



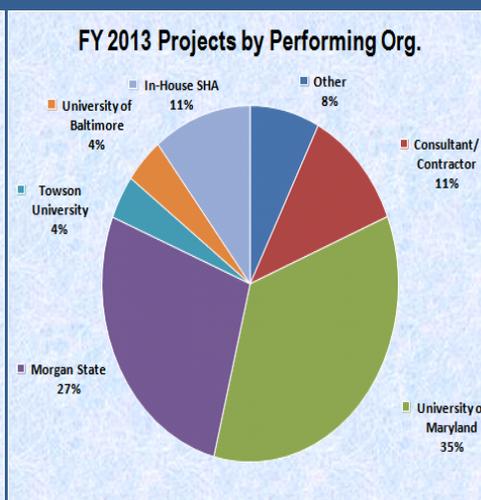
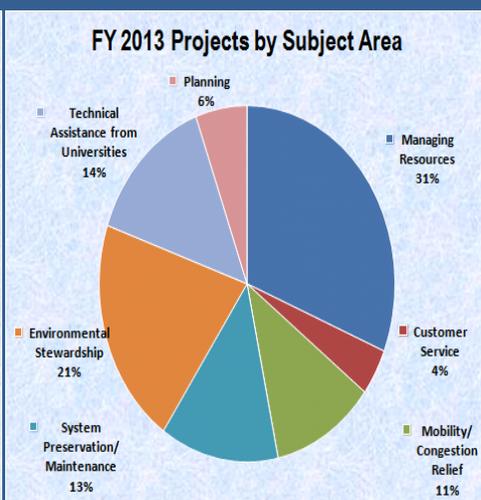
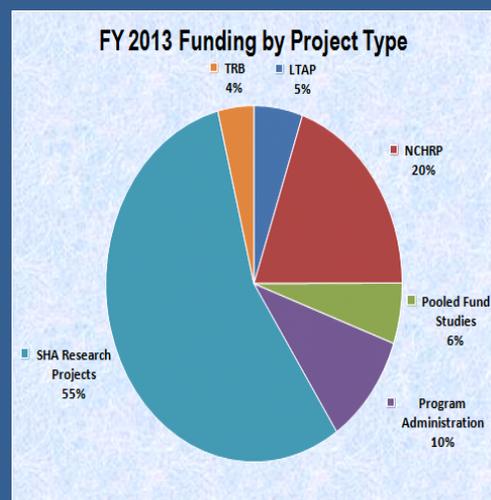
Research Annual Report

STATE PLANNING & RESEARCH PART II PROGRAM

2013 At-A-Glance

JANUARY 1, 2013 – DECEMBER 31, 2013

This report presents a summary of the Maryland State Highway Administration's State Planning & Research (SPR) Part II Program. The funding statistics are provided for the FY 2013 Research Work Program in the following charts. The tables on pages 2 through 5 list all SHA-funded research projects by subject area that were active or completed during 2013. Three completed projects during the year are highlighted in the third section.



LTAP	\$ 170,000
NCHRP Fees	\$ 628,548
Pooled Fund Studies	\$ 176,667
Program Administration	\$ 325,000
SHA Research Projects	\$ 1,778,080
TRB Fees	\$ 125,870
TOTAL	\$ 3,204,165

Managing Resources	\$ 554,080
Customer Service	\$ 75,000
Mobility/Congestion Relief	\$ 200,000
System Preservation/Maintenance	\$ 230,000
Environmental Stewardship	\$ 369,000
Technical Assistance from Universities	\$ 250,000
Planning	\$ 100,000
TOTAL	\$ 1,778,080

Other	\$ 135,000
Consultant/Contractor	\$ 200,000
University of Maryland	\$ 624,080
Morgan State	\$ 483,000
Towson University	\$ 71,000
University of Baltimore	\$ 75,000
In-House SHA	\$ 190,000
TOTAL	\$ 1,778,080

In addition to administering the annual Research Work Program, in 2013 the Research Division focused on providing access to SHA research reports, encouraging SHA employees' technology transfer activities, and on improving existing programs and processes. All SHA research reports since Year 2000 can be accessed online: <http://www.roads.maryland.gov/pages/oprreports.aspx?pageid=367>. Visitors to the page can search by keywords or browse by subject areas.

Maryland SHA 2013 Research

TABLES ARE ORGANIZED BY SUBJECT AREAS:

ABBREVIATIONS:

SHA Maryland State Highway Administration
 FHWA Federal Highway Administration
 MSU Morgan State University
 TU Towson University
 UB University of Baltimore
 UMBC University of Maryland, Baltimore County
 UMCP University of Maryland, College Park

 Cancelled research projects
 Research projects that are still active
 Completed research projects

Safety

Project Number	Project Title	Performing Organization	Research Manager	Work Program	Funding	% Complete as of 12/31/2013	FY 2013 Expenditures	Spotlight
SP708B4D	Maryland Motor Carrier Program Performance Measures	MSU	Allison Hardt	FY 2007	\$100,000	100%	\$ -	
SP209B4J	The Development of Local Calibration Factors for Implementing the Highway Safety Manual in Maryland	MSU	Hua Xiang	FY 2012	\$100,000	100%	\$ 32,073.51	

Mobility/Congestion Relief

Project Number	Project Title	Performing Organization	Research Manager	Work Program	Funding	% Complete as of 12/31/2013	FY 2013 Expenditures	Spotlight
SP309B4C	Work Zone Performance Monitoring and Assessment through RITIS	UMCP	Hua Xiang	FY 2013	\$100,000	10%	\$ -	
SP309B4F	Validation and Augmentation of INRIX Arterial Travel Time Data Using Independent Sources	UMCP	Hua Xiang	FY 2013	\$100,000	70%	\$ 1,309.63	
SP109B4C	Understanding the Potential Impact of Various DMS Messages on Traffic Flow	UMCP	Hua Xiang	FY 2011	\$150,000	100%	\$ 79,572.56	
SP209B4K	Travelers' Response to DMS Using a Driving Simulator	MSU	Hua Xiang	FY 2012	\$100,000	100%	\$ -	
SP209B4M	Real-Time Truck Parking Information System	UMCP	Hua Xiang	FY 2012	\$100,000	100%	\$ 85,543.77	X
SP209B4R	Understanding CHART's Overall Effectiveness and Identification of Areas for Growth	UMCP	Hua Xiang	FY 2012	\$100,000	90%	\$ 49,004.75	
SP209B4T	Exploring Travelers' Behavior in Response to Variable Message Signs	MSU	Hua Xiang	FY 2012	\$100,000	100%	\$ -	

Planning

Project Number	Project Title	Performing Organization	Research Manager	Work Program	Funding	% Complete as of 12/31/2013	FY 2013 Expenditures	Spotlight
SP309B4H	MOSAIC Phase 3: Comprehensive Model Calibration/Validation and Additional Model Enhancement	UMCP	Hua Xiang	FY 2013	\$100,000	82%	\$ 3,566.66	
SP109B4P	Developing a Data and Modeling Framework for Integrated	UMCP	Hua Xiang	FY 2011	\$100,000	100%	\$ 10,000.00	
SP109B4Q	Sustainability Impact of Multimodal Corridor Improvements in Urbanized Area	UMCP	Matt	FY 2011	\$100,000	100%	\$ 17,569.52	
SP209B4F	An Integrated Framework for Modeling Freight Mode, and Route Choice	UMCP	Hua Xiang	FY 2012	\$100,000	100%	\$ -	
SP209B4N	Developing a Framework and Models for Transit-Oriented Development (TOD) Analysis	UMCP, MSU	Allison Hardt	FY 2012	\$100,000	100%	\$ 68,913.00	X
SP209B4P	Measuring Economic Contribution of Freight Industry to the MD Economy	MSU	Allison Hardt	FY 2012	\$100,000	90%	\$ 40,505.11	

Administrative

Project Number	Project Title	Performing Organization	Research Manager	Work Program	Funding	% Complete as of 12/31/2013	FY 2013 Expenditures	Spotlight
SP309B42	Research Program Administration (with overhead)	In-House SHA	Allison Hardt	FY 2013	\$325,000	100%	\$147,175.18	

System Preservation/Maintenance

Project Number	Project Title	Performing Organization	Research Manager	Work Program	Funding	% Complete as of 12/31/2013	FY 2013 Expenditures	Spotlight
SP309B45	LTPP Maryland Performance Data Collection/Monitoring	In-House SHA	Allison Hardt	FY 2013	\$30,000	100%	\$ 22,428.15	
SP309B4E	Durability Assessment of Prefabricated Bridge Elements and Systems	MSU	Sharon Hawkins	FY 2013	\$100,000	60%	\$ 4,176.93	
SP309B4R	Effective Implementation of Ground Penetrating Radar (GPR) for Condition Assessment & Monitoring of Critical Infrastructure Components	UMCP	Hua Xiang	FY 2013	\$100,000	65%	\$ 156.52	
SP909B4E	Design and Evaluation of Foamed Asphalt Base Course	UMCP	Hua Xiang	FY 2009	\$225,000	100%	\$ 19,778.95	
SP009B4D	Evaluation of Condition of All SHA Bridge Rocker Type Bearings	Consultant/Contractor	Allison Hardt	FY 2010	\$100,000	Cancelled	\$ -	
SP009B4M	Determining Sinkhole Susceptibility for the Hagerstown Valley: Phase II	Other	Allison Hardt	FY 2010	\$136,924	85%	\$ 56,170.00	
SP009B4N	Soil Slope Failure Investigation Management System	UMCP	Hua Xiang	FY 2010	\$125,000	100%	\$ 13,192.03	X
SP109B4G	Development of Design Guidelines for Proper Selection of Graded Aggregate Base in MD Highways	UMCP	Hua Xiang	FY 2011	\$95,000	100%	\$ 66,284.89	
SP209B4G	Using Bar Codes and Electronic Chips to Track and Store Sample and Structure Data	UMCP	Sharon Hawkins	FY 2012	\$90,000	100%	\$ 46,463.27	
SP209B4H	Geotechnical and Environmental Impacts of Steel and Blast Furnace Slag Use in Highway Construction	UMCP	Hua Xiang	FY 2012	\$95,000	70%	\$ 26,885.96	

Customer Service

Project Number	Project Title	Performing Organization	Research Manager	Work Program	Funding	% Complete as of 12/31/2013	FY 2013 Expenditures	Spotlight
SP309B4K	Survey on the Public's Perception of Freight Movement in Maryland by all Transportation Modes	UB	Allison Hardt	FY 2013	\$75,000	50%	\$ -	
SP209B4D	Development of Customer Service Improvement Initiatives	Other	Richard Woo	FY 2012	\$53,111	Cancelled	\$ -	

Environmental Stewardship

Project Number	Project Title	Performing Organization	Research Manager	Work Program	Funding	% Complete as of 12/31/2013	FY 2013 Expenditures	Spotlight
SP309B4J	Evaluation of Reclaimed (Recycle) Concrete Aggregate (RCA) Road Materials for Use in Oyster Aquaculture: Phase 2 - Field Testing	MSU	Hua Xiang	FY 2013	\$98,000	75%	\$ -	
SP309B4N	Informing Nest Site Restoration for the Endangered Northern Map Turtle	TU	Sharon Hawkins	FY 2013	\$56,000	40%	\$ 7,245.24	
SP309B4P	Monitoring Highway Runoff for Total Maximum Daily Load (TMDL) Compliance	MSU	Hua Xiang	FY 2013	\$100,000	Cancelled	\$ -	
SP309B4S	Evaluating Channel Degradation of Maryland Streams (Phase III)	Consultant/Contractor	Hua Xiang	FY 2013	\$100,000	60%	\$ 44,965.30	
SP309B4T	Bog Turtle Population Assessment - Added to Program on 04/18/13	TU	Hua Xiang	FY 2013	\$15,000	100%	\$ 4,740.55	
SP109B4D	Identification of Techniques to Meet pH Standards During In-Stream Construction	MSU	Hua Xiang	FY 2011	\$100,000	100%	\$ 7,231.97	
SP209B4S	Sustainable Landscaping Practices for Enhancing Vegetation	UMBC	Sharon Hawkins	FY 2012	\$100,000	0%	\$ -	

Managing Resources

Project Number	Project Title	Performing Organization	Research Manager	Work Program	Funding	% Complete as of 12/31/2013	FY 2013 Expenditures	Spotlight
SP309B44	Evaluation of Experimental Features	In-House SHA	Allison Hardt	FY 2013	\$80,000	100%	\$ 33,231.13	
SP309B46	Technology Transfer Program - Amended 04/18/13	Other	Allison Hardt	FY 2013	\$35,000	100%	\$ -	
SP309B47	New Products Evaluation	In-House SHA	Allison Hardt	FY 2013	\$80,000	100%	\$ 52,041.57	
SP309B4D	Updated Regression Equations for Piedmont and Western Maryland	Consultant/Contractor	Hua Xiang	FY 2013	\$100,000	66%	\$ 35,347.84	
SP309B4G	Stainless Steel Prestressing Strands and Reinforcing bars for Use in Concrete Structural Elements	MSU	Sharon Hawkins	FY 2013	\$60,000	59%	\$ 15,802.67	
SP309B4M	Serviceability-related Issues for Bridge Live Load Deflection and Construction Closure Pours	UMCP	Hua Xiang	FY 2013	\$99,080	30%	\$ -	
SP109B4H	Geographic Information System Based Subsurface Database Interface	In-House SHA	Hua Xiang	FY 2011	\$100,000	100%	\$ 77,196.59	
SP209B46	Technology Transfer Program	Other	Allison Hardt	FY 2012	\$75,000	100%	\$ 28,124.48	

Technical Assistance from Universities

Project Number	Project Title	Performing Organization	Research Manager	Work Program	Funding	% Complete as of 12/31/2013	FY 2013 Expenditures	Spotlight
SP309B48	UMCP Technical Assistance	UMCP	Allison Hardt	FY 2013	\$75,000	75%	\$ -	
SP309B49	MSU Technical Assistance	MSU	Allison Hardt	FY 2013	\$75,000	75%	\$ -	
SP309B4A	Support For UTC Research	UMCP, MSU	Allison Hardt	FY 2013	\$100,000	75%	\$ -	
SP209B48	UMCP Technical Assistance	UMCP	Allison Hardt	FY 2012	\$75,000	100%	\$ -	
SP209B49	MSU Technical Assistance	MSU	Allison Hardt	FY 2012	\$75,000	100%	\$ 24,505.85	
SP209B4A	Support for the UMCP UTC	UMCP	Allison Hardt	FY 2012	\$100,000	100%	\$ 74,626.66	

National Initiatives

Project Number	Project Title	Performing Organization	Research Manager	Work Program	Funding	% Complete as of 12/31/2013	FY 2013 Expenditures	Spotlight
SP309B41	Local Technical Assistance Program (LTAP)	UMCP	Allison Hardt	FY 2013	\$170,000	100%	\$ 31,599.52	
SP309B43	TRB Technical Activities Service	Other	Allison Hardt	FY 2013	\$125,870	100%	\$118,725.00	
SP309B4B	AASHTO Technical Services Programs	Other	Allison Hardt	FY 2013	\$100,000	100%	\$ 94,200.00	
SHRP 2	SHRP 2 Implementation	Other	Allison Hardt	FY 2013	\$455,139	100%	\$455,139.00	
NCHRP	National Cooperative Highway Research Program	Other	Allison Hardt	FY 2013	\$628,548	100%	\$600,782.95	

Transportation Pooled Fund Studies

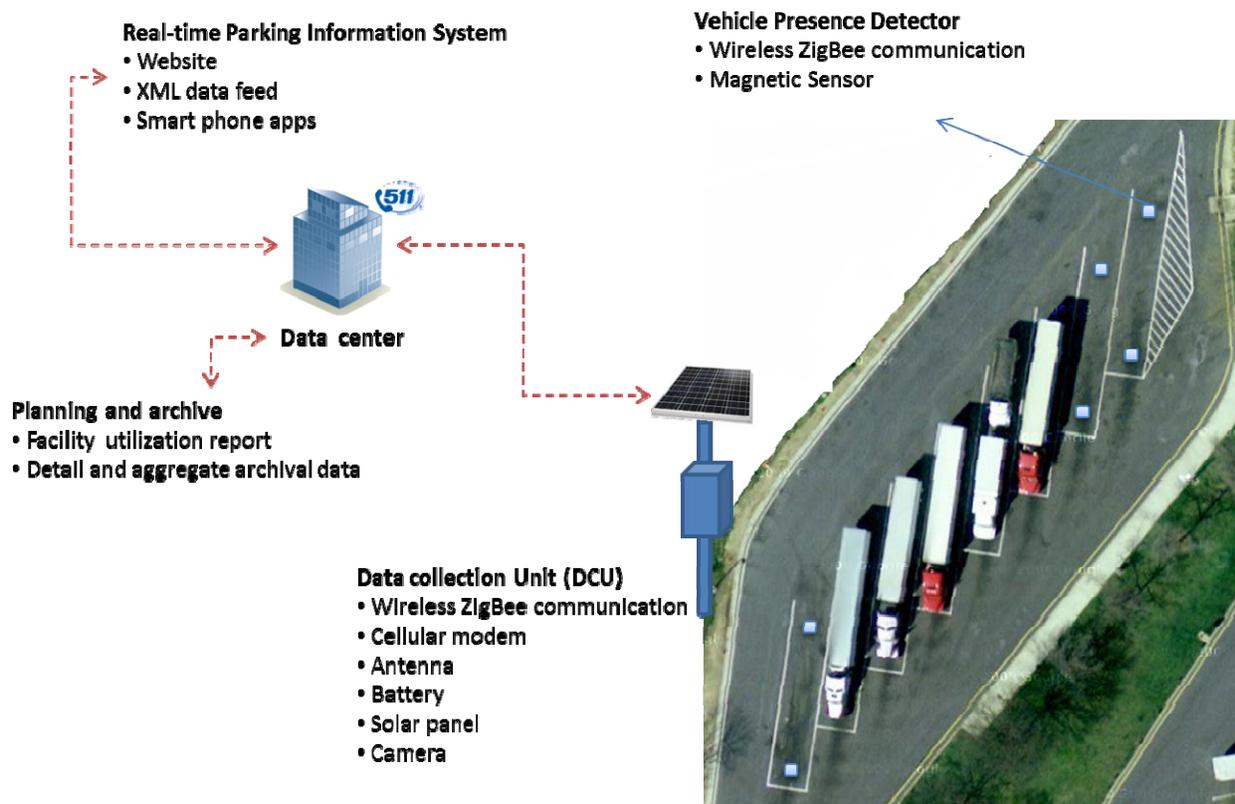
Project Number	Project Title	Lead Agency	Research Manager	Work Program	Funding	Transfer Completed?	FY 2013 Expenditures	Spotlight
TPF-5(065)	Traffic Control Device (participation revisited on annual basis)	FHWA	Sharon Hawkins	FY2013	\$10,000	Y	\$10,000	
TPF-5(099)	Eval. of Low Cost Safety Improvements (participation revisited annually)	FHWA	Sharon Hawkins	FY 2013	\$30,000	Y	\$30,000	
TPF-5(198)	Urban Mobility Study	TX	Sharon Hawkins	FY 2013	\$25,000	Y	\$25,000	
TPF-5(054)	MDSS	SD	Sharon Hawkins	FY 2013	\$25,000	Y	\$25,000	
TPF-5(242)	Traffic and Data Preparation for AASHTO MEPDG Analysis and Design (3rd year of a 3 year commitment)	LA	Sharon Hawkins	FY 2013	\$16,667	Y	\$16,667	
TPF-5(230)	Evaluation of Plant-Produced High Percentage RAP Mixtures in the Northeast (3rd year of a 3 year commitment)	NH	Sharon Hawkins	FY 2013	\$30,000	Y	\$30,000	
TPF-5(209)	Transportation Curriculum Coordination Council (TCCC) (1st year of a 2 year commitment)	FHWA	Sharon Hawkins	FY 2013	\$15,000	Y	\$15,000	
TPF-5(285)	Standardizing the Lightweight Deflectometer (LWD) equipment for measuring the Modulus/Stiffness of Unbounded Soils and Aggregate tool as Compaction QA Measures (QA) (1st year of a 2 year commitment)	MD	Allison Hardt	FY 2013	\$25,000	Y	\$25,000	

2013 Research Highlights

SP209B4M – AUTOMATED LOW-COST AND REAL-TIME TRUCK PARKING INFORMATION SYSTEM

Lack of available truck parking is a significant safety concern nationwide. Commercial drivers seeking to comply with the Federal Motor Carrier Safety Administration's Hours of Service regulations often park illegally on freeway shoulders and ramps when parking in a truck parking facility is either not available, or the availability is not easily known. The Maryland State Highway Administration (SHA) has an interactive emergency truck parking map, but real-time parking availability information is not yet provided.

The main objective of this project was to develop an inexpensive and scalable wireless sensor network prototype, which encompasses a cost-effective and reliable architecture for real-time detection of trucks and other vehicles in truck parking facilities.



The vehicle detection system consists of four main components: sensing, collecting, processing and user interface (UI). The sensing component refers to networks of magnetic sensors that measure the magnetic field at parking spots. The sensors are enabled by a microcontroller using IEEE 802.15.4 protocol, and wirelessly communicate with the collectors, and are powered by two 1.5 volts triple-A batteries. The collecting component using the same microcontroller collects the data measured by the sensors, and is powered by solar panels and lithium acid batteries as backup. A cellular broadband component is used to forward the collected data to remote servers. A camera can optionally be utilized to capture ground truth images from empty and occupied spots for validation purposes.

The processing component consists of a central database located at remote stations. A TCP/IP data logger application is designed for receiving the incoming packets from collectors and saving data in the database. The processing application connects to the database, processes the data, and updates the status of each spot in real time. The UI component enables remote connection to the servers and parking availability updates in real-time. The UI can be customized for any type of internet enabled device on various operating platforms.

The SHA deployed and tested the system at the I-95 Northbound Welcome Center from January 2013 to May 2013. Several experiments were conducted and ground truth information was also collected to measure the system performance. The overall error rate during the experiment was 3.75%, and can potentially be lowered by using more sensors at each spot and employing repeaters to avoid signal blockings.

Unlike imagery based methods, magnetic truck detection is completely anonymous and privacy of drivers is maintained. It is also independent of parking layout. In addition to providing real-time parking availability information to truckers, analyzing historical facility usage data could facilitate efficient operations. If all truck parking facilities in Maryland were equipped with such a system, truckers could be directed to the closest available facility and utilization of all facilities could be optimized.

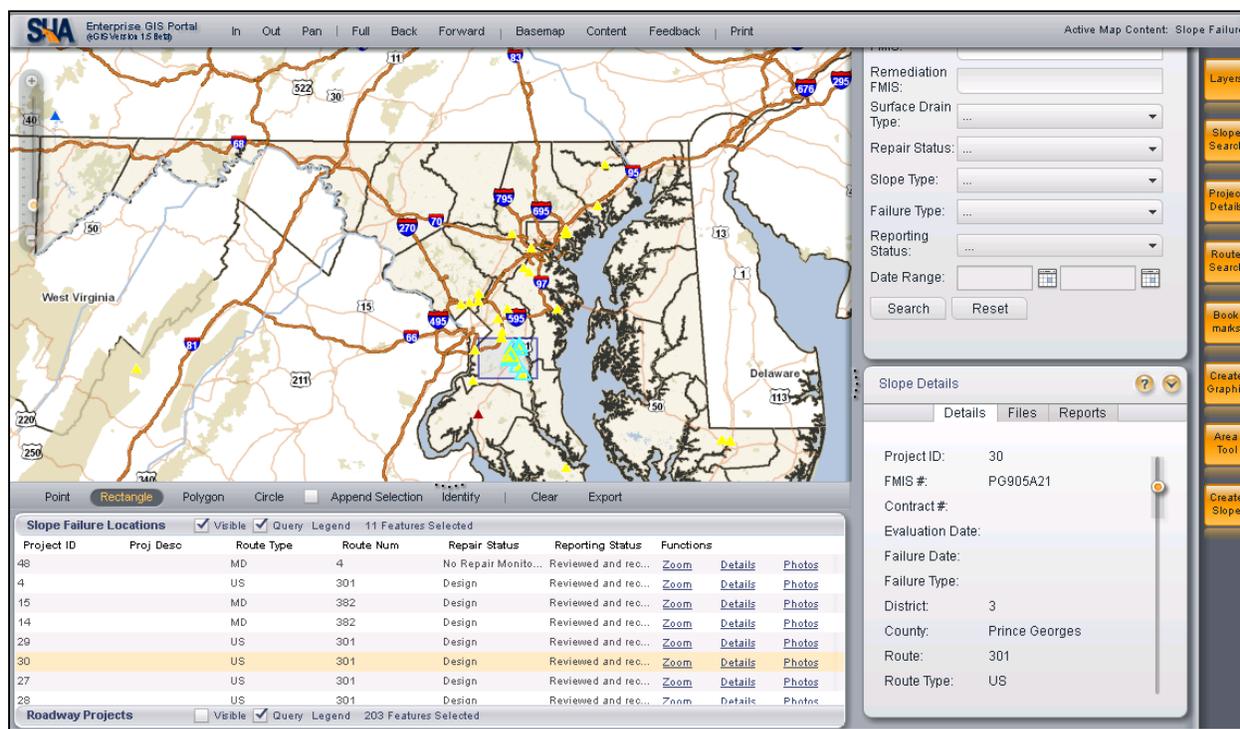
SP009B4N – SLOPE FAILURE INVESTIGATION MANAGEMENT SYSTEM

Highway slopes are exposed to a variety of environmental and climatic conditions, such as deforestation, freeze-thaw cycles, and heavy storms. Over time, these climatic conditions, in combination with other factors such as geological formations, slope angle and groundwater conditions can influence slope stability. These factors contribute to slope failures that are hazardous to highway structures and to the traveling public, and are extremely expensive to repair. Consequently, it is crucial to have a management system that tracks, records, evaluates, analyzes, and reviews the soil slope failure and remediation data so that cost effective and statistically efficient remedial plans may be developed.



In this project, SHA created a Soil Slope Failure Reporting database that can be expanded to cover all geohazards on SHA Rights-of-Way. The Office of Materials Technology (OMT) implemented the database in the SHA eGIS Portal, a web-based mapping application.

Once slope failures are reported by various technical offices and districts in eGIS, OMT slope failure team is notified via email. The team is responsible for reviewing and approving reported slope failure and assigning them for remediation. SHA's eGIS system allows engineers to quickly search for slope failures geographically and by attribute while presenting failure statistics and summary charts to senior managers. The geospatial and tabular information captured in eGIS can help to identify slope failure trends over time. OMT will use the information collected to direct design and construction policy changes to reduce the number of slope failures in the future.



Benefits:

Prior to the implementation of the Slope Failure Investigation Management System, few analyses were conducted on historical slope failures and remediation costs. The database tracks slope failure projects starting from failure identification stage, through construction and maintenance stages. It documents post-construction data including as-built plans, total cost, and pictures. With the current data on 60 (and counting) slope failures in the system, trends in geographic distributions, soil and hydraulic conditions of slope failure areas can be identified and incorporated in future earthwork designs. Geotechnical engineers are also using relevant content in the eGIS system such as geology maps and highway as-built plans in conjunction with the slope failure content for project level studies for future projects.

Long term Benefits:

Most slope failures are progressive in nature and get worse with time. With the database, it is anticipated that more slope failures will be reported, and the cost of repairs will be reduced by allowing the right repairs to be conducted at the right time before the failures progress to a critical stage. Once more slope failure data is collected, statistical analysis can be conducted to identify the likely failure causes for a given area. These types of studies will inform policy changes in design or construction to minimize future slope failures in the same geographical area. Quantitative slope failure prediction models and hazard maps can then be developed by incorporating factors such as location, geology, climatic conditions and slope geometry.

SP209B4N – DEVELOPMENT OF A FRAMEWORK FOR TRANSIT-ORIENTED DEVELOPMENT (TOD)

Transit-oriented development is a type of development that encourages public transit and a transit-friendly urban environment. In general TOD provides an environment where residents live within walking distance of one or more major transit stations and other amenities such as places to shop thanks to mixed and higher density land use patterns. In theory they can significantly reduce the need to drive, increase multimodal mobility, reduce air pollution and greenhouse gas emissions, and reduce long-term highway infrastructure needs.

When planning, designing, and assessing TODs, their impact on travel behavior, mobility and sustainability should be considered and incorporated into the decision-making process. However, there currently are no guidelines on how to successfully develop TODs or standard tools for TOD evaluation in Maryland. The objective of this project was to perform a comprehensive analysis of TODs in the Washington D.C. and Baltimore metropolitan areas, and to investigate if they reduce automobile travel and encourage transit as well as walking and bicycling. A better understanding of these issues will lead to improved guidance and tools for decision makers.

Description:

The research team developed statistical models to analyze the relationship between TOD, land use development patterns, and travel behavior, including the amount of driving or vehicle miles traveled (VMT), trip generation, trip lengths, and mode choice (at household and trip levels), in the Washington D.C. and Baltimore metropolitan areas based on observed data. These models employ different statistical methods, including comparative analysis, hypothesis testing, multiple regression, fixed and random effect methods and environmental impact analysis.

In order to estimate the models, a number of data sources were used including the most recent Household Travel Survey data, land-use data with geocoded population and employment information at the Transportation Analysis Zone (TAZ) level, geocoded rail and bus transit station data, Census block and TAZ shapefiles, and the Maryland Statewide Transportation Model (MSTM). The research team also developed several innovative data processing, geo-coding, merging, and enhancement tools to combine the aforementioned datasets for this research project.

Results:

The findings from two in-depth case studies and statistical models covering the whole study area are consistent, and show that TOD land-use planning is associated with an overall lower level of household VMT, increased transit ridership, and reduced traffic congestion and environmental impacts. The VMT model shows that after controlling for several land-use factors, living in TOD areas results in an additional 20 percent reduction in VMT in the Washington D.C. metropolitan area and an additional 