problem statements.
- Coordinated the review and prioritization of statements for new FFY23 projects.
- Coordinated initial scope discussion and PI identification approach for the FFY23 research projects.
- Produced FFY21 Research & Tech Transfer Annual Report.
- Produced four MassDOT Research Quarterly Newsletters.
- Updated MassDOT research website with new contents regularly.
- Conducted web-based project completion survey with project champions, principal investigators and project managers for thirteen projects completed in 2021 to collect feedback and information on how research process can be improved and research results have been/are to be utilized and implemented.

- Prepared quarterly reports on the status of research and training programs.
- Worked on a first draft of the updated Research Manual.

Proposed activities for next year:

- Continue providing the management of research contracts and agreements.
- Continue research project management.
- Prepare quarterly reports on the status of research and training programs.
- Update MassDOT Research Section website regularly.
- Produce FFY22 Research & Tech Transfer Annual Report.
- Produce MassDOT Research Quarterly Newsletters.
- Continue tracking research project performance, implementation and impacts.
- Track equipment purchased with research funds.
- Finalize the updated MassDOT Research Manual.

Anticipated products:

- Executed ISAs and contracts.
- Quarterly reports.
- Final draft of the updated Research Manual.
- Regular updating of the Research & Technology Transfer website.
- FFY22 Research & Tech Transfer Annual Report.
- Research Quarterly Newsletters.
- Improved research processes for increased effectiveness and better communication of research value.

Estimated task completion: 09-30-2023

Estimated task budget: \$98,278.25

Staff salaries and benefits: \$98,278.25

MassDOT staff members	% Time to task
Nicholas Zavolas	20.0
Patrick McMahon	20.0
Hongyan Oliver	20.0
Drew Pflaumer	20.0
Michael Flanary	20.0

Other costs: \$0

B. Massachusetts Cooperative Research Program (MCRP)

Task Lead: Hongyan Oliver

Task Purpose: MassDOT plans to renew the multi-year Interdepartmental Service Agreements (ISA) with the University of Massachusetts Amherst to continue receiving the UMass Transportation Center (UMTC) services in assisting MassDOT with transportation research, training, and technology transfer activities for FFY23-25. There are four components in the ISA Amendment: Massachusetts Cooperative Research Program (Task B), Local Technical Assistance Program (Task C), MassDOT Technical Services (Task D) and MassDOT Conference Services (Task J). Through the MCRP component, the Research Section directs, coordinates, and oversees UMTC to provide research support and conducting tasks as requested. MCRP's services fall into five categories:

a) Literature searches and reviews: Perform literature and information searches and syntheses at the Research Section's request.

b) Research subtasks: Perform quick-turnaround subtasks to address MassDOT's imminent research needs. These subtasks can typically be completed in under 12 months (including a 3-month final product review and acceptance period) with a cost less than \$100,000, and carried out by researchers with matching expertise (principal investigators) within the UMass system, but not by UMTC staff directly funded under the ISA.

c) Research project support: Assist MassDOT during the annual problem statement solicitation process; plan and support research roundtables; assist with identification of potential principal investigators (PI) with expertise matching specific research needs; assist with initial scope of work description; ensure quality control (final copy-editing and 508 compliance of all research final reports and cut sheets); and submit final reports to Transportation Research International Documentation (TRID), National Transportation Library and other national transportation research record repositories.

d) Research collaboration and outreach support: Maintain the UMTC associated transportation researcher network; curate and host MassDOT transportation research and innovation webinar series; assist MassDOT with the National Cooperative Highway Research Program (NCHRP) problem statement

review process; compiling contents for MassDOT Research Annual Report; and other activities as needed.

e) Research project administration: Provide fiscal and procedural administration for all research projects with UMass Amherst, including budget preparation; invoicing backup preparation; template developments/updates; accounting, orientation/training; and on-demand activities. Provide advice to other state universities on how to administrate ISAs with MassDOT.

Under Category B, MassDOT intends to conduct up to 5 research subtasks during FFY23 through the UMTC ISA to address research problems and needs. Some of the subtasks are generated from the annual research problem statement solicitation process and some may be selected outside of that process. The second type of research subtask will depend on the emerging agency needs and may include technical assistance in implementing completed research. The Research Section works with MassDOT project champions to identify the suitable principal investigators for each of the subtasks based on researcher expertise and anticipated completion dates, and assists with the development of scopes, budgets, and schedules for these projects. MassDOT will coordinate with and request FHWA's approval of the scopes and budgets prior to the issuance of any research subtasks.

Subtasks:

- MCRP

Accomplishments in prior year:

- Initiated and administrated two research subtasks (FYA Phase II and Concrete Sidewalks Phase II)
- Completed one MCRP research subtask (Best Practices for Cost-Recovery)
- Assisted with 2023 MassDOT Research Problem Statement solicitation (for FFY23 SPR Work Program).
- Assisted with research solicitation outreach materials and hosted the outreach sessions.
- Assisted with research project completion survey.
- Conducted literature searches for 22 received problem statements.
- Drafted brief project statements for the final list of FFY23 projects to initiate PI identification process.
- Assisted with PI Interest Statement solicitation.

- Facilitated dialogues between the Affiliate network/academic researchers and MassDOT practitioners.
- Maintained the network of the transportation affiliated researchers.
- Conducted literature search on travel demand alternative analysis and state-of-practice for managing ferry services at MassDOT staff's request.

Proposed activities for next year:

Subtasks: MCRP

Currently MCRP research subtasks to be completed during FFY23 include:

B.1. Construction & Materials Best Practice for Concrete Sidewalks Phase II (Continuing Research Subtask): Phase II investigates concrete placed in hot weather and continues to monitor the performance of the concrete placed in Phase I that was not included in Phase I but may also be also critical in triggering concrete scaling. All sample preparation, field observation, data collection, lab experiment and data analysis were completed in FFY22. Final report draft is in progress and is anticipated to be submitted for review in the first quarter of FFY23. Anticipated duration: 21 months. Anticipated costs for FFY23: \$30,000. Project total costs: \$250,000.

B.2. Evaluating the Safety Impacts of Flashing Yellow Permissive Left-Turn Indications in Massachusetts: Approach Level Analysis (Continuing Research Subtask: Phase II aims at evaluating the before/after crashes of these FYA intersections from the approach-level to better understand the safety impacts of the Left-Turn permissive FYA signal. The advancement of these crash data analytics, methodologies, and applications will continue to remain important in years to come and will increase safety by providing an increased understanding of conflict risk at signalized intersections involving this novel traffic control device. All data collection and analysis were completed in FFY22. Final report draft is in progress and is anticipated to be submitted for review in the first quarter of FFY23. Anticipated duration: 21 months. Anticipated costs in FFY23: \$20,000.

Additional subtasks will be developed based on emerging needs and be issued with FHWA's approval; such subtasks may include technical assistance in implementing completed research.

- Continue to provide research services in the categories listed above.
- Complete the two existing research subtasks listed above.

- Initiate and perform up to 5 new research subtasks under MCRP's Services (Category B above).
- Assist Research Section in preparing FY22 Research Annual Report.
- Assist Research Section in preparing FY23 quarterly updates.

Anticipated products:

- Delivery of research subtask interim and final reports.
- Delivery of monthly and quarterly reports.
- Delivery of 2022 Research Annual Report.
- Delivery of other research services as requested by the MassDOT Research Section.
- Delivery of logistical support for the annual NCHRP problem statement review.

Estimated task completion: 09-30-2023

Timeline for new consultant support: MCRP

Consultant name: UMass Amherst

Scope development and FHWA review/approval: 08-15-2022

Contract negotiations and FHWA review/approval: 08-31-2022

Consultant Notice to Proceed: 10-01-2022

Total duration of task: 72 months

Estimated task budget: \$982,193.03

Staff salaries and benefits: \$53,656.03

MassDOT staff members	% Time to task
Hongyan Oliver	20.0
Michael Flanary	15.0
Drew Pflaumer	10.0
Nicholas Zavalas	10.0

Consultant costs: \$928,537.00

Subtask / contract #	Total cost:	Pre-FFY 2023:	FFY 2023:	Post-FFY 2023:	Consultant/Contractor Name:	Consultant NTP:	Duration of Task (months):	Contract end date
MCRP / 109600	\$5,677,226.00	\$2,788,822.00	\$928,537.00	\$1,959,867.00	UMass Amherst	10-01-2022*	72	09-30-2025

Consultant notes: This is the MCRP component of the MassDOT-UMA UMTC ISA Amendment for FFY23-25. The duration of the whole ISA, after being amended, is 72 months. The total cost reflects the total amount estimated for the 72-month period.

* Anticipated NTP date for the ISA Amendment.

Other costs:

C. Local Technical Assistance Program (LTAP)

Task Lead: Hongyan Oliver

Task Purpose: MassDOT plans to renew the multi-year Interdepartmental Service Agreements (ISA) with the University of Massachusetts Amherst to continue receiving the UMass Transportation Center (UMTC) services in assisting MassDOT with transportation research, training, and technology transfer activities for FFY23-25. There are four components in the ISA Amendment: Massachusetts Cooperative Research Program (Task B), Local Technical Assistance Program (Task C), MassDOT Technical Services (Task D) and MassDOT Conference Services (Task J). Baystate Roads is the longstanding program name for Massachusetts LTAP, and it serves as a conduit for information transfer on technologies, best practices, and methodologies for operating, maintaining, and managing municipal departments of public works and highway departments throughout the Commonwealth. The program also serves as an efficient communications network, by which MassDOT transfers policy information, engineering directives, program funding, and other updates to the 351 municipalities in Massachusetts. Please see Appendix B for FFY23 LTAP Training Plan.

Subtasks:

- LTAP

Accomplishments in prior year:

The Local Technical Assistance Program (LTAP) resumed in person training in 2022 while maintaining a variety of additional remote options including virtual classes, blended learning, webinars and self-paced virtual courses. Major accomplishments to date, with estimated Quarter 4 trainings scheduled, provided 117 classes attended by about 2,400 participants in total. trainings are summarized below (including scheduled sessions for Q4):

- AASHTO TC3 Plan Reading
- ADA Accessible sidewalk Ramp Construction
- AASHTO TC3 Intro to GIS Mapping
- Basic Welding
- Bucket Truck
- Capital Budgeting for municipal DPWs
- Chainsaw Maintenance
- Chainsaw Skills and Safety
- Class A CDL
- Class B CDL

- Complete Street 201
- Complete Streets 302
- Complete Streets 303 – Bicycle/Pedestrian Network Planning
- Complete Streets 304 – Traffic Calming
- Complete Streets 306
- Concrete Sidewalk Construction
- Confined Space
- Design of ADA Curb Ramps
- Drainage – Roadway Maintenance and Reconstruction
- Effective Beaver Management
- Erosion Prevention and Sediment Control – BMPs
- Flagger/First Aid Certification
- FAA Remote Pilot Certification Pilot Test Preparation
- Grader Operator
- Grader Training
- Hands on Excavator/Loader/Backhoe Operation & Safety
- Hands on Grader Operation & Safety
- Large Mower Operation & Safety
- Illicit Discharge Detection & Elimination for MS4 Permitting
- Load Securement & Rigging
- Maintaining your Roadways with Pavement Preservation Part 1
- Maintaining your Roadways with Pavement Preservation Part 2
- MaPIT 3.0
- Municipal Culvert Assessment
- Municipal DPW Operating Budget
- MS4
- NHI Urban Drainage Design
- OSHA 10
- Pavement Management & Preservation
- Ped & Bike Work Zone Safety Training
- Roundabouts Series #11: Multilane Design
- Roundabouts Series #12: Signage and Markings
- Roundabouts #13: Construction and Operations
- Roundabouts Series #14 – Simulation
- Snow & Ice Operations for Front Line Employees
- Snow & Ice Operations for Supervisors
- Street Tree Essentials
- Stump the Instructor – Been there and Bid that!
- Stump the Instructor – Calibration is the Key
- Stump the Instructor – CDL Entry Level Driver Training Requirements
- Stump the Instructor – Concrete Sidewalks
- Stump the Instructor – Future of Commonwealth’s Curbs
- Stump the Instructor – Scopes, Contracts and Contractors

- Stump the Instructor – Equipment Inspection and Operation
- Stump the Instructor – From Brine to Beet Juice
- Stump the Instructor – Grader Operation
- Stump the Instructor – Gravel Roads 101
- Stump the Instructor – Gravel Road 201
- Stump the Instructor – Snow and Ice
- Stump the Instructor – So, you had a...Flood, Major Snow Event. Now what!
- Stump the Instructor – Spring is in the Air and Mud is Coming for Your Roads
- Stump the Instructor – Trench Safety Month Kickoff
- Traffic Signal Warrants
- Trenching and Excavation Safety
- Truck or Backhoe Maintenance Essentials
- Welding Equipment Safety and Operation
- Woodchipper Safety
- Work Zone Safety
- Conducted training evaluation at end of each class.
- Conducted training impact evaluations on selected classes.
- Hosted one hybrid LTAP Advisory Board meetings.
- Developed job-aids on selected topics for municipal DPWs.
- Provided monthly and quarterly reports.
- Published quarterly LTAP M3 newsletters.
- Updated LTAP website frequently to disseminate information.
- Conducted and evaluated FFY23 LTAP training needs survey.
- Developed draft FFY23 LTAP Training Plan.

Proposed activities for next year:

- Continue to prepare, coordinate, and deliver training classes to municipalities per the FFY23 training plan (Attachment B), and yet be flexible to accommodate evolving, critical municipal needs and to follow MassDOT's guidance.
- Continue to expand and deliver online training and information sharing videos.
- Continue to develop and implement suitable approaches to evaluate training effectiveness.

Anticipated products:

- Delivery of at least 100 virtual or in-person training sessions throughout the state.
- Quarterly M3 newsletters.
- Updates to and maintenance of LTAP website.

- Training and conference feedback surveys and summaries.
- Monthly and quarterly reports on LTAP training activities.
- Draft FFY24 LTAP Training Plan.

Estimated task completion: 09-30-2023

Timeline for new consultant support: LTAP

Consultant name: UMass Amherst

Scope development and FHWA review/approval: 08-15-2022

Contract negotiations and FHWA review/approval: 08-31-2022

Consultant Notice to Proceed: 10-01-2022

Total duration of task: 72 months

Estimated task budget: \$1,217,551.88

Staff salaries and benefits: \$14,698.88

MassDOT staff members	% Time to task
Drew Pflaumer	5.0
Hongyan Oliver	10.0

Consultant costs: \$1,202,853.00

Subtask / contract #	Total cost:	Pre-FFY 2023:	FFY 2023:	Post-FFY 2023:	Consultant/Contractor Name:	Consultant NTP:	Duration of Task (months):	Contract end date:
LTAP / 109600	\$7,509,659.00	\$3,748,574.00	\$1,202,853.00	\$2,558,232.00	UMass Amherst	10-01-2022	72	09-30-2025

Consultant notes: This is the LTAP component of the four components of the MassDOT-UMA UMTC services ISA Amendment for FFY23-25. The duration of the whole ISA, after being amended, is 72 months. The total cost reflects the total amount estimated for the 72-month period.

* Anticipated NTP date for the ISA Amendment.

Other costs:

D. MassDOT Training Services (MTS)

Task Lead: Hongyan Oliver

Task Purpose: MassDOT plans to renew the multi-year Interdepartmental Service Agreements (ISA) with the University of Massachusetts Amherst to continue receiving the UMass Transportation Center (UMTC) services in assisting MassDOT with transportation research, training, and technology transfer activities for FFY23-25. There are four components in the ISA Amendment: Massachusetts Cooperative Research Program (Task B), Local Technical Assistance Program (Task C), MassDOT Technical Services (Task D) and MassDOT Conference Services (Task J). MassDOT Training Services (MTS) assist MassDOT in developing and implementing an annual plan to provide essential and high-quality technical training to MassDOT employees with a focus on the Highway Division. Through this component, MassDOT coordinates, directs, and oversees the UMTC training team as it provides training classes requested by MassDOT's Highway Division to its staff throughout the state. Please see Appendix C for FFY23 MTS Training Plan.

Subtasks:

- MTS

The MTS annual budget has increased considerably for the FY23-25 period for two reasons: a significant amount of mandatory Highway employee technical trainings and certifications were transferred from MassDOT HR Training to UMTC starting in FFY22; and, the Highway Division is expecting to hire a large number of new staff to develop and deliver projects funded by the BIL; and these new staff will need to take technical trainings to get up to speed and perform their responsibilities satisfactorily.

Accomplishments in prior year:

MassDOT Training Services resumed in-person training while continuing with a variety of training topics via a variety of remote training environments. Trainings were offered through a virtual format (live-streamed through a variety of platforms), a blended learning approach, combining self-paced online modules and live streamed sessions, webinars, and on-demand video options. MTS provided over 100 classes for over 2,800 attendees. Individual classes are listed below (including scheduled sessions for Q4):

- AASHTO TC3 Aggregate Sampling Basics

- AASHTO TC3 Erosion and Sediment Control for Construction
- AASHTO TC3 Global Positioning System
- AASHTO TC3 Introduction to GIS
- AASHTO TC3 Micropile
- American Concrete Institute (ACI) training and certification
- Asphalt 101
- ATSSA - Guardrail Installation
- AutoCAD Civil 3D
- Bridge Specialized Processes: Bolted Connections
- Bridge Specialized Processes: Removal & Replacement of Bridge Coatings
- Bucket Truck Operation & Safety
- Chainsaw Maintenance
- Chainsaw Safety & Storm Damage Awareness
- Confined Space Training
- Construction Supervisor License CEUs
- Design of ADA Curb Ramps
- Drainage – Roadside Maintenance and Reconstruction
- FHWA NHI-130055 - Safety Inspection of In-Service Bridges (10 Day)
- FHWA NHI 130091 Underwater Bridge Inspection
- FHWA NHI 130108 – Bridge Maintenance
- FHWA NHI 135056 Culvert Design
- FHWA NHI 131141 – Quality Assurance for Construction
- FHWA NHI 132042 – Design of Mechanically Stabilized Earth Walls and Reinforced Soil Slopes
- FHWA NHI 132078 - Micropile Design and Construction
- FHWA NHI 134067 - Construction Inspection of Bridge Rehabilitation Projects
- FHWA NHI-135048 - Countermeasure Design for Bridge Scour & Stream Instability
- Highway/Construction Survey
- Introduction to SIDRA
- Larger Mower Operation & Safety
- Load Securement and Rigging
- MassDOT Project Manager Certification Training
- Mechanics Training
- New England Transportation Technician Certification Program (NETTCP) training and exams
- NRMCA Concrete Exterior Finishers Certification

- OSHA-10 for Construction
- OSHA Safety Awareness Training
- Railroad ROW safety trainings
- School of PE – FE Prep Course
- SIDRA Fundamentals
- Sign Installation & Maintenance
- Stormwater Maintenance
- Sweeper Operation and Safety
- Trenching & Excavation Safety
- Woodchipper Operation and Safety
- Work Zone Safety for Construction Supervisors
- Work Zone Safety for Field Personnel
- Work Zone Safety for Maintenance Field Personnel
- Work Zone Safety for Maintenance Supervisors & Foremen
- Welding Procedure Safety Explained
- Procured, coordinated, and administered 3-party training and certification services to meet Highway Division needs.
- Worked on streamlining MTS processes to improve training effectiveness and quality including needed coordination, registration, evaluation, and customized contents to reflect MassDOT's technical requirements.
- Coordinated with the Highway Division to develop FFY23 training plan.
- Submitted monthly and quarterly reports.

Proposed activities for next year:

- Prepare, coordinate, and deliver MTS training classes per the FFY23 Training Plan (Attachment C), which will be updated quarterly based on availability and schedule of external training classes and to accommodate critical, emerging Highway training needs.
- Coordinate with the Highway Division and OTP to accommodate on-demand training needs.
- Record training attendance to inform future plans.
- Conduct training needs and effectiveness surveys.
- Develop FFY24 annual training plan.
- Prepare and submit monthly and quarterly reports.

Anticipated products:

- Implementation of the FFY23 Training Plan.

- Accommodation of Highway Division urgent training needs.
- Implementation of FFY24-25 training needs survey.
- Training attendance records.
- Training feedback surveys and summaries.
- Development of FFY24 MTS annual plan.
- Monthly and quarterly reports.

Estimated task completion: 09-30-2023

Timeline for new consultant support: MTS

Consultant name: UMass Amherst

Scope development and FHWA review/approval: 08-15-2022

Contract negotiations and FHWA review/approval: 08-31-2022

Consultant Notice to Proceed: 10-01-2022

Total duration of task: 72 months

Estimated task budget: \$1,675,080.88

Staff salaries and benefits: \$14,698.88

MassDOT staff members	% Time to task
Hongyan Oliver	10.0
Drew Pflaumer	5.0

Consultant costs: \$1,660,382.00

Subtask / contract #	Total cost:	Pre-FFY 2023:	FFY 2023:	Post-FFY 2023:	Consultant/Contractor Name:	Consultant NTP:	Duration of Task (months):	Contract end date:
MTS / 109600	\$777,798.00	\$2,703,932.00	\$1,660,382.00	\$3,413,484.00	UMass Amherst	10-01-2022	72	09-30-2025

Consultant notes: This is the MTS component of the four components of the MassDOT-UMA UMTC Services ISA Amendment for FFY23-25. The duration of the whole ISA, after being amended, is 72 months. The total cost reflects the total amount estimated for the 72-month period.

* Anticipated NTP date for the ISA Amendment.

Other costs:

E. Short-Term Research Projects

Task Lead: Michael Flanary

Task Purpose: To perform the studies contained within this task, MassDOT contracts directly with universities, research institutes and/or private companies. The anticipated duration of active investigation and report writing efforts for short-term, medium-term and long-term projects are, respectively: less than 15 months, 15-21 months, and longer than 21 months (including 3 months of final report review, approval and 508 compliance). There may be an occasion when a project's actual duration doesn't align with the anticipated duration due to challenges arising during research investigation and beyond the project team's control. Under such circumstances, additional time may be granted pending FHWA's approval, and the project shall remain within the original category for fiscal tracking purposes. The Research Section conducts annual research problem statement (RPS) solicitations to collect research needs from agency staff. The submitted problem statements are then prioritized based on MassDOT Division/Shared-Service Office Senior Leaders' rankings, MassDOT overall priorities, and research funding eligibility and availability. The Research Section assists MassDOT project champions with literature searches; the drafting of scopes of work; identification and selection of principal investigators, and the administration of project agreements/contracts, deliverables, final report reviews and publication, and coordination with FHWA.

Subtasks:

1. **Implementing the AASHTO Mechanistic-Empirical Pavement Design Guide Phase III (Continuing Project)**

A four-phased approach was planned to complete this research effort. Phase I (Literature Review and State of Practice Assessment) was completed in June 2021 and Phase II (Develop an AASHTOWare Pavement ME User Manual and the Local Experimental Plan and Sampling Template) deliverables are being reviewed. Phase III (Sample and Test Mixtures for Local Calibration and Field Data Collection) will be based on the local experimental plan and sampling template developed under Phase 2, and a larger volume of mixtures will be tested to have the best local calibration possible for Massachusetts. Additionally, field data needed for calibration will be collected. All this lab and field data will be used in Phase IV (Calibrate and Validate the M-E Prediction Models). The phase III ISA is expected to

be in place before FFY23 and the project will be kicked off in early FFY23 subsequently.

2. Methods to Identify Problematic Carriers and Prevent Infrastructure Damage (Continuing Project)

This project aims to develop methods to connect and harmonize various Massachusetts datasets on carriers, permits, citations, road accidents, road infrastructure inventory, and freight restrictions to improve the use and availability of relevant datasets. Following a compilation of state-of-the-practice from other states, the available datasets are examined to determine consistency and usability on mirrored or relational fields. Specific datasets and their fields are being categorized by relevancy to formulate data canisters for analysis across multiple enterprise platforms. Thresholds will be determined to identify overrepresented carriers and resulting trigger points on a rolling basis at which further investigation should be conducted. Additionally, experimentation of a comprehensive scoring system will assign individual factors a weight to best accommodate incomplete data in determining overall carrier risk to road and infrastructure safety. Research results will provide a solid foundation for conducting risk assessments of overweight/oversize use and flagging problematic use of existing weight-permit practices to further protect roadway assets and sensitive bridge structures.

3. Feasibility Study of 3D Printing Applications for Bridge Elements in MA (Continuing Project)

Building on the promising experimental results of Phase I (i.e., additive repair of real corroded steel plates in the lab), the current project aims at exploring the onsite feasibility of additive repair technology for corroded steel beam ends. Cold spray solutions as well as other applicable onsite technologies will be studied and tested. The project will further connect interested MassDOT bridge engineers with additive manufacturing facilities to explore potential collaborative opportunities around implementation of candidate objects identified during Phase I. Additionally, the project will further characterize the cost and value of implementing these candidate components by using specific econometric models and will contextualize that cost within MassDOT-specific operational models and planning.

4. Data-Driven Approach for Transit Capital Planning (Continuing Project)

This research aims to develop new approaches and identify best practices by peer State-level agencies for MassDOT to compile, aggregate and understand data that

enables better decision making for transit capital planning. It will also work to define a standard operating procedure, focusing on what data is currently being collected and the existing collection methods used at MassDOT, and how this data is ultimately integrated into or used to validate MassDOT's forecast of need. This research could eventually serve as the framework for a solution that will help to streamline time-consuming data collection efforts while ensuring the accuracy of the predicted need across MassDOT's transit grantees. A transparent, repeatable, and uniform processes for data aggregation and analysis will allow MassDOT to make capital planning decisions that are driven by data and consistent with needs and priorities across the Commonwealth.

5. BIM for Transit Infrastructure: A Feasibility and gap assessment with current practices and systems at the MBTA (Continuing Project)

It is important to consider data governance and integration from the conception of a project's data dictionary, through the asset provisioning and commissioning process of new infrastructure and data management, to computerized maintenance management systems. MBTA management of new projects and ongoing operations can be improved by implementing the Building Information Modeling (BIM) delivery methodology in the Capital Delivery department. The project aims to review practices at other state and regional agencies to recommend best practices for implementing a systemwide BIM workflow throughout the MBTA infrastructure design, construction, operations, and maintenance areas.

6. Using Traffic Signals to Limit Speeding Opportunities on Arterial Roads (Continuing Project)

This project will provide guidance and case studies for developing traffic signal timing plans in Massachusetts that limit the number of speeding opportunities, while addressing other signal control objectives such as capacity and delay. This will be achieved by creating a method for determining the number of speeding opportunities afforded by a signal timing plan on an arterial with the similar inputs used in traffic signal timing design and developing an easy-to-use, no-cost tool that implements this method. Literature review and the initial online tool development has been completed; and MassDOT will review and implement the revised signal timing plan for the tool validation in FFY23.

7. Uncovering the Root Causes for Truck Rollover Crashes on Ramps (Continuing Project)

This project will provide a better understanding of the causes of truck rollover crashes on highway ramps, and develop effective countermeasures (e.g., improved ramp design and traffic control). The project has reviewed literature and best practices on reducing highway ramp truck rollovers; 2) analyzed historical ramp truck rollover data in Massachusetts by utilizing existing traffic cameras on state-maintained highways and advanced video analytics tools to uncover the causes of truck rollovers on highway ramps and derive surrogate safety performance measures, and (3) identified some correlations between truck rollovers and Intelligent Transportation System (ITS) devices, signage and markings, and roadway design practices. Additional video images were collected by the MassDOT drone team and are being analyzed by the researchers. A 6-month NCTE was approved by FHWA in August 2022 to extend the project end date to March 31, 2023.

8. Synthesis study: Microfiltration Treatment and Design Options (Continuing Project)

This project involves synthesizing microfiltration treatment design and operations for projects by type and making recommendations on their potential use on MassDOT projects for stormwater management and water quality improvement particularly with sediment control barriers and bioswales. A no-cost contract amendment was approved in FFY22 for updating the scope and extending the project end date to April 30, 2023.

Accomplishments in prior year:

- Contracted and initiated "Implementing the AASHTO Mechanistic-Empirical Pavement Design Guide Phase III" project. 1% completed.
- Contracted and initiated "Methods to Identify Problematic Carriers and Prevent Infrastructure Damage" project. 5% completed.
- Contracted and initiated "Feasibility Study of 3D Printing Applications for Bridge Elements in MA" project. 5% completed.
- Contracted and initiated "Data-Driven Approach for Transit Capital Planning" project. 1% completed.
- Contracted and initiated "BIM for Transit Infrastructure: A Feasibility and gap assessment with current practices and systems at the MBTA" project. 10% completed.
- Managed "Using Traffic Signals to Limit Speeding Opportunities on Arterial Roads" project. 40% completed.

- Managed "Uncovering the Root Causes for Truck Rollover Crashes on Ramps" project. 80% completed.
- Managed "Microfiltration Treatment and Design Options" synthesis project. 65% completed.
- Identified FFY24 short-term research projects.

Proposed activities for next year:

- Complete "BIM for Transit Infrastructure: A Feasibility and gap assessment with current practices and systems at the MBTA" project.
- Complete "Using Traffic Signals to Limit Speeding Opportunities on Arterial Roads" project.
- Complete "Uncovering the Root Causes for Truck Rollover Crashes on Ramps" project. 80% completed.
- Complete "Microfiltration Treatment and Design Options" synthesis project.
- Advance "Implementing the AASHTO Mechanistic-Empirical Pavement Design Guide Phase III" project to 75% completion.
- Advance "Methods to Identify Problematic Carriers and Prevent Infrastructure Damage" project to 85% completion.
- Advance "Feasibility Study of 3D Printing Applications for Bridge Elements in MA" project to 75% completion.
- Advance "Data-Driven Approach for Transit Capital Planning" project to 75% completion.
- Solicit and identify FFY24 short-term projects.

Anticipated products:

- Interim deliverables and final reports for all short-term research projects.
- List of short-term projects for FFY24.

Estimated task completion: 09-30-2022

Timeline for new consultant support: 1.Implementing the AASHTO Mechanistic-Empirical Pavement Design Guide Phase III (Continuing Project)

Consultant name: UMass Dartmouth

Scope development and FHWA review/approval: 08-15-2022

Contract negotiations and FHWA review/approval: 09-15-2022

Consultant Notice to Proceed: 09-30-2022

Total duration of task: 18 months

Timeline for new consultant support: 2.Methods to Identify Problematic Carriers and Prevent Infrastructure Damage (Continuing Project)

Consultant name: UMass Amherst
Scope development and FHWA review/approval: 03-23-2022
Contract negotiations and FHWA review/approval: 05-10-2022
Consultant Notice to Proceed: 06-02-2022
Total duration of task: 18 months

Timeline for new consultant support: 3.Feasibility Study of 3D Printing Applications for Bridge Elements in MA (Continuing Project)

Consultant name: UMass Amherst
Scope development and FHWA review/approval: 03-20-2022
Contract negotiations and FHWA review/approval: 04-14-2022
Consultant Notice to Proceed: 04-25-2022
Total duration of task: 19 months

Timeline for new consultant support: 4.Data-Driven Approach for Transit Capital Planning (Continuing Project)

Consultant name: UMass Amherst
Scope development and FHWA review/approval: 08-03-2022
Contract negotiations and FHWA review/approval: 08-15-2022
Consultant Notice to Proceed: 08-31-2022
Total duration of task: 15 months

Timeline for new consultant support: 5.BIM for Transit Infrastructure: A Feasibility and gap assessment with current practices and systems at the MBTA (Continuing Project)

Consultant name: UMass Amherst
Scope development and FHWA review/approval: 02-09-2022
Contract negotiations and FHWA review/approval: 03-15-2022
Consultant Notice to Proceed: 03-21-2022
Total duration of task: 15 months

Timeline for new consultant support: 6.Using Traffic Signals to Limit Speeding Opportunities on Arterial Roads (Continuing Project)

Consultant name: Northeastern University
 Scope development and FHWA review/approval: 12-10-2020
 Contract negotiations and FHWA review/approval: 06-10-2021
 Consultant Notice to Proceed: 07-01-2021
 Total duration of task: 24 months

Timeline for new consultant support: 7.Uncovering the Root Causes for Truck Rollover Crashes on Ramps (Continuing Project)

Consultant name: UMass Lowell
 Scope development and FHWA review/approval: 01-08-2021
 Contract negotiations and FHWA review/approval: 03-11-2021
 Consultant Notice to Proceed: 04-07-2021
 Total duration of task: 22 months

Timeline for new consultant support: 8.Synthesis study: Microfiltration Treatment and Design Options (Continuing Project)

Consultant name: Offshoot Inc
 Scope development and FHWA review/approval: 01-04-2021
 Contract negotiations and FHWA review/approval: 07-19-2021
 Consultant Notice to Proceed: 07-23-2021
 Total duration of task: 21 months

Estimated task budget: \$789,216.72

Staff salaries and benefits: \$55,234.72

MassDOT staff members	% Time to task
Michael Flanary	20.0
Drew Pflaumer	15.0
Nicholas Zavalas	10.0
Patrick McMahon	10.0
Hongyan Oliver	5.0

Consultant costs: \$733,982.00

Subtask / contract #	Total cost:	Pre-FFY 2023:	FFY 2023:	Post-FFY 2023:	Consultant/Contractor Name:	Consultant NTP:	Duration of Task (months):	Contract end date:
1. Implementing the AASHTO Mechanistic-Empirical Pavement Design Guide Phase III (Continuing Project) / None	\$400,167.00	\$0.00	\$241,352.00	\$158,755.00	UMass Dartmouth	09-30-2022	18	N/A
2. Methods to Identify Problematic Carriers and Prevent Infrastructure Damage (Continuing Project) / 117649	\$126,200.00	\$5,000.00	\$107,000.00	\$14,220.00	UMass Amherst	06-02-2022	18	11-30-2023
3. Feasibility Study of 3D Printing Applications for Bridge Elements in MA (Continuing Project) / 117646	\$150,000.00	\$7,000.00	\$139,000.00	\$4,000.00	UMass Amherst	04-25-2022	19	11-30-2023
4. Data-Driven Approach for Transit Capital Planning (Continuing Project) / None	\$100,000.00	\$0.00	\$80,000.00	\$20,000.00	UMass Amherst	08-31-2022	15	N/A
5. BIM for Transit Infrastructure: A Feasibility and gap assessment with current practices and systems at the MBTA (Continuing Project) / 117455	\$99,997.00	\$39,875.00	\$60,122.00	\$0.00	UMass Amherst	03-21-2022	15	05-31-2023
6. Using Traffic Signals to Limit Speeding Opportunities on Arterial Roads (Continuing Project) / 114372	\$140,000.00	\$80,000.00	\$60,000.00	\$0.00	Northeast University	07-01-2021	24	05-31-2023
7. Uncovering the Root Causes for Truck Rollover Crashes on Ramps (Continuing Project) / 113772	\$120,000.00	\$83,492.00	\$36,508.00	\$0.00	UMass Lowell	04-07-2021	22	03-31-2023
8. Synthesis study: Microfiltration Treatment and Design Options (Continuing Project) / 114903	\$40,000.00	\$30,000.00	\$10,000.00	\$0.00	Offshoot Inc	07-23-2021	21	04-01-2023

Consultant notes:

Other costs:

F. Medium-term Research Projects

Task Lead: Michael Flanary

Task Purpose: To perform the studies contained within this task, MassDOT contracts directly with universities, research institutes and/or private companies. The anticipated duration of active investigation and report writing efforts for short-term, medium-term and long-term projects are, respectively: less than 15 months, 15-21 months, and longer than 21 months (including 3 months of final report review, approval and 508 compliance). There may be occasion when a project's actual duration doesn't align with the anticipated duration due to challenges arising during research investigation and beyond the project team's control. Under such circumstances, additional time may be granted pending FHWA's approval, and the project shall remain within the original category for fiscal tracking purpose. The Research Section conducts annual research problem statement (RPS) solicitations to collect research needs from agency staff. The submitted problem statements are then prioritized based on MassDOT Division/Shared-Service Office Senior Leaders' rankings, MassDOT overall priorities, and research funding eligibility and availability. The Research Section assists MassDOT project champions with literature searches; the drafting of scopes of work; identification and selection of principal investigators, and the administration of project agreements/contracts, deliverables, final report reviews and publication, and coordination with FHWA.

Subtasks:

1. Measuring Accessibility to Improve Public Health (Continuing Project)

This project aims to 1) develop a methodology to identify and classify gaps in accessibility to jobs, health care, and food across time, demographic groups, and locations, which impact the public health of the populations affected; and 2) provide a set of recommendations for actions to address the specific types of identified accessibility gaps to reduce inequities. These methods could support MassDOT's existing accessibility data dashboard to continuously monitor accessibility gaps and inequities that affect public health. The research team has completed substantial work bringing together a diverse and representative group of public and private stakeholders from across Massachusetts for a technical advisory committee. Spatial analysis and travel time methodology are largely completed, to be refined with additional data as available. Accessibility metrics are

under development, as are the anticipated questions and discussion topics for intended stakeholder engagement meetings.

2. Energy-Focused Decision-making Framework for MBTA Operations and Planning (FY23 New Project)

This project aims to develop an enhanced system-wide energy model for MBTA urban rail transit building on prior efforts and harnessing network-specific substation energy data and to calibrate train-specific energy models for all the lines in the MBTA in order to evaluate high-resolution trajectory and ridership impacts on energy consumption. It will eventually build a decision-support tool to provide system-wide energy and cost predictions for given input on operational strategies in order to enable robust planning by the MBTA.

3. Accessible Bus Stop Design in the Presence of Bike Lanes (FY23 New Project)

The MBTA has been upgrading its bus stops for better accessibility, especially for wheelchair users and visually impaired individuals. While these accessible bus stops are integrated with Complete Street designs and other multi-modal accommodations, the impact of other modes and related infrastructure on transit user safety (e.g., conflicts between bicycles traveling on adjacent bike lanes and transit riders), has not been fully investigated. There is a pressing need for a better understanding of the impacts of bicycle infrastructure on bus stop accessibility and the exploration of mitigation plans that will ensure an accessible, equitable, and safe travel experience for all travelers. The objectives of this research are to: 1) investigate interactions of bus riders and bicyclists when bicycle infrastructure is adjacent to bus stops, and 2) propose design improvements to mitigate conflicts between bus riders of all abilities and bicyclists.

4. Developing a Salt Spreader Control Program based on Grip (Continuing Project)

Deicing material conservation makes fiscal sense and is also critical to protecting environmental resources while engaged in combating wintry precipitation on our roadways. There is growing interest in the design and utilization of systems that automatically adjust a salt spreader's deicing material (salt) dispensation rate based on observed grip levels in real time. The project aims to develop a prototypical technology and equip it onto one or more of MassDOT's salt spreaders to calibrate a salter's material dispensation rate to observed grip levels. The project

was kicked off in FFY22 Q3. Literature review and investigation of specifications and capabilities of MassDOT current equipment are currently underway.

5. Cross-Modal Impact Assessment for Sustainable Transportation Networks (FY23 New Project)

State agencies must make large investments into the transportation system which should be environmentally friendly, equitable and cost-effective which defines the three pillars of sustainable development. Therefore, when investing in a multi-mode transportation system, the following questions are crucial for defining the sustainability of the system: 1) What is the best way to quantify complex impacts across multiple domains (i.e., social, economic, and environmental)? 2) How does an agency quantify the impact of taking different transportation modes? 3) How can policy decisions about mode choice be evaluated through an equity lens? This project has three objectives: 1) introducing normalized metrics that can be used for cross-modal comparisons; 2) quantifying impacts in social, economic, and environmental dimensions; and 3) analyzing investment decisions with respect to equity.

6. Speed Management and Emergency Personnel (FY23 New Project)

Emergency personnel are frequently cited as reason not to implement speed management roadway treatments. The objective of this research is to learn more about specific concerns; how communities have overcome them; and share exemplary case studies from Massachusetts as well as other states for our new mass.gov/safe-speeds site. Additionally, research could include pilot and testing of treatments. The resulting data will be used to inform standards and specifications on speed management treatments that are workable for emergency personnel while still controlling speed.

7. LIMMS Gap Analysis and Development Plan (FY23 New Project)

The Laboratory Information Materials Management System (LIMMS) was designed as a secure platform to streamline and centralize materials data collection and provide tools to analyze patterns and trends statewide. The current design of LIMMS limits the expected benefits of the system. Through this project, MassDOT will investigate alternative software that can meet or exceed MassDOT's technical and design requirements. The purpose of this project is to conduct a gap analysis that will examine the needs of LIMMS users from system design to functionality. Findings will be used to inform the selection of future LIMMS software vendors.

8. Smart Work Zone Control and Performance Evaluation Based on Trajectory Data (Continuing Project)

The goal of this study is to develop computer vision technologies to extract trajectories of vehicles approaching work zones, and use the results to analyze driver behavior; identify safety hazards; and develop effective control strategies. The findings can be integrated into the existing MassDOT smart work zone systems for dynamic traffic control and can also be used to analyze and improve traffic operations at on-ramps and entrances of managed lane facilities.

9. Developing Massachusetts Specific Trip Generation Rates for Land Use Projects (Continuing Project)

This project aims to assist MassDOT in developing trip generation rates for high-priority land uses in Massachusetts. It intends to develop an algorithm-based model for deriving accurate trip generation rates for development projects located in Massachusetts. It will also identify and study available innovative technologies such as machine learning models and video analytics that can be used to assist MassDOT's efforts to collect vehicular and multi-modal trip generation data. The results of the project will improve the current methods used by MassDOT for projecting trip generation rates resulting from new, large urban development projects. The project champion established a wide-ranging group of technical experts as an advisory committee. The research team identified targeted land use types and all representative examples recently approved and constructed in Massachusetts to calibrate trip generation model. Due to the relatively low sample size, streetlight data was collected for comparable existing projects, with the added benefit of providing a longer-term example and sample. Pilot study, model guidance, and comparison of data collection methods are expected to be completed in FFY23.

10. Multisource Data Fusion for Real-Time and Accurate Traffic Incident Detection (Continuing Project)

This research investigates how data from the various traffic data sources that MassDOT owns or has access can be merged for accurate, real-time traffic incident detection, to improve travel time reliability. It assesses the current traffic incident detection methods employed by MassDOT and develops new tools for improved traffic incident detection based on available traffic data and addresses the fusion of

information from multiple sources of different temporal and spatial scales such as traffic data collected from loop detectors; information from the MassDOT Real Time Traffic Management (RTTM) system; and information available through third-party vendors (e.g., Waze, Google, INRIX). The research team continued working on model evaluation, while work was being completed on the anomaly detection model. Field implementation, led by the Highway Operation Center, was started in FFY22 Q3. A 4-month No-cost Time Extension was approved by FHWA in early September, which extends the project end date from December 30, 2022 to April 30, 2023.

11. Post-fire Damage Inspection of Concrete Structures Phase II (Continuing Project)

This phase focuses on physical testing of critical components of tunnels after being exposed to high combustion temperature. Key activities in this phase include identification of critical tunnel components for testing; physical testing of the components in a structural testing facility for their post-fire residual capacity; evaluating the non-destructive test methods identified in the Phase I literature review and owned by MassDOT based on the testing results; and adding new information resulting from lab testing to the inspection protocol checklist to assist field inspections. The project team conducted experimental testing; worked on the post-fire inspection checklist and drafted recommendations for future research. Slab testing will be completed in FFY23.

12. Massachusetts Depth to Bedrock Project (Continuing Project)

This project achieved the followings: 1) identified, collected, assembled and applied necessary data validation, quality control, attribution and processing to each of the existing geofomation data sources to unify the information for modeling soil thickness; 2) Combined soil thickness values with the constraints in the recently completed statewide surficial materials map (outcrops and shallow bedrock areas), LiDAR data (surface elevation) and other sources to model a continuous soil thickness raster along with a data quality confidence raster using appropriate geostatistical or other methods; and, 3) Used the soil thickness raster along with existing shear wave velocity data to generate a National Earthquake Hazards Reduction Program soil classification map for Massachusetts. The team is currently delivering resource maps in raster format showing the altitude of the top of bedrock and thickness of overburden that can be imported directly into MassDOT's Geographic Information System (GIS) for use in helping plan and design any

highway project in Massachusetts. A 6-month No-Cost Time Extension was approved by FHWA in early September, which extends the project end date from November 31, 2022 to May 31, 2023.

13. Outdoor Information Panels to Convey Real-Time Travel Information for Ridership Recovery (Continuing Project)

This research aims to provide a better understanding of which transit Real Time Travel Information (RTTI) meets the needs of current ridership connecting to transit by vehicle; how RTTI can be used to incentivize off-peak travel; and how RTTI may lead to mode-shifting based on the value propositions of information presented. Semi-structured interviews of selected travelers and broader online surveys are to be carried out in FFY23 to understand traveler's preference for position-specific RTTI and their behavior change. A no-cost time request is expected to accommodate the delays caused by the MBTA project champion change and the new approach to collect traveler preferences and mode choices.

14. Post-Fire Damage Inspection of Concrete Structures Phase III – Field Verification Phase (Continuing Project)

Built upon efforts of previous phases, this project addresses site conditions through in-situ heat testing of structural elements scheduled for demolition and evaluation of concrete patching materials subjected to high thermal load. This will allow for field results (including moisture content and thermal conductivity) to verify results from the laboratory tests, as well as proof of concept for using the heating set up in field testing. Testing will only be completed on components that are scheduled for demolition or removal and are expected to include both tunnel (wall or panel elements) and bridge components (deck, abutment or pier). In addition, Phase III will also evaluate the performance of concrete patches under extreme fire temperatures and test new materials which are currently proposed as protection methods for future tunnel structures in MassDOT.

15. Measuring Fare Payment Compliance on MBTA Buses and Light Rails (FY23 New Project)

Fare collection is a critical revenue stream for transit agencies, and evasion or underpayment reduces these needed revenues. Most MBTA riders are required to pay fares either on a pre-trip basis or by purchasing a pass, although some riders are eligible to use the system for free. Faregates in MBTA heavy rail stations provide reliable measures of fare non-payment but it is more difficult to

understand who is evading payment and how often on buses and light rail vehicles without direct manual observations. As the MBTA implements new fare and proof of payment policies, it is important to track any changes in fare-evasion over time. This project has two objectives: 1) use existing data from infrequent manual observations and from continuous AFC and APC devices to estimate rates of fare evasion on buses and light rail vehicles, and 2) develop a method to identify when and where manual spot checks of fare payment/evasion behaviors are most valuable.

16. Effectiveness of Two-stage Turn Queue Boxes in Massachusetts: A Comparison with Bike Boxes (Continuing Project)

A recently completed MassDOT study investigated both motorist and bicyclist behavior at single-stage bike box locations using field data from Massachusetts, and this project will assess the effectiveness of two-stage turn queue boxes. Results will be compared with the completed study to develop a design and implementation guideline for these two treatments. Data of interest that will be collected from field studies include how bicyclists are using these treatments (e.g., turning maneuvers, use of bike lane upstream) and how drivers behave when encountering these treatments, conflicts between bicycles and cars, as well as design characteristics. Design characteristics of specific bike box and two-stage turn queue box implementations, e.g., dimensions, the existence of green pavement markings vs. plain markings, and their impact on bicyclist and driver behavior and conflicts, will also be studied to inform design guidelines.

17. Developing a Visualization, Sharing and Processing Platform for Large-Scale Highway Asset Point Cloud Data (FY23 New Project)

MassDOT initiated procurement of a Mobile LiDAR unit this year. Due to the large size and the complex format, the utilization of the data has been burdened with expensive hardware, proprietary software, extensive training, and inflexible workflow. The point cloud data is only beneficial if MassDOT has the means to extract, process, access and visualize the information. There is a great need for a convenient platform that can maximize the utilization of the valuable point cloud data. The objectives of this study include 1) to develop a convenient data platform to enable visualization, sharing and processing of large-scale point cloud dataset; 2) to integrate the platform with the existing data sources and analysis tools in MassDOT; and 3) to customize processing pipelines using the platform for several

MassDOT's critical highway applications and demonstrate the feasibility and benefits of the platform.

Accomplishments in prior year:

- Completed the "A Method for Pavement Marking Inventory and Retroreflectivity Condition Assessment Using Mobile LiDAR " project.
- Completed the "Feasibility of the 3D Printing Application for Highway Infrastructure Construction and Maintenance" project.
- Completed the "Impact of Advanced Driver Assistance Systems (ADAS) on Road Safety and Implications for Education, Licensing, Registration and Enforcement" project.
- Completed the "Implementing the AASHTO Mechanistic-Empirical Pavement Design Guide Phase II" project. Final report was posted on Research website and submitted to TRID and the National Transportation Library.
- Completed the "UAS Network for Surface Transportation Emergency Response" project.
- Completed the "Detecting Subsurface Voids Using UAS with Infrared Thermal Imaging" project.
- Advanced the "Measuring Accessibility to Improve Public Health" project. 65% completed.
- Advanced the "Developing Massachusetts Specific Trip Generation Rates for Land Use Projects" project. 65% completed.
- Advanced the "Multisource Data Fusion for Real-Time and Accurate Traffic Incident Detection" project. 65% completed.
- Advanced the "Post-Fire Damage Inspection of Concrete Structures in Tunnels Phase II" project. 40% completed.
- Advanced the "Massachusetts Depth to Bedrock Project" project. 85% completed.
- Advanced the "Outdoor Information Panels to Convey Real-Time Travel Information for Ridership Recovery" project. 45% completed.
- Scoped, contracted, and started the "Using Grip Sensors to Control a Salt Spreader Application Rate" project. 8% completed.
- Scoped, contracted, and started the "Smart work zone control and performance evaluation based on trajectory data" project. 10% completed.

- Scoped, contracted, and started the “Post-Fire Damage Inspection of Concrete Structures Phase III Field Verification Phase” project. 5% completed.
- Scoped, contracted, and started the “Effectiveness of Two-stage Turn Queue Boxes in Massachusetts: A Comparison with Bike Boxes” project.
- Solicited and selected FFY23 medium-term research projects.

Proposed activities for next year:

- Identify PIs, develop amplified work plans, and establish ISAs and contracts for FFY23 new medium-term research projects.
- Complete the “Measuring Accessibility to Improve Public Health” project.
- Complete the “Developing Massachusetts Specific Trip Generation Rates for Land Use Projects” project.
- Complete the “Multisource Data Fusion for Real-Time and Accurate Traffic Incident Detection” project.
- Complete the “Post-Fire Damage Inspection of Concrete Structures in Tunnels Phase II” project.
- Complete the “Massachusetts Depth to Bedrock Project” project.
- Complete the “Outdoor Information Panels to Convey Real-Time Travel Information for Ridership Recovery” project.
- Complete the “Smart work zone control and performance evaluation based on trajectory data” project.
- Advance the “Using Grip Sensors to Control a Salt Spreader Application Rate” project to 50% completion.
- Advance the “Post-Fire Damage Inspection of Concrete Structures Phase III Field Verification Phase” project to 65% completion.
- Advance the “Effectiveness of Two-stage Turn Queue Boxes in Massachusetts: A Comparison with Bike Boxes” project to 50% completion.
- Scope, contract, and kick off all seven FFY23 new medium-term research projects.
- Solicitate and identify the list of FFY24 medium-term research projects.

Anticipated products:

- Contracts/ISAs for FFY23 medium-term projects.
- Initiation of FFY 23 medium-term projects.
- Interim deliverables and final reports for medium-term research projects that are scheduled to be completed in FFY23.

- Identification of FFY24 medium-term research projects.

Estimated task completion: 09-30-2023

Timeline for new consultant support: 1. Measuring Accessibility to Improve Public Health (Continuing Project)

Consultant name: UMass Amherst

Scope development and FHWA review/approval: 02-08-2021

Contract negotiations and FHWA review/approval: 03-23-2021

Consultant Notice to Proceed: 03-29-2021

Total duration of task: 21 months

Timeline for new consultant support: 2. Energy-Focused Decision-making Framework for MBTA Operations and Planning (FY23 New Project)

Consultant name: TBD

Scope development and FHWA review/approval: 12-31-2022

Contract negotiations and FHWA review/approval: 02-28-2023

Consultant Notice to Proceed: 02-28-2023

Total duration of task: 18 months

Timeline for new consultant support: 3. Accessible Bus Stop Design in the Presence of Bike Lanes (FY23 New Project)

Consultant name: TBD

Scope development and FHWA review/approval: 12-31-2022

Contract negotiations and FHWA review/approval: 02-28-2023

Consultant Notice to Proceed: 02-28-2023

Total duration of task: 18 months

Timeline for new consultant support: 4. Developing a Salt Spreader Control Program based on Grip (Continuing Project)

Consultant name: UMass Amherst

Scope development and FHWA review/approval: 03-28-2022

Contract negotiations and FHWA review/approval: 04-15-2022

Consultant Notice to Proceed: 04-25-2022

Total duration of task: 24 months

Timeline for new consultant support: 5. Cross-Modal Impact Assessment for Sustainable Transportation Networks (FY23 New Project)

Consultant name: TBD

Scope development and FHWA review/approval: 01-31-2023

Contract negotiations and FHWA review/approval: 03-31-2023

Consultant Notice to Proceed: 04-30-2023

Total duration of task: 18 months

Timeline for new consultant support: 6. Speed Management and Emergency Personnel (FY23 New Project)

Consultant name: TBD

Scope development and FHWA review/approval: 01-31-2023

Contract negotiations and FHWA review/approval: 03-31-2023

Consultant Notice to Proceed: 04-30-2023

Total duration of task: 21 months

Timeline for new consultant support: 7. LIMMS Gap Analysis and Development Plan (FY23 New Project)

Consultant name: TBD

Scope development and FHWA review/approval: 01-31-2023

Contract negotiations and FHWA review/approval: 03-31-2023

Consultant Notice to Proceed: 04-30-2023

Total duration of task: 18 months

Timeline for new consultant support: 8. Smart Work Zone Control and Performance Evaluation Based on Trajectory Data (Continuing Project)

Consultant name: UMass Lowell

Scope development and FHWA review/approval: 02-08-2022

Contract negotiations and FHWA review/approval: 03-15-2022

Consultant Notice to Proceed: 04-12-2022

Total duration of task: 18 months

Timeline for new consultant support: 9. Developing Massachusetts Specific Trip Generation Rates for Land Use Projects (Continuing Project)

Consultant name: UMass Lowell

Scope development and FHWA review/approval: 01-29-2021
Contract negotiations and FHWA review/approval: 03-11-2021
Consultant Notice to Proceed: 03-26-2021
Total duration of task: 19 months

Timeline for new consultant support: 10. Multisource Data Fusion for Real-Time and Accurate Traffic Incident Detection (Continuing Project)

Consultant name: UMass Lowell
Scope development and FHWA review/approval: 01-21-2021
Contract negotiations and FHWA review/approval: 03-31-2021
Consultant Notice to Proceed: 04-01-2021
Total duration of task: 18 months

Timeline for new consultant support: 11. Post-fire Damage Inspection of Concrete Structures Phase II (Continuing Project)

Consultant name: UMass Amherst
Scope development and FHWA review/approval: 03-18-2021
Contract negotiations and FHWA review/approval: 04-19-2021
Consultant Notice to Proceed: 05-01-2021
Total duration of task: 22 months

Timeline for new consultant support: 12. Massachusetts Depth to Bedrock Project (Continuing Project)

Consultant name: UMass Amherst
Scope development and FHWA review/approval: 01-21-2021
Contract negotiations and FHWA review/approval: 02-18-2021
Consultant Notice to Proceed: 03-24-2021
Total duration of task: 21 months

Timeline for new consultant support: 13. Outdoor Information Panels to Convey Real-Time Travel Information for Ridership Recovery (Continuing Project)

Consultant name: UMass Amherst
Scope development and FHWA review/approval: 03-23-2021
Contract negotiations and FHWA review/approval: 05-14-2021
Consultant Notice to Proceed: 05-24-2021
Total duration of task: 18 months

Timeline for new consultant support: 14. Post-Fire Damage Inspection of Concrete Structures Phase III – Field Verification Phase (Continuing Project)

Consultant name: UMass Amherst
Scope development and FHWA review/approval: 04-03-2022
Contract negotiations and FHWA review/approval: 04-15-2022
Consultant Notice to Proceed: 04-25-2022
Total duration of task: 22 months

Timeline for new consultant support: 15. Measuring Fare Payment Compliance on MBTA Buses and Light Rails (FY23 New Project)

Consultant name: TBD
Scope development and FHWA review/approval: 01-31-2023
Contract negotiations and FHWA review/approval: 03-31-2023
Consultant Notice to Proceed: 04-30-2023
Total duration of task: 21 months

Timeline for new consultant support: 16. Effectiveness of Two-stage Turn Queue Boxes in Massachusetts: A Comparison with Bike Boxes (Continuing Project)

Consultant name: UMass Amherst
Scope development and FHWA review/approval: 06-02-2022
Contract negotiations and FHWA review/approval: 08-01-2022
Consultant Notice to Proceed: 08-31-2022
Total duration of task: 21 months

Timeline for new consultant support: 17. Developing a Visualization, Sharing and Processing Platform for Large-Scale Highway Asset Point Cloud Data (FY23 New Project)

Consultant name: TBD
Scope development and FHWA review/approval: 12-31-2022
Contract negotiations and FHWA review/approval: 01-31-2023
Consultant Notice to Proceed: 02-15-2023
Total duration of task: 21 months

Estimated task budget: \$1,313,839.12

Staff salaries and benefits: \$95,067.12

MassDOT staff members	% Time to task
Nicholas Zavalas	25.0
Patrick McMahon	25.0
Michael Flanary	20.0
Drew Pflaumer	15.0
Hongyan Oliver	10.0

Consultant costs: \$1,218,772.00

Subtask / contract #	Total cost:	Pre-FFY 2023:	FFY 2023:	Post-FFY 2023:	Consultant/ Contractor Name:	Consultant NTP:	Duration of Task (months):	Contract end date:
1. Measuring Accessibility to Improve Public Health (Continuing Project) / 114069	\$149,999.00	\$127,724.00	\$22,275.00	\$0.00	UMass Amherst	03-29-2021	21	01-31-2023
2. Energy-Focused Decision-making Framework for MBTA Operations and Planning / TBD	\$125,000.00	\$0.00	\$60,000.00	\$65,000.00	TBD	02-28-2023	18	N/A
3. Accessible Bus Stop Design in the Presence of Bike Lanes / TBD	\$200,000.00	\$0.00	\$100,000.00	\$100,000.00	TBD	02-28-2023	18	N/A
4. Developing a Salt Spreader Control Program based on Grip / 117740	\$125,000.00	\$13,000.00	\$80,000.00	\$32,000.00	UMass Amherst	04-25-2022	24	04-30-2024
5. Cross-Modal Impact Assessment for Sustainable Transportation Networks / TBD	\$100,000.00	\$0.00	\$50,000.00	\$50,000.00	TBD	04-30-2023	18	N/A
6. Speed Management and Emergency Personnel / TBD	\$300,000.00	\$0.00	\$100,000.00	\$200,000.00	TBD	04-30-2023	21	N/A
7. LIMMS Gap Analysis and Development Plan / TBD	\$300,000.00	\$0.00	\$100,000.00	\$200,000.00	TBD	04-30-2023	18	N/A
8. Smart work zone control and performance evaluation based on trajectory data / 117478	\$150,000.00	\$27,400.00	\$122,600.00	\$0.00	UMass Lowell	04-12-2022	18	09-30-2023
9. Developing Massachusetts Specific Trip Generation Rates for Land Use Projects / 113773	\$150,000.00	\$88,371.00	\$61,629.00	\$0.00	UMass Lowell	03-26-2021	19	12-31-2022
10. Multisource Data Fusion for Real-Time and Accurate Traffic Incident Detection / 113774	\$150,000.00	\$84,770.00	\$65,230.00	\$0.00	UMass Lowell	04-01-2021	18	12-31-2022
11. Post-fire Damage Inspection of Concrete Structures Phase II / 114201	\$160,000.00	\$153,735.00	\$6,265.00	\$0.00	UMass Amherst	05-01-2021	22	02-28-2023
12. Massachusetts Depth to Bedrock Project / 113776	\$114,675.00	\$103,720.00	\$10,955.00	\$0.00	UMass Amherst	03-24-2021	21	11-30-2022

13. Outdoor Information Panels to Convey Real-Time Travel Information for Ridership Recovery / 114217	\$124,999.00	\$86,181.00	\$38,818.00	\$0.00	UMass Amherst	05-24-2021	18	01-21-2023
14. Post-Fire Damage Inspection of Concrete Structures Phase III – Field Verification Phase / 117741	\$180,000.00	\$17,000.00	\$138,000.00	\$25,000.00	UMass Amherst	04-25-2022	22	02-28-2024
15. Measuring Fare Payment Compliance on MBTA Buses and Light Rails / TBD	\$150,000.00	\$0.00	\$50,000.00	\$100,000.00	TBD	04-30-2023	21	None
16. Effectiveness of Two-stage Turn Queue Boxes in Massachusetts: A Comparison with Bike Boxes / 118671	\$149,778.00	\$4,000.00	\$138,000.00	\$7,778.00	UMass Amherst	08-31-2022	21	12-31-2023
17. Developing a Visualization, Sharing and Processing Platform for Large-Scale Highway Asset Point Cloud Data / TBD	\$175,000.00	\$0.00	\$75,000.00	\$100,000.00	TBD	02-15-2023	21	N/A

Consultant notes: 10. Expecting a 4-month NCTE to be approved. 12. Expecting a 6-month NCTE to be approved.

Other costs:

G. Long-term Research Projects

Task Lead: Michael Flanary

Task Purpose: To perform the studies contained within this task, MassDOT contracts directly with universities, research institutes and/or private companies. The anticipated duration of active investigation and report writing efforts for short-term, medium-term and long-term projects are, respectively: less than 15 months, 15-21 months, and longer than 21 months (including 3 months of final report review, approval and 508 compliance). There may be occasion when a project's actual duration doesn't align with the anticipated duration due to challenges arising during research investigation and beyond the project team's control. Under such circumstances, additional time may be granted pending FHWA's approval, and the project shall remain within the original category for fiscal tracking purpose. The Research Section conducts annual research problem statement (RPS) solicitations to collect research needs from agency staff. The submitted problem statements are then prioritized based on MassDOT Division/Shared-Service Office Senior Leaders' rankings, MassDOT overall priorities, and research funding eligibility and availability. The Research Section assists MassDOT project champions with literature searches; the drafting of scopes of work; identification and selection of principal investigators, and the administration of project agreements/contracts, deliverables, final report reviews and publication, and coordination with FHWA.

Subtasks:

1. Ultra-High-Performance Concrete Reinforced with Multi-Scale Hybrid Fibers and Its Durability-Related Properties (Continuing Project)

The study is to develop a novel UHPC reinforced with Multi-Scale Hybrid Fibers (MSHF) and nano-scale additives with enhancements in both early-age properties and long-term performance such as high early-age strength, low volume change, low permeability and extended service life in the presence of environmental threats in Massachusetts. The project will also develop a comprehensive understanding of the roles of MSHF, additives, and cement chemistry in improving durability-related properties of UHPC. The project team purchased an appropriate mixer for fiber-reinforced concrete and performed analysis of fiber properties for several materials, lengths, and diameters, finalized mixture component analysis and mixture design, and developed a toolbox for modified Andersen and Andersen model and least square fitting. Instruments for mechanical and physical property

testing have been calibrated and prepared for use. Initial castings have been performed with property testing and further mixture refinement to occur shortly.

2. Complete Street and Urban Trees (Continuing Project)

Focusing on soil impacts and root systems, the research will bring a much-needed arboricultural perspective to early project development, as well as design and construction, when it can most effectively anticipate, minimize, and mitigate impacts to trees, at the same time identifying strategies for both restoration and enhancement of the urban forest. This research includes a multifaceted approach to surveying the state of the practice, including: a literature search of related professional journals; input from a cross-disciplinary panel of experts; an on-line survey of practicing professionals responsible for the health of urban forests at select DOTs and cities. These information resources will yield guidance documentation for preliminary corridor tree-health evaluation and general impact analysis for engineers, planners, and landscape architects, as well as consulting arborists. Research will also provide guidance for soil area planting requirements for new trees, as well as best management practices for soil protection during construction.

3. Recycled Ground-Glass Pozzolan (RGGP) for Use in Cement Concrete (FY23 New Project)

Cement concrete is the most critical building material used in the construction of our infrastructure. However, hydraulic cement, the key ingredient of cement concrete, produces an immense amount of heat and carbon dioxide during the manufacturing process. Recycled ground-glass pozzolan (RGGP) is a new type of material that has the potential to greatly reduce the amount of hydraulic cement (up to 50% reduction) needed in the mix design formulation. Additionally, other hydraulic cement replacement materials used in today's cement concrete, such as fly ash and slag, are becoming more and more scarce, resulting in a problematic supply crunch and increases in cost. The objectives of this research project include validation of the efficacy of RGGP and development of new mix design formulations with RGGP, which will lead to decreasing our carbon footprint, while increasing the quality and long-term durability of cement concrete used in MassDOT projects.

4. Revised Load Rating Procedures for Deteriorated Prestressed Concrete Beams (Continuing Project)

The project is to develop an approach to determine a safe working capacity realistically and reliably for existing precast, prestressed concrete bridges which exhibit deterioration to avoid unnecessary bridge closures while also keeping the public safe. This project is being carried out through a combination of computer model simulations and full-scale testing of actual deteriorated beams in the laboratory. Extensive literature review and inspection report synthesis have been completed. The project team developed and calibrated computer models and prepared lab setup and equipment for beam testing. Six 40'-long concrete beams from MassDOT bridge demolition projects were delivered to the lab in August. These beams are much longer than what had been anticipated during scoping. As a result, a professional crane truck service must be hired to move the beams in and out of the lab facility at UMass and allow the project team to proceed with beam testing. Consequently, a request for \$20K cost increase is anticipated for the necessary crane truck service. This cost increase can be accommodated within Task G's overall budget.

5. Field Study to Determine Salt Usage Efficiency on Two Pavement Types (Continuing Project)

Winter maintenance activities are a high priority to MassDOT in order to ensure its roadways are safe for the motoring public during winter events. MassDOT is concerned that certain pavement surface types may have been over-treated during winter maintenance. As such, there is a need to collect and analyze field data to understand if the current treatment applications and frequencies are correct, deficient or excessive. Through field study, the project will quantify the minimum safe level of salt application for typical pavement surface types and compare the results to the current application rates and frequency. The study will also investigate both safety and environmental aspects of the current salt treatment rate and those of the determined efficient rate.

6. Evaluating Driver Education Modules on Safety (FY23 New Project)

This project intends to conduct a comprehensive examination of the contents of current Massachusetts driver's education modules and their delivery methods to determine which, if any, modules of the program positively influence novice driver behavior and improve roadway safety. Additionally, there are numerous new technologies affecting drivers, such as advanced driving assistance systems, that are not yet covered under any drivers' education modules. The project will yield data and an associated report detailing the effectiveness of drivers' education on

improving safety and reducing drivers' citations, guidelines/standards for driver's education components, and delivery methods. that lead to optimal effectiveness. It will also provide guidance on the creation and implementation of new modules covering emerging technologies affecting drivers.

7. Optimization of MassDOT's High Performance Thin Lift Mixtures (Continuing Project)

This project aims to 1) evaluate the three types of high-performance thin pavement lift mixture specifications and performance characteristics as they currently stand; 2) test the current MassDOT mixes and benchmark their performance and construction costs and determining if it is possible to optimize materials or design parameters to improve on the current specifications; and 3) perform a life cycle cost analysis for the optimized mixture types. Extensive literature review has been completed and extensive lab testing of different overlay mixtures are being conducted during FFY22.

8. Development of Improved Inspection Techniques using LiDAR for Deteriorated Steel Beam Ends (Continuing Project)

Through recently completed research, MassDOT has developed new improved procedures to accurately describe the remaining load carrying capacity of deteriorated steel beams and has also explored using LiDAR scanning technology for acquiring crucial data for load rating in the lab environment. This project employs the LiDAR scanner for a field verification of the methodology. This will produce field results reflecting challenges faced by bridge inspectors in the field, a comparison with lab results from Phase II, and verification of using the 3D scanning technology for bridge inspection in reality. More specifically, the study will collect data using the LiDAR in the field, develop appropriate methods to process the data (filter noise, scale the problem) and use the output to provide important information for the estimation of the residual capacity.

9. Measuring Accessibility to Improve Public Health Phase II (FY23 New Project)

Efforts have been made to quantify the access that communities across Massachusetts have to opportunities like jobs, food, healthcare, and education. The first phase accounted for different modes but did not consider the built environment and transportation infrastructure's impact on accessibility. This research expands on current work on the measurement of accessibility to focus on

the data and metrics needed to adequately account for access by bicycling, walking, microtransit, and ridesource/ridesharing services. This research has two objectives: 1) develop measures of accessibility for alternative modes of transportation that account for relevant characteristics of infrastructure, built environment, and hours and area of service, and 2) identify gaps and inequities in accessibility that can be addressed by improving transportation access.

10. 3D-Printed Lattice-based Structures for Next Gen Bridge Bearings (FY23 New Project)

Bridge bearings are installed between the bridge substructure and the superstructure to transfer loads and allow controlled translations to reduce stresses in the structure. Recent progress in 3D printing applications through the MassDOT research program examined promising customizable designs for typical bridge and isolation bearings. This project will develop a prototype architected bearing system and manufacture and test the 3D printing bearing systems and will involve the design of architected lattices which will serve as the reinforcement of the rubber elastomer intended to replace the undesirable lead core in the traditional isolation bearings. The main research efforts including the manufacturing of the prototype and testing of the composite bearings for a variety of loading conditions.

11. A Method for Pavement Marking Inventory and Retroreflectivity Condition Assessment Using Mobile Lidar (Phase II) (FY23 New Project)

FHWA's minimum pavement marking retroreflectivity level requirement in the forthcoming MUTCD creates a pressing need for MassDOT to implement an effective and efficient means for pavement marking inventory and retroreflectivity assessments. Phase 1 of this project successfully developed an automated methodology for identifying pavement marking, evaluating retroreflectivity condition and surface condition. The objective of Phase 2 of this project is twofold: 1) to continue monitoring the existing testing sections and include more sections with waterborne and preformed tape, and to investigate the effects of wet marking, recessed marking and skip sections on the retroreflectivity. 2) to investigate the feasibility of using a LiDAR-based methodology for the QA/QC processes of newly installed pavement markings.

12. Effect of Asphalt Binder Source in Asphalt Mixture Performance (FY23 New Project)

There is a need to understand how asphalt binder source affects the asphalt mixture's overall performance between laboratory and paving settings. The research will investigate how binder source affects mixture performance by determining properties with significant variation; determining the mixture changes that significantly affect performance; analyzing the lifecycle cost based on binder properties; establishing specifications for allowable tolerances; and providing guidance on updating MassDOT pavement specifications to include new testing protocols.

Accomplishments in prior year:

- Completed the "Asset Management Systems at Municipalities " project.
- Completed the " Development of Comprehensive Inspection Protocols for Deteriorated Steel Beam End" project.
- Advanced the "Ultra-High-Performance Concrete Reinforced with Multi-Scale Hybrid Fibers and Its Durability-Related Properties" project to 40% completion.
- Advanced the "Revised Load Rating Procedures for Deteriorated Prestressed Concrete Beams" project to 55% completion.
- Advanced the "Optimization of MassDOT's High Performance Thin Lift Mixtures" project to 41% completion.
- Scoped, contracted, and kicked off the "Complete Streets v.2: Respecting the Roots" project. 15% completed.
- Scoped and contracted the "Field Study to Determine Salt Usage Efficiency on Two Pavement Types" project. Project will be kicked off at the beginning of FFY23 Q1.
- Scoped, contracted, and kicked off the "Development of Improved Inspection Techniques using LiDAR for Deteriorated Steel Beam Ends" project. 10% completed.
- Solicited and selected FFY23 long-term research projects.

Proposed activities for next year:

- Complete the "Revised Load Rating Procedures for Deteriorated Prestressed Concrete Beams" project.
- Complete the "Optimization of MassDOT's High Performance Thin Lift Mixtures" project.

- Advance the "Ultra-High-Performance Concrete Reinforced with Multi-Scale Hybrid Fibers and Its Durability-Related Properties" project to 90% completion.
- Advance the "Complete Streets v.2: Respecting the Roots" project to 40% completion.
- Advance the "Field Study to Determine Salt Usage Efficiency on Two Pavement Types" project to 40% completion.
- Advance "Development of Improved Inspection Techniques using LiDAR for Deteriorated Steel Beam Ends" project to 60% completion.
- Scope, contract, and kick off all seven FFY23 new long-term research projects.
- Solicit and Identify FFY24 long-term research projects.

Anticipated products:

- Contracts/ISAs for FFY23 long-term projects.
- Initiation of FFY23 long-term projects.
- Interim deliverables and final reports for long-term research projects that are scheduled to be completed during FFY23.
- Identification of FFY24 long-term projects.

Estimated task completion: 09-30-2023

Timeline for new consultant support: 1. Ultra-High-Performance Concrete Reinforced with Multi-Scale Hybrid Fibers and Its Durability-Related Properties (Continuing Project)

Consultant name: UMass Dartmouth
 Scope development and FHWA review/approval: 06-29-2021
 Contract negotiations and FHWA review/approval: 07-30-2021
 Consultant Notice to Proceed: 08-05-2021
 Total duration of task: 27 months

Timeline for new consultant support: 2. Complete Street and Urban Trees (Continuing Project)

Consultant name: UMass Amherst
 Scope development and FHWA review/approval: 02-25-2022
 Contract negotiations and FHWA review/approval: 03-22-2022
 Consultant Notice to Proceed: 04-01-2023

Total duration of task: 29 months

Timeline for new consultant support: 3. Recycled Ground-Glass Pozzolan (RGGP) for Use in Cement Concrete (FY23 New Project)

Consultant name: TBD

Scope development and FHWA review/approval: 01-31-2023

Contract negotiations and FHWA review/approval: 04-30-2023

Consultant Notice to Proceed: 05-31-2022

Total duration of task: 22 months

Timeline for new consultant support: 4. Revised Load Rating Procedures for Deteriorated Prestressed Concrete Beams (Continuing Project)

Consultant name: UMass Amherst

Scope development and FHWA review/approval: 02-17-2021

Contract negotiations and FHWA review/approval: 04-15-2021

Consultant Notice to Proceed: 04-27-2021

Total duration of task: 29 months

Timeline for new consultant support: 5. Field Study to Determine Salt Usage Efficiency on Two Pavement Types (Continuing Project)

Consultant name: UMass Dartmouth

Scope development and FHWA review/approval: 08-02-2022

Contract negotiations and FHWA review/approval: 09-15-2022

Consultant Notice to Proceed: 09-30-2022

Total duration of task: 36 months

Timeline for new consultant support: 6. Evaluating Driver Education Modules on Safety (FY23 New Project)

Consultant name: TBD

Scope development and FHWA review/approval: 01-31-2023

Contract negotiations and FHWA review/approval: 03-31-2023

Consultant Notice to Proceed: 04-30-2023

Total duration of task: 24 months

Timeline for new consultant support: 7. Optimization of MassDOT's High Performance Thin Lift Mixtures (Continuing Project)

Consultant name: UMass Dartmouth
Scope development and FHWA review/approval: 04-27-2021
Contract negotiations and FHWA review/approval: 06-10-2021
Consultant Notice to Proceed: 07-01-2021
Total duration of task: 27 months

Timeline for new consultant support: 8. Development of Improved Inspection Techniques using LiDAR for Deteriorated Steel Beam Ends (Continuing Project)

Consultant name: UMass Amherst
Scope development and FHWA review/approval: 02-04-2022
Contract negotiations and FHWA review/approval: 03-08-2022
Consultant Notice to Proceed: 03-21-2022
Total duration of task: 24 months

Timeline for new consultant support: 9. Measuring Accessibility to Improve Public Health Phase II (FY23 New Project)

Consultant name: TBD
Scope development and FHWA review/approval: 01-31-2023
Contract negotiations and FHWA review/approval: 03-31-2023
Consultant Notice to Proceed: 04-30-2023
Total duration of task: 24 months

Timeline for new consultant support: 10. 3D-Printed Lattice-based Structures for Next Gen Bridge Bearings (FY23 New Project)

Consultant name: TBD
Scope development and FHWA review/approval: 12-31-2022
Contract negotiations and FHWA review/approval: 03-31-2023
Consultant Notice to Proceed: 04-30-2023
Total duration of task: 24 months

Timeline for new consultant support: 11. A Method for Pavement Marking Inventory and Retroreflectivity Condition Assessment Using Mobile Lidar (Phase II) (FY23 New Project)

Consultant name: UMass Amherst
 Scope development and FHWA review/approval: 12-31-2022
 Contract negotiations and FHWA review/approval: 01-31-2023
 Consultant Notice to Proceed: 02-28-2023
 Total duration of task: 24 months

Timeline for new consultant support: 12. Effect of Asphalt Binder Source in Asphalt Mixture Performance (FY23 New Project)

Consultant name: TBD
 Scope development and FHWA review/approval: 01-31-2023
 Contract negotiations and FHWA review/approval: 04-30-2023
 Consultant Notice to Proceed: 05-31-2023
 Total duration of task: 24 months

Estimated task budget: \$1,590,433.12

Staff salaries and benefits: \$95,067.12

MassDOT staff members	% Time to task
Patrick McMahon	25.0
Nicholas Zavalas	25.0
Michael Flanary	20.0
Drew Pflaumer	15.0
Hongyan Oliver	10.0

Consultant costs: \$1,495,366.00

Subtask / contract #	Total cost:	Pre-FFY 2023:	FFY 2023:	Post-FFY 2023:	Consultant /Contractor Name:	Consultant NTP:	Duration of Task (months):	Contract end date:
1. Ultra-High-Performance Concrete Reinforced with Multi-Scale Hybrid Fibers and Its Durability-Related Properties / 115287	\$197,402.00	\$23,162.00	\$166,828.00	\$7,412.00	UMass Dartmouth	08-05-2021	27	10-30-2023
2. Complete Street and Urban Trees / 117524	\$89,897.00	\$12,029.00	\$72,868.00	\$5,000.00	UMass Amherst	04-01-2022	29	08-31-2024
3. Reccycled Ground-Glass Pozzolan (RGGP) for Use in Cement Concrete / TBD	\$250,000.00	\$0.00	\$100,000.00	\$150,000.00	TBD	05-31-2023	22	N/A
4. Revised Load Rating Procedures for Deteriorated Prestressed Concrete Beams / 114071	\$199,995.00	\$97,285.00	\$102,670.00	\$0.00	UMass Amherst	04-27-2021	29	08-31-2023
5. Field Study to Determine Salt Usage Efficiency on Two Pavement Types / 119069	\$450,000.00	\$0.00	\$250,000.00	\$200,000.00	UMass Dartmouth	09-30-2022	36	9-30-2025
6. Evaluating Driver Education Modules on Safety / TBD	\$370,000.00	\$0.00	\$150,000.00	\$220,000.00	TBD	04-30-2023	24	N/A
7. Optimization of MassDOT's High Performance Thin Lift Mixtures / 114557	\$249,997.00	\$66,000.00	\$165,000.00	\$18,997.00	UMass Dartmouth	07-01-2021	27	03-31-2022
8. Development of Improved Inspection Techniques using LiDAR for Deteriorated Steel Beam Ends / 117416	\$199,998.00	\$44,771.00	\$98,000.00	\$57,227.00	UMass Amherst	03-21-2022	24	03-31-2024
9. Measuring Accessibility to Improve Public Health Phase II / TBD	\$200,000.00	\$0.00	\$80,000.00	\$12,000.00	TBD	04-30-2023	24	N/A
10. 3D-Printed Lattice-based Structures for Next Gen Bridge Bearings / TBD	\$200,000.00	\$0.00	\$80,000.00	\$120,000.00	TBD	04-30-2023	24	N/A
11. A Method for Pavement Marking Inventory and Retroreflectivity Condition Assessment Using Mobile Lidar (Phase II) / TBD	\$200,000.00	\$0.00	\$80,000.00	\$12,000.00	UMass Amherst	02-28-2023	24	N/A
12. Effect of Asphalt Binder Source in Asphalt Mixture Performance / TBD	\$400,000.00	\$0.00	\$150,000.00	\$250,000.00	TBD	05-31-2023	24	N/A

Consultant notes:

Other costs:

H. National RD&T2 Collaboration

Task Lead: Hongyan Oliver

Task Purpose: To coordinate MassDOT's participation in national and regional transportation research activities, including the research committees, research statement submission and reviews, project panels, technical working groups, and task forces; to disseminate MassDOT's research efforts, products, program management and delivery approaches both nationally and regionally; and to distribute research results and activities of Transportation Research Board (TRB), American Association of State Highway and Transportation Officials (AASHTO) and other state DOTs within MassDOT.

Accomplishments in prior year:

- Hosted the 2022 AASHTO Research Advisory Committee Annual Meeting.
- Coordinated within MassDOT Highway Division to establish participation in transportation pooled fund (TPF) projects funded through SPRII.
- Participated in and contributed to AASHTO RAC activities.
- Coordinated the TRB National Cooperative Highway Research Program (NCHRP) problem statement review process.
- Disseminated TRB research reports, technical webinars and NCHRP project panel member solicitations to appropriate MassDOT staff.
- Participated in and contributed to New England Transportation Consortium (NETC) program management and technical activities.
- Participated in and contributed to AASHTO's RAC Regional 1 activities including preparation activities for the RAC 2021 summer meeting.
- Applied for and received AASHTO RAC Committee High Value Research Project Award.
- Updated MassDOT research projects in the TRB Research-In-Progress database.
- Disseminated MassDOT research reports through the TRB E-Newsletter.
- Participated in FHWA's 2022 State Innovation Forum.
- Participated in MnDOT's Research Peer Exchange.

Proposed activities for next year:

- Coordinate within MassDOT to establish participation in pooled fund programs, and support AASHTO RAC activities, NCHRP research statement reviews, NCHRP technical panel participation, and TRB representative's visit.

- Lead and contribute to RAC Region I activities.
- Participate in and contribute to the remaining NETC project activities.
- Participate in the TRB's Northeast state group visit.
- Participate in other State DOTs' Research Peer Exchange when appropriate.

Anticipated products:

- Distribution of research products and information from TRB, TPF and other state DOTs.
- Communication of MassDOT research reports through TRB E-Newsletter.
- Organizing and participation in AASHTO RAC activities.
- Identification of MassDOT's position on problem statements for the annual NCHRP project cycle.
- Coordination of MassDOT subject matter experts' participation in NETC projects.

Estimated task completion: 09-30-2023

Estimated task budget: \$1,426,905.93

Staff salaries and benefits: \$47,647.93

MassDOT staff members	% Time to task
Patrick McMahon	20.0
Nicholas Zavolas	10.0
Hongyan Oliver	10.0
Drew Pflaumer	5.0

Other costs: \$1,379,258.00

Below is a list of Transportation Pooled Fund projects with a total cost of \$1,370,258 (eligible for 100% federal funds and thus not included in the SPR financial table but will be included in the FFY23 STIP as its own line item). They are noted here for informational purposes:

- 5(370) Fostering Innovation in Pedestrian and Bicycle Transportation, \$25,000
- 5(398) Moving Forward with The Next Generation Travel Behavior Data Collection, \$5,000
- 5(422) National Cooperative Highway Research Program, \$826,802

- 5(437) Tech Transfer Concrete Consortium, \$12,000
- 5(431) Application of Enterprise GIS for Transportation, Guidance or a National Transportation Framework (AEGIST), \$100,000 (100% federal fund waiver is for SPRI)
- 5(447) Traffic Control Device (TCD) Consortium, \$10,000
- 5(455) National Accessibility Evaluation Phase II, \$38,000
- 5(456) Econworks, \$4,000 (100% federal fund waiver is for SPRI)
- 5(464) H&H software updates, \$10,000
- 5(479) Clear Roads Phase III, \$25,000
- 5(481) In-Service Performance Evaluation (ISPE) of Roadside Safety Features, \$30,000
- 5(482) Development and Evaluation of Roadside Safety Systems for Motorcyclists, \$40,000
- 5(TBD) Roadside Safety Research for MASH Implementation Phase III, \$65,000
- 5(TBD) TRB Core Support Services \$154,456
- Additional requests during FFY 23: \$25,000

I. Construction Management Certificate Program (Delivered by MassDOT HR Training)

Task Lead: Claudia Smith-Reid

Task Purpose: To support MassDOT HR Training Program activities that provide oversight and administration of the MassDOT/Wentworth Construction Management Certificate Program (CMCP) for employees of the MassDOT Highway Division.

Subtasks:

Construction Management Certificate Program

Continue implementing the 3-year partnership agreement with the Wentworth Institute of Technology (WIT). Deliver the Construction Management Certification Program to 30 participants representing all Highway districts. The annual expense is set at \$60,000, which covers the delivery of the 7-week curriculum (the module contents had been jointly developed by WIT and MassDOT in FFY18 and approved by FHWA in FFY19). It is anticipated that about thirty (30) MassDOT Highway construction staff will attend the 7-week training program each year. The second annual training to be delivered under this contract will be January - March 2023. No training was conducted in FFY21 due to COVID restrictions; a contract extension is expected to allow the 3rd annual training to be delivered in FFY24.

Accomplishments in prior year:

- Worked with Wentworth Institute on Management Certificate Program in January – March 2022.

Proposed activities for next year:

- Implement the year two of the 3-year partnership agreement with the Wentworth Institute of Technology. Deliver the Construction Management Certification Program to 30 participants representing all Highway districts. The annual expense is \$60,000 to pay for the delivery of the previously approved 7-week curriculum.

Anticipated products:

- Administration of the Mass DOT/Wentworth Construction Management Certificate Program

Estimated task completion: 09-30-2023

Timeline for new consultant support: Construction Management Certificate Program

Consultant name: Wentworth

Scope development and FHWA review/approval: 09-30-2020

Contract negotiations and FHWA review/approval: 12-31-2020

Consultant Notice to Proceed: 01-15-2021

Total duration of task: 33 months

Estimated task budget: \$60,000.00

Consultant costs: \$60,000.00

Subtask / contract #	Total cost:	Pre-FFY 2023:	FFY 2023:	Post-FFY 2023:	Consultant/ Contractor Name:	Consultant NTP:	Duration of Task (months):	Contract end date:
Construction Management Certificate Program / 113551	\$180,000.00	\$60,000.00	\$60,000.00	\$60,000.00	Wentworth	01-15-2021	33	09-30-2023

Consultant notes: \$180,000 for 3 years (\$60,000 per year).

Other costs:

J. MassDOT Moving Together and Innovation Conferences

Task Lead: Drew Pflaumer

Task Purpose: MassDOT convenes two transportation technology transfer conferences each year: a one-day Moving Together Conference in the fall and a two-day Transportation Innovation Conference in the spring. Through the comprehensive MassDOT-UMass Amherst Interdepartmental Service Agreement (ISA #109600), UMTC provides services to MassDOT including conference program planning; coordinating with speakers and moderators; managing event registration and exhibitors; contracting with venue and event support services; managing conference logistics; and delivering the conferences.

Subtasks:

MassDOT Conferences

Conference supporting efforts and expenses were previously embedded in other UMTC ISA components (mostly LTAP); and are to be separated from those components for FY23-FY25 through the ISA Amendment.

Accomplishments in prior year:

- Delivered the virtual 2021 Moving Together conference.
- Delivered the hybrid 2022 Innovation Conference.

Proposed activities for next year:

- Coordinate in-person and/or virtual delivery of conference content and host the annual conference.
- Explore equitable delivery options for future conferences.
- Support the conference organizing committee by coordinating logistics both for the UMTC conference planning committee as well as those involved on the MassDOT event planning team. UMTC will also support conference planning logistics between any vendors or consultants providing services for the conference.
- Manage initiatives to secure sponsors, vendors, and exhibitors.
- Manage conference content including presenters, moderators and facilitators, abstracts, agenda items, schedule, and accompanying projects including video creation and editing.

- Provide day-of support relating to registration; troubleshooting any issues or concerns; managing flow of the conference; providing support for featured speakers and session speakers.
- Manage temporary conference student workers, including: advertising, interviewing, training, scheduling and day-of coordination.
- Work with MassDOT to provide talking points and press release content as needed.
- Prepare marketing materials prior to and for day-of conference activities including: email marketing campaigns, website information, virtual platform needs (if virtual), agenda, social media messaging, conference app preparation (if using an app), posters, day-of signage, evaluation collection materials, final reports.
- Manage and secure all vendor contracts, billing, invoices, expense reports, payroll and reimbursements

Anticipated products:

- Delivery of 2022 Moving Together Conference.
- Delivery of 2023 Innovation Conference.

Estimated task completion: 09-30-2023

Timeline for new consultant support: MassDOT Conferences

Consultant name: UMass Amherst
 Scope development and FHWA review/approval: 08-15-2022
 Contract negotiations and FHWA review/approval: 08-31-2022
 Consultant Notice to Proceed: 10-01-2022
 Total duration of task: 36 months

Estimated task budget: \$804,438.36

Staff salaries and benefits: \$17,042.36

MassDOT staff members	% Time to task
Drew Pflaumer	10.0
Michael Flanary	5.0
Hongyan Oliver	5.0

Consultant costs: \$787,396.00

Subtask / contract #	Total cost:	Pre-FFY 2023:	FFY 2023:	Post-FFY 2023:	Consultant/ Contractor Name:	Consultant NTP:*	Duration of Task (months):	Contract end date:
MassDOT Conferences / 109600	\$2,497,959.00	\$0.00	\$787,396.00	\$1,717,563.00	UMass Amherst	10-01-2022	36	09-30-2025

Consultant notes: This Task is to be separated from other UMTC services through the ISA Amendment for FFY23-25. Thus, the duration is 36 months. The total cost includes only the total amount for the period of FFY23-25.

* Anticipated NTP date for the ISA Amendment.

Other costs:

K. Activities with non-Federal-Match Waivers -- AASHTO TSP

Task Lead: Maria Ramirez

Task Purpose: This task allows MassDOT to subscribe to a list of AASHTO Technical Services Programs which are approved for SPRII non-federal match waivers. 100% federal funds will be used to pay for these services.

Accomplishments in prior year:

Coordinated with Highway Division on programs to subscribe for FFY23.

Proposed activities for next year:

Acquire needed subscription services.

Anticipated products:

AASHTO TSP invoices are paid.

Estimated task completion: 09-30-2023

Estimated task budget: \$190,000.00

Other costs: \$190,000.00

In FFY23, MassDOT intends to participate in the following AASHTO TSP programs with a total cost of \$190,000; and they are eligible for 100% federal share for SPR funds per FHWA guidance:

- AASHTO Innovation Initiative (A.I.I.), \$6,000
- Development of AASHTO Materials Standards (DAMS), \$10,000
- Design Publication Maintenance Technical Service Program (DPM), \$15,000
- Environment Technical Assistance Program (ETAP), \$10,000
- Equipment Management Technical Service Program (EMTSP), \$5,000
- Highway Safety Policy and Management Technical Service Program (SAFETY), \$10,000
- Load and Resistance Factor Design (LRFD) Bridges and Structures Specifications (LRFDSM), \$15,000
- Manual for Assessing Safety Hardware (MASH) Technical Support, \$10,000

- National Transportation Product Evaluation Program (NTPEP), \$25,000
- National Operations Center of Excellence Technical Service Program (NOCoE), \$15,000
- Resilient and Sustainable Transportation Systems Technical Assistance Program (RSTS), \$10,000
- Snow and Ice Cooperative Program (SICOP), \$4,000
- Transportation Curriculum Coordination Council (TC3), \$20,000
- Transportation Performance Management Technical Service Program (TPM), \$15,000
- Transportation System Preservation Technical Service Program (TSP2), \$20,000

SPR II Financial Table

Task	PARS #	Staff cost	Consultant cost	Other cost	Total task cost
A. Research Program Development, Administration, and Implementation	TBD	\$ 98,278	\$ -	\$ -	\$ 98,278
B. Massachusetts Cooperative Research Program (MCRP)	TBD	\$ 53,656	\$ 928,537	\$ -	\$ 982,193
C. Local Technical Assistance Program (LTAP)	TBD	\$ 14,699	\$ 1,202,853	\$ -	\$ 1,217,552
D. MassDOT Training Services	TBD	\$ 14,699	\$ 1,660,382	\$ -	\$ 1,675,081
E. Short-Term Research Projects	TBD	\$ 55,235	\$ 733,982	\$ -	\$ 789,217
<i>1. Implementing the AASHTO Mechanistic-Empirical Pavement Design Guide Phase III (Continuing Project)</i>			\$ 241,352		
<i>2. Methods to Identify Problematic Carriers and Prevent Infrastructure Damage (Continuing Project)</i>			\$ 107,000		
<i>3. Feasibility Study of 3D Printing Applications for Bridge Elements in MA (Continuing Project)</i>			\$ 139,000		
<i>4. Data-Driven Approach for Transit Capital Planning (Continuing Project)</i>			\$ 80,000		
<i>5. BIM for Transit Infrastructure: A Feasibility and gap assessment with current practices and systems at the MBTA (Continuing Project)</i>			\$ 60,122		
<i>6. Using Traffic Signals to Limit Speeding Opportunities on Arterial Roads (Continuing Project)</i>			\$ 60,000		
<i>7. Uncovering the Root Causes for Truck Rollover Crashes on Ramps (Continuing Project)</i>			\$ 36,508		
<i>8. Synthesis study: Mycofiltration Treatment and Design Options (Continuing Project)</i>			\$ 10,000		
F. Medium-Term Research Projects	TBD	\$ 95,067	\$ 1,218,772	\$ -	\$ 1,313,839
<i>1. Measuring Accessibility to Improve Public Health (Continuing Project)</i>			\$ 22,275		
<i>2. Energy-Focused Decision-making Framework for MBTA Operations and Planning (FFY23 New Project)</i>			\$ 60,000		
<i>3. Accessible Bus Stop Design in the Presence of Bike Lanes (FFY23 New Project)</i>			\$ 100,000		

4. Developing a Salt Spreader Control Program based on Grip (Continuing Project)			\$ 80,000		
5. Cross-Modal Impact Assessment for Sustainable Transportation Networks (FFY23 New Project)			\$ 50,000		
6. Speed Management and Emergency Personnel (FFY23 New Project)			\$ 100,000		
7. LIMMS Gap Analysis and Development Plan (New Project)			\$ 100,000		
8. Smart work zone control and performance evaluation based on trajectory data (Continuing Project)			\$ 122,600		
9. Developing Massachusetts Specific Trip Generation Rates for Land Use Projects (Continuing Project)			\$ 61,629		
10. Multisource Data Fusion for Real-Time and Accurate Traffic Incident Detection (Continuing Project)			\$ 65,230		
11. Post-Fire Damage Inspection of Concrete Structures in Tunnels Phase II (Continuing Project)			\$ 6,265		
12. Massachusetts Depth to Bedrock Project (Continuing Project)			\$ 10,955		
13. Outdoor Information Panels to Convey Real-Time Travel Information for Ridership Recovery (Continuing Project)			\$ 38,818		
14. Post-Fire Damage Inspection of Concrete Structures Phase III Field Verification Phase (Continuing Project)			\$ 138,000		
15. Measuring Fare Payment Compliance on MBTA Buses and Light Rails (FFY23 New Project)			\$ 50,000		
16. Effectiveness of Two-stage Turn Queue Boxes in Massachusetts: A Comparison with Bike Boxes (Continuing Project)			\$ 138,000		
17. Developing a Visualization, Sharing and Processing Platform for Large-Scale Highway Asset Point Cloud Data (FFY23 New Project)			\$ 75,000		
G. Long-Term Research Projects	TBD	\$ 95,067	\$ 1,495,366	\$ -	\$ 1,590,433
1. Ultra-High Performance Concrete Reinforced with Multi-Scale Hybrid Fibers and Its Durability-Related Properties (Continuing Project)			\$ 166,828		

2. Complete Street and Urban Trees (Continuing Project)			\$ 72,868		
3. Recycled Ground-Glass Pozzolan (RGGP) for Use in Cement Concrete (FFY23 New Project)			\$ 100,000		
4. Revised Load Rating Procedures for Deteriorated Prestressed Concrete Beams (Continuing Project)			\$ 102,670		
5. Field Study to Determine Salt Usage Efficiency on Two Pavement Types (Continuing Project)			\$ 250,000		
6. Evaluating Driver Education Modules on Safety (FFY23 New Project)			\$ 150,000		
7. Optimization of MassDOT's High Performance Thin Lift Mixtures (Continuing Project)			\$ 165,000		
8. Development of Improved Inspection Techniques using LiDAR for Deteriorated Steel Beam Ends (Continuing Project)			\$ 98,000		
9. Measuring Accessibility to Improve Public Health Phase II (FFY23 New Project)			\$ 80,000		
10. 3D-Printed Lattice-based Structures for Next Gen Bridge Bearings (FFY23 New Project)			\$ 80,000		
11. A Method for Pavement Marking Inventory and Retroreflectivity Condition Assessment Using Mobile Lidar (Phase II) (FFY23 New Project)			\$ 80,000		
12. Effect of Asphalt Binder Source in Asphalt Mixture Performance (FFY23 New Project)			\$ 150,000		
H. National RD&T2 Collaboration	TBD	\$ 47,648	\$ -	\$ 1,379,258	\$ 1,426,906
I. Construction Management Certificate Program (Delivered by MassDOT HR Training)	TBD	\$ -	\$ 60,000	\$ -	\$ 60,000
J. MassDOT MT and Innovation Conferences	TBD	\$ 17,042.36	\$ 787,396.00		\$ 804,438.36
K. Activities with non-Federal-Match Waivers -- AASHTO TSP	TBD	\$ -		\$ 190,000.00	\$ 190,000.00

Totals

Task	Staff cost	Consultant cost	Other cost	Total task cost
SPR II Totals	\$491,391.29	\$8,087,288.00	\$1,569,258.00	\$10,147,937.29

The SPR II is 25.6% of the overall SPR Work Program, meeting the 25% minimum threshold.