MARYLAND DEPARTMENT OF TRANSPORTATION

STATE HIGHWAY ADMINISTRATION

OFFICE OF POLICY & RESEARCH

RESEARCH ANNUAL REPORT

2024

Report contains data recorded as of September 30, 2024

Summary

MARYLAND STATE HIGHWAY ADMINISTRATION

Research Annual Report 2024

The Maryland State Highway Administration (SHA) Office of Policy & Research (OPR) supports transportation policy development, research, knowledge management, PIA compliance, and COMAR regulatory coordination. In 2024, OPR focused on data-driven decision-making, contributed to national research initiatives, and maintained transparency through PIA and COMAR compliance. This report outlines the State Planning and Research Funds (SP&R) Part II research program's key achievements, initiatives, and program contributions.

MISSION & VISION

SHA's Mission Statement

The State Highway Administration team will deliver a safe, sustainable, reliable and equitable transportation network for Maryland, providing multimodal access, connectivity value for the communities and customers we serve.

SHA's Vision

To enable mobility choices for all state highway customers through bicycle, pedestrian and transit connectivity to our highway network while supporting Maryland's growing communities, economy and environment.

OPR supports the mission of SHA by serving as a leadership hub for Public Information Act requests, external correspondence, COMAR coordination and knowledge management. The office also manages SHA's research program and leads Maryland's involvement in the AASHTO Transportation and Civil Engineering (TRAC) and Roadways in Developing Elementary Students (RIDES) programs, fostering educational outreach in transportation careers.

Activities documented in this report are predominantly funded with State Planning and Research Funds (SP&R) Part II funds from the Federal Highway Administration (FHWA). Each year, SHA develops its SP&R Work Program to coordinate planning and research activities funded through FHWA's SP&R funds, as authorized by Title 23, U.S. Code, Section 505, and regulated by Title 23, Code of Federal Regulations (CFR), Part 420. The contents of this report do not necessarily reflect the official views or policies of SHA or the Federal Highway Administration and do not constitute a standard, specification, or regulation.

2024 MILESTONES

Team Milestones

Ms. Sophie-Ann Ridge was promoted to Research Project Manager, continuing to contribute her expertise to OPR's evolving research initiatives. Additionally, as the fiscal year drew to a close, we welcomed our third Research Project Manager, Mr. Steve Wyatt. Steve joined us from the Knowledge Management team and will leverage his experience to elevate and support the research administration operations.

Completed Research Projects

During FFY 2024, six research projects were successfully completed:

1. ***Machine Learning Phase II. Effectively Implementing Machine Learning with Office of Materials Technology*** **-** This project leveraged machine learning to enhance SHA's geotechnical asset management, including landslide risk assessment, slope detection, and material testing predictions. The research improved data-driven decision-making, enabling cost savings and more efficient infrastructure planning.
2. ***MASH Test Level 3 Design, Testing, and Evaluation of the Maryland Temporary Precast Single-Face F-Type Concrete Barrier*** **-** This project developed and evaluated an anchored, temporary precast single-face F-Type concrete barrier to meet MASH Test Level 3 (TL-3) safety standards. Full-scale crash testing confirmed the barrier's ability to contain and redirect vehicles while minimizing structural damage.
3. ***Evaluation of Smart Pedestrian Crosswalk Technologies: Technical Guidelines for Implementation in the State of Maryland*** **-** This study assessed smart crosswalk technologies for pedestrian detection and developed evaluation criteria to aid in decision-making. A data dashboard was created to analyze crash patterns and support technology selection for improved pedestrian safety.
4. ***Improving Roadway Debris Clearance for CHART Responders*** **-** This project received the 2024 AASHTO High Value Research (HVR) Supplemental Award in Safety for its innovative strategies enhancing debris clearance efficiency and responder safety on Maryland's roadways.
5. ***Machine Learning Phase III (Task 1)*** **-** Concluded in 2024, this project focused on advancing machine learning algorithms for operational efficiencies. Recognizing the value of this work, the project has been amended to include a secondary task (Task 2) for a 12-month continuation to integrate the technology within SHA's IT infrastructure for long-term application.
6. ***Enhancing and Increasing State-Of-The-Practice Capability Video Pipe Inspection Technology*** - This project has been submitted for consideration in the 2025 AASHTO HVR Award, recognizing its contribution to advancing infrastructure inspection technologies.

Peer Exchange & Collaboration

Peer exchanges are vital for promoting collaboration, exchanging innovative ideas, and developing strategies to overcome shared challenges. They provide valuable opportunities to learn from the successes and experiences of other states, while also encouraging the development of tools and practices to enhance research impact.

In FFY 2024, SHA participated in the combined Pennsylvania and Maryland Peer Exchange, held in Harrisburg, PA, from August 19 to 22, focusing on communicating the value of research, research implementation, and knowledge management. Representatives from Texas, Utah, Mississippi, Pennsylvania, and Maryland came together to share insights and experiences.

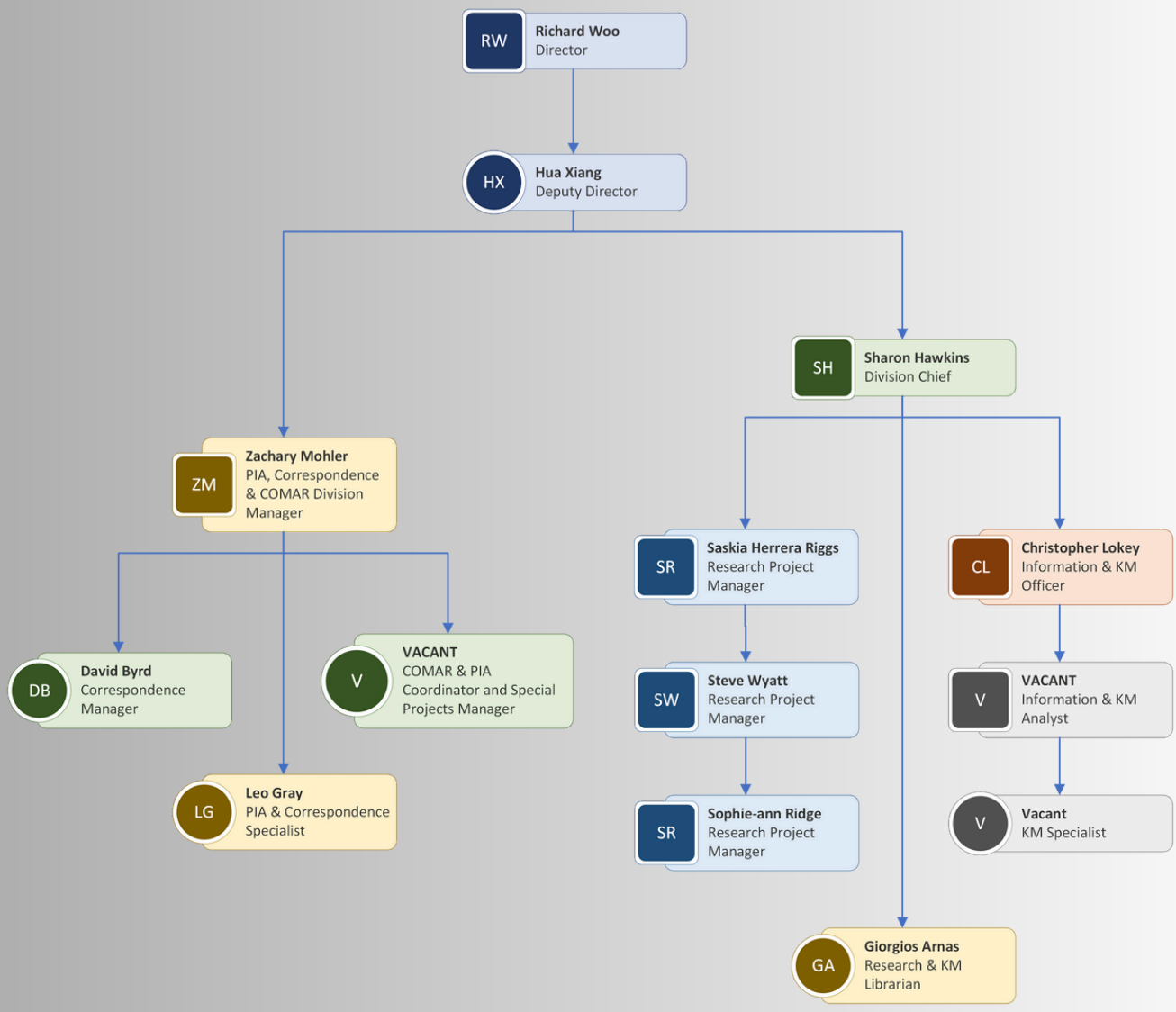
- ***Click here to access the full Peer Exchange Report.***

Moving forward, SHA remains committed to strengthening its research program by focusing on key areas for improvement. In 2024, our focus has been on enhancing project selection through more streamlined criteria to ensure projects have dedicated champions committed to implementation, exploring the re-formation of a Research Advisory Board to improve the research idea selection process, and updating the Research Manual to incorporate best practices in tracking and implementation. Additionally, we have prioritized strengthening partnerships with the Office of Communications to amplify communicating value of research outcomes, while leveraging technology to develop robust project management tools for real-time tracking and increased accountability. This focus remains a priority as we continue advancing the effectiveness, impact, and long-term success of the research program.

OFFICE OF POLICY AND RESEARCH

Our Team

The OPR team at SHA consists of professionals committed to supporting our agency's mission and goals. The organizational chart below highlights our team structure and key roles.



FFY 2024 At-A-Glance *October 1, 2023-September 30, 2024*

In FFY 2023-2024, the Office of Policy & Research (OPR) at SHA formulated a two-year research program and managed a total funding allocation of $8.27 million. For FFY 2024 specifically, expenditures have reached $3.8 million.

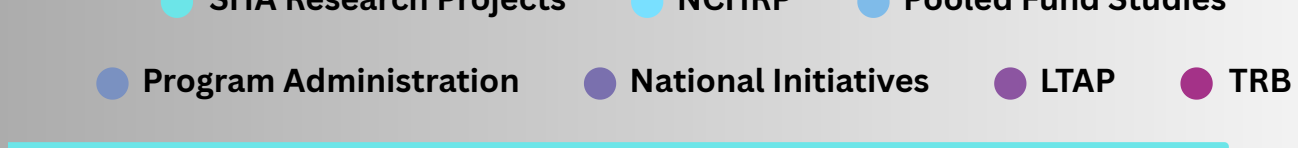
The largest share of funding supported SHA Research Projects (44%), followed by NCHRP projects (22%) and Pooled Fund Studies (11%).

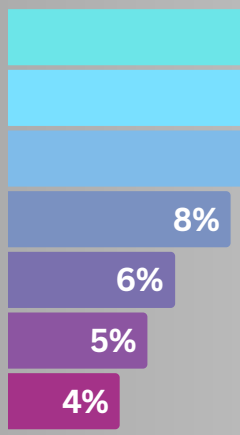
Funding was primarily allocated to the following research areas: Traffic & Safety (21.3%), Maintenance & Preservation (19.9%), and Materials & Pavement (18.9%), highlighting SHA's commitment to enhancing infrastructure reliability, optimizing operations, and advancing roadway safety across Maryland.

In terms of performing organizations, the University of Maryland led with 43.6% of projects, followed by Consultants/Contractors (19.9%), Morgan State University (12.7%), In-House SHA (12.2%), and AASHTO (11.6%).

This report presents a summary of the Maryland State Highway Administration's (SHA) State Planning & Research (SPR) Part II Research Program. The funding statistics are provided for the FFY 2024 Research Work Program in the following charts. The tables on pages 5 through 9 list all SHA-funded research projects by subject area that were active or completed during 2024. Two of the completed projects are highlighted starting on page 10.

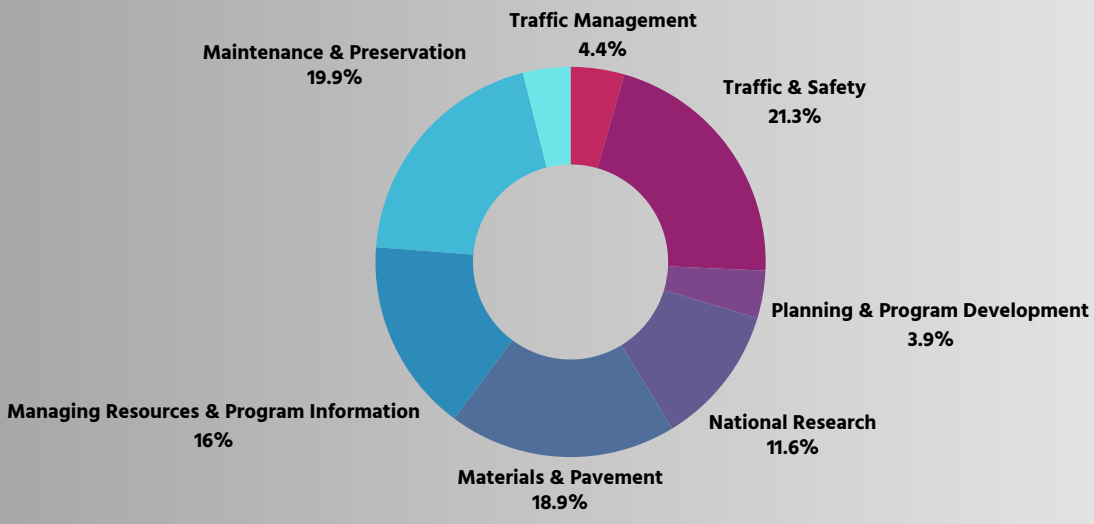
FFY 2023-2024 FUNDING BY PROJECT TYPE





SHA Research Projects	$3,678,209.00	National Initiatives	$457,500.00
NCHRP	$1,778,391.00	LTAP	$420,000.00
Pooled Fund Studies	$902,000.00	TRB	$333,280.00
Program Administration	$700,000.00	Total	$8,269.380.22

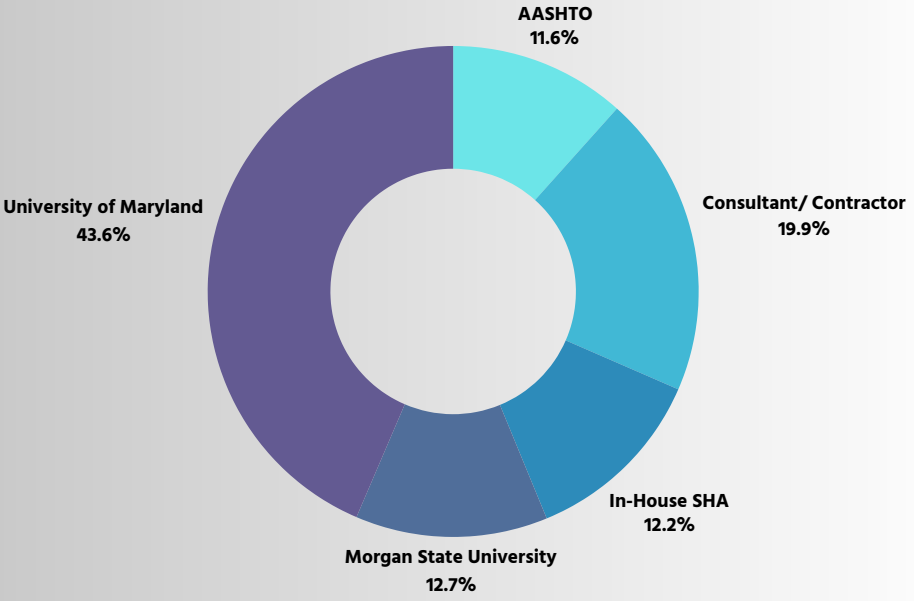
FFY 2024 PROJECTS BY RESEARCH CATEGORY



Traffic & Safety	$837,053.00
Managing Resources & Program Information	$631,558.22
Maintenance & Preservation	$781,316.00
Materials & Pavement	$742,992.00
National Research	$457,500
Traffic Management	$175,000.00
Environmental	$155,145.00
Planning & Program Development	$155,145.00
Total	**$3,935,709.22**

FFY 2024 PROJECTS BY PERFORMING ORGANIZATION

AASHTO	$457,500.00
Consultant/ Contractor	$783,344.00
In-House SHA	$482,064.00
Morgan State University	$498,534.00
University of Maryland	$1,714,267.22
Total	**$3,935,709.22**



FFY 2024 Expenditures

October 1, 2023-September 30, 2024

Project Status

- In Progress
- Completed
- On Hold/ Paused

Abbreviations

AASHTO	American Association of State Highway and Transportation Officials
FHWA	Federal Highway Administration
MSU	Morgan State University
SHA	State Highway Administration
TTI	Texas Transportation Institute

ENVIRONMENTAL

Project #	FFY	Project Name	Funding	Cumulative Expenditures	% Budget Used	Expenditures	PM	Performing Organization
SPR23B4F	2024	Effectiveness of Low Barriers to Reduce Noise Generated by Different Types of Highway Vehicles	$155,145	$145,666.61	94%	$145,666.61	Sophie-ann Ridge	Morgan State University
SPR21B4G	2021	Fish Passage	$170,000	$162,343.96	95%	$17,457.18	Sharon Hawkins	Consultant/ Contractor
SPR21B49	2021	Use of Alternative Water Sources for Brine	$160,000	$74,264.29	46%	$98.45	Sharon Hawkins	University of Maryland

HIGHWAY DESIGN & OPERATIONS

Project #	FFY	Project Name	Funding	Cumulative Expenditures	% Budget Used	Expenditures	PM	Performing Organization
SPR22D48	2022	MASH Test Level 3 Testing and Evaluation of the MD Temporary Precast Single Face F-Type Concrete Barrier	$163,000	$113,762.01	70%	$19,168.28	Sharon Hawkins	In-House SHA

HIGHWAY OPERATIONS

Project #	FFY	Project Name	Funding	Cumulative Expenditures	% Budget Used	Expenditures	PM	Performing Organization
TPF-5(489)	2024	Safety Service Patrol Standardization and Management Practices	$50,000	$50,000	100%	$25,000	Sharon Hawkins	FHWA
TPF-5(487)	2024	Transportation Management Center	$50,000	$50,000	100%	$25,000	Sharon Hawkins	FHWA

HYDROLOGY & HYDRAULICS

Project #	FFY	Project Name	Funding	Cumulative Expenditures	% Budget Used	Expenditures	PM	Performing Organization
SPR21B4H	2021	Characterizinsing Chloride Sources in Groundwater in MD	$230,000	$63,564.54	28%	$63,564.54	Saskia Herrera-Riggs	Consultant/ Contractor

ITS

Project #	FFY	Project Name	Total Funding	Cumulative Expenditures	% Budget Used	Total Expenditures	PM	Performing Organization
SPR21B4E	2021	Machine Learning Phase II	$254,945	$219,277.25	86.01%	$14,674.79	Saskia Herrera-Riggs	University of Maryland

MAINTENACE & PRESERVATION

Project #	FFY	Project Name	Total Funding	Cumulative Expenditures	% Budget Used	Total Expenditures	PM	Performing Organization
SPR21B45	2021	LTPP Maryland Performance Data Collection/ Monitoring	$19,999	$70.9	0.35%	$70.9	Sharon Hawkins	In-House SHA
SPR22B45	2022	New Products Evaluation	$120,000	$188,670.78	157.23%	$26,971.86	Sharon Hawkins	In-House SHA
SPR23B44	2024	Evaluation of Experimental Features	$140,000	$219.57	0.16%	$219.57	Sharon Hawkins	In-House SHA
SPR23B45	2024	New Products Evaluation	$240,000	$212,237.62	88.43%	$212,237.62	Sharon Hawkins	In-House SHA
SPR23B4H	2024	Use of Stainless-Steel bridge Bearings with Steel Girder Bridges	$113,741	$89,054.83	78.30%	$40,092.15	Sharon Hawkins	University of Maryland
SPR23B4Q	2024	Determining Effect of RAP on Long-Term Durability of Asphalt Pavements in Maryland	$206,041	$0	0.00%	$0	Sophie-ann Ridge	Consultant/ Contractor
SPR23B4R	2024	Enhancing and Increasing State-Of-The-Practice Capability Video Pipe Inspection Technology	$81,534	$59,375.13	72.82%	$58,900.97	Sophie-ann Ridge	University of Maryland

MANAGING RESOURCES

Project #	FFY	Project Name	Total Funding	Cumulative Expenditures	% Budget Used	Total Expenditures	PM	Performing Organization
SPR21B4J	2021	AASHTO Technical Services Programs 2021	$300,000	$271,367.98	90.46%	$17,351.08	Sharon Hawkins	University of Maryland
SPR23B49	2024	Evaluating MDOT SHA's Facility Maintenance Technician's Training Program	$136,983.22	$105,104.59	76.73%	$80,546.45	Saskia Herrera-Riggs	University of Maryland
SPR23B4K	2024	Incorporating Precipitation Data into Geotechnical Asset Management	$188,244	$76,195.48	40.48%	$75,924.91	Saskia Herrera-Riggs	Morgan State University
SPR23B4N	2024	Developing a Comprehensive System to Illustrate The Career Pathways with MDOT SHA	$183,393	$155,629.87	84.86%	$144,240.32	Saskia Herrera-Riggs	University of Maryland
SPR23B4P	2024	Determining Alternatives to the Leased Circuits for ITS Devices	$122,938	$41,089.73	33.42%	$25,694.28	Saskia Herrera-Riggs	Consultant/ Contractor

MATERIALS & PAVEMENT

Project #	FFY	Project Name	Total Funding	Cumulative Expenditures	% Budget Used	Total Expenditures	PM	Performing Organization
SPR22B4D	2022	Performance of Ultra-Thin Bonded Wearing Course During Winter Events	$135,900	$149,044.46	99.36%	$39,307.52	Saskia Herrera-Riggs	University of Maryland
SPR23B48	2024	Thin Asphalt Overlay	$102,064	$10,265.92	10.06%	$8,398.46	Saskia Herrera-Riggs	In-House SHA
SPR23B4D	2024	Evaluating the Correlation Between Slip Resistance and Skid Resistance of Pavement Markings at Crosswalks	$195,928	$92,317.28	47.12%	$92,051.92	Sophie-ann Ridge	University of Maryland
SPR23B4T	2024	Out of Cycle Research Projects	$315,447	$86,666.91	27.47%	$66,388.96	Saskia Herrera-Riggs	University of Maryland
SPR23B4T-1	2024	Machine Learning Phase III (Out of Cycle Research Projects-Task 1)	$129,553	$0	66.89%	$0	Saskia Herrera-Riggs	University of Maryland

FFY 2024 Expenditures

October 1, 2023-September 30, 2024

NATIONAL RESEARCH

Project #	FFY	Project Name	Total Funding	Cumulative Expenditures	% Budget Used	Total Expenditures	PM	Performing Organization
SPR22B47	2022	AASHTO Technical Services Programs 2022	$185,000	$205,209.14	107.25%	$350.36	Sharon Hawkins	AASHTO
SPR23B47	2024	AASHTO Technical Services Programs 2023	$457,500	$402,948.67	88.08%	$208,698.67	Sharon Hawkins	AASHTO

PLANNING & PROGRAM DEVELOPEMENT

Project #	FFY	Project Name	Total Funding	Cumulative Expenditures	% Budget Used	Total Expenditures	PM	Performing Organization
SPR22B49	2022	Development of a Project Tracking Tool	$160,000	$114,941.9	71.84%	$5,255.08	Sharon Hawkins	University of Maryland
SPR23B4G	2024	Develop a Mode Choice Model to Estimate Walk and Bike Trips in the Statewide Model	$155,145	$73,545.51	47.40%	$73,545.51	Sophie-ann Ridge	Morgan State University

STRUCTURES

Project #	FFY	Project Name	Funding	Cumulative Expenditures	% Budget Used	Expenditures	PM	Performing Organization
SPR22B4C	2022	Recommended Approach to Placing Concrete Bridge Decks During Staged Construction	$46,047	$19,272.89	35%	$6,434.55	Sharon Hawkins	University of Maryland

TRAFFIC & SAFETY

Project #	FFY	Project Name	Total Funding	Cumulative Expenditures	% Budget Used	Total Expenditures	PM	Performing Organization
SPR20B4K	2020	Design and Demonstration of Pedestrian Waiting Time Countdown	$153,468	$167,015.92	108.83%	$63,369.1	Saskia Herrera-Riggs	University of Maryland
SPR20B4N	2020	Identification of Best Practice Metrics for Varying Levels of Traffic Operations Analysis	$100,000	$97,419.86	97.42%	$110.49	Sharon Hawkins	University of Maryland
SPR21B4D	2021	Evaluation of Various Smart Pedestrian Crosswalk Technologies	$150,000	$147,731.05	98.49%	$54,415.36	Hua Xiang	University of Maryland
SPR22B4F	2022	Pedestrian Safety Analysis Tool	$170,000	$52,207.5	30.71%	$41,331.85	Saskia Herrera-Riggs	University of Maryland
SPR23B4B	2024	Develop a Knowledge-Based System for Guiding Design, Operations, and Evaluation of Highway/Freeway Work Zones	$175,000	$132,106.4	75.49%	$117,027.06	Saskia Herrera-Riggs	University of Maryland
SPR23B4C	2024	Improving Roadway Debris Clearance for CHART Responders	$210,360	$187,295.18	89.04%	$135,704.37	Saskia Herrera-Riggs	University of Maryland
SPR23B4J	2024	MD 210 Before and After Case Study for Speed Management Practices	$172,328	$75,496.49	43.81%	$60,614.63	Sharon Hawkins	University of Maryland
SPR23B4M	2024	Traffic Control Device Selection at Intersections with Two-Way Bicycle Facilities	$279,365	$100,137.7	35.84%	$73,180	Sophie-ann Ridge	Consultant/ Contractor

TRAFFIC MANAGEMENT

Project #	FFY	Project Name	Total Funding	Cumulative Expenditures	% Budget Used	Total Expenditures	PM	Performing Organization
SPR21B4B	2021	Secondary Route Awareness Support	$182,478	$182,477.73	100.00%	$12,258.21	Saskia Herrera-Riggs	University of Maryland
SPR23B4A	2024	Assessment of Corridor Impacts with Context-Driven Treatment Implementation	$175,000	$118,758.16	67.86%	$109,640.46	Sharon Hawkins	Consultant/ Contractor

SPR23B4C

MARYLAND DEPARTMENT OF TRANSPORTATION

STATE HIGHWAY ADMINISTRATION

OFFICE OF POLICY & RESEARCH

RESEARCH SPOTLIGHT

Clearing the way for safer roads

Ensuring the safety of CHART responders during roadway debris clearance is a critical priority for SHA. This project explored the feasibility and effectiveness of LaneBlade® technology, an innovative solution designed to expedite debris removal while reducing exposure risks for responders.

Project Information

PROJECT NAME: Improving Roadway Debris Clearance for CHART Responders

START DATE: April 11, 2023

REPORT DATE: March 26,2024

PROJECT #: SPR23B4C

COST: $ 210,360

COST SHARING: 20% state, 80% federal through the SPR Part II Program

PRINCIPAL INVESTIGATOR:
Xianfeng (Terry) Yang
Associate Professor
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Civil and Environmental Engineering
xtyang@umd.edu
(301) 405-2881

Research Institution: University of Maryland College Park

SPR23B4C

MARYLAND DEPARTMENT OF TRANSPORTATION
STATE HIGHWAY ADMINISTRATION

To view the complete report click here.

PROBLEM

CHART responders face significant safety risks during roadway debris removal, often exposing themselves to high-speed traffic. These risks are heightened during adverse weather conditions, low visibility, or when removing larger, hazardous debris. Manual removal can lead to prolonged exposure to traffic hazards, increasing the likelihood of accidents or injury. Furthermore, traditional debris clearance methods often require temporary lane closures, contributing to traffic delays and secondary hazards. The need for a safer, more efficient solution led to the evaluation of the LaneBlade® technology, which aims to enhance responder safety while minimizing roadway disruptions.

RESEARCH

The research involved structured field experiments to evaluate LaneBlade®'s performance under various operational conditions. These experiments considered different debris types, weather conditions, blade materials (steel and rubber), and operating speeds. Each variable was tested for its impact on debris clearance efficiency and responder safety. The team also analyzed how LaneBlade® could reduce the need for lane closures and minimize responder exposure to traffic hazards.

RESULTS

The study concluded that LaneBlade® significantly improved debris clearance operations, particularly under challenging conditions like rain and snow. Steel blades proved to be more effective for heavy debris, while rubber blades were better suited for minimizing pavement damage. The ideal operational speed for safety and effectiveness ranged from 5 to 10 mph. Additionally, LaneBlade® allowed for quicker debris removal without lane closures, reducing the risk to responders and minimizing traffic disruptions. These findings support the development of standard operating procedures and training programs for effective deployment.

How will SHA use the results?

"The results of this research project validate the necessity for SHA to procure and install debris removal systems on our patrol vehicles, justifying the purchase of the specific 'Lane Blade' system. By contrasting the 'Lane Blade' with systems used by other transportation organizations, we highlight its unique benefits and efficiencies. The report emphasizes the need for training and the development of standard operating procedures to ensure effective use, detailing all structural pros and cons prior to procurement. Furthermore, we will share the outcomes of this project with FHWA during their pooled fund exchange with safety service patrols nationwide, and present our findings to the EDC-7 group."

Eric Fogle
Deputy Director of Operations
Office of Transportation Mobility & Operations (OTMO)

SP910B4C

MARYLAND DEPARTMENT OF TRANSPORTATION

STATE HIGHWAY ADMINISTRATION

OFFICE OF POLICY & RESEARCH

RESEARCH SPOTLIGHT

Securing Highways with Advanced Barrier Design

To enhance roadside safety, the Maryland Department of Transportation State Highway Administration (SHA) collaborated with the Texas A&M Transportation Institute to develop and evaluate an anchored, temporary precast single-face F-Type concrete barrier. The project aimed to ensure the barrier met MASH Test Level 3 (TL-3) crashworthiness criteria, improving protection for road users and infrastructure during construction and maintenance activities.

Project Information

PROJECT NAME: MASH Test Level 3 Design, Testing, and Evaluation of the Anchored Maryland Temporary Precast Single-Face F-Type Concrete Barrier

START DATE: June 1, 2020

REPORT DATE: June 4, 2024

PROJECT #: SP910B4C

COST: $ 445,289

COST SHARING: 20% state, 80% federal through the SPR Part II Program

PRINCIPAL INVESTIGATOR:
Chiara Silvestri Dobrovolny, Ph.D.
Senior Research Scientist
C-Dobrovolny@tti.tamu.edu
(979) 317-2823

Research Institution: Texas A&M Transportation Institute Proving Ground

SP910B4C

MARYLAND DEPARTMENT OF TRANSPORTATION

STATE HIGHWAY ADMINISTRATION

To view the complete report click here.

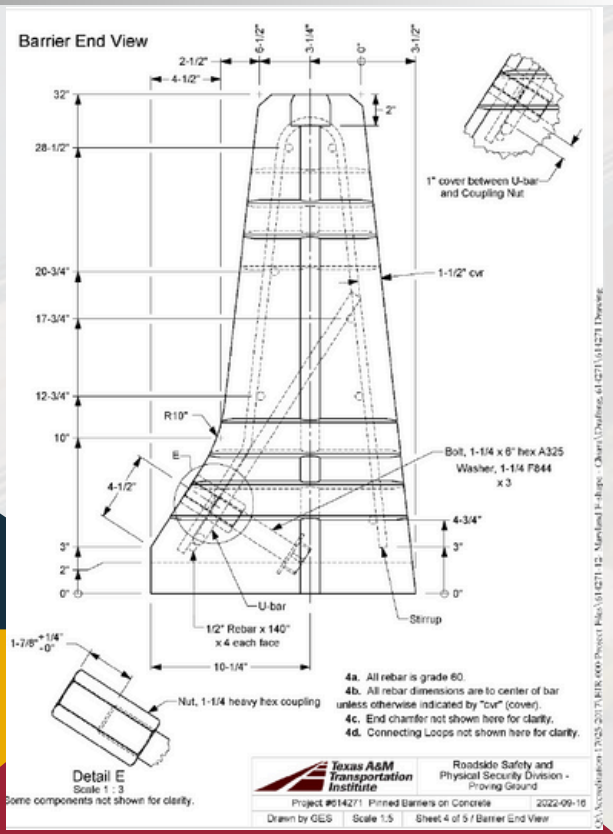
PROBLEM

The challenge was to design a barrier system that could withstand severe vehicular impacts while ensuring minimal deflection and structural damage. The barrier needed to meet stringent safety standards while accommodating Maryland's specific roadside conditions and installation requirements. Achieving this required not only innovative design approaches but also extensive modeling and testing to ensure the barrier's resilience under real-world impact scenarios. This required rigorous finite element simulations and crash testing to validate the barrier's effectiveness and adherence to safety standards.

RESEARCH

Researchers began by utilizing Finite Element Analysis (FEA) simulations to design and refine the barrier. These simulations focused on improving structural integrity and assessing the impact responses of different design configurations. Following the simulation phase, two full-scale crash tests were conducted. The first test involved a 2,420 lb vehicle traveling at 62 mph at a 25-degree angle, and the second involved a 5,000 lb vehicle at the same speed and angle. Both tests aimed to evaluate the barrier's ability to contain and redirect vehicles while minimizing structural damage and deflection.

Details of Anchored Maryland F-Type Temporary Barrier End View



Test 614271-12-2 - Before & After Crash Test

Maryland F-Type - Ground Connection Details

RESULTS

The crash tests confirmed that the modified barrier design met the MASH TL-3 evaluation criteria for longitudinal barriers. The barrier successfully contained and redirected impacting vehicles while minimizing damage to both the barrier and the vehicles. The enhanced reinforcement structure and anchor plate design proved effective in absorbing and distributing impact forces, reducing the likelihood of catastrophic failure. Additionally, the refined connection details contributed to the stability and integrity of the barrier system during testing. These results not only validated the simulation models but also demonstrated the barrier's practical reliability for field applications. Based on these outcomes, the project team recommends the integration of this barrier design into SHA's construction protocols to enhance roadside safety and reduce potential crash severity.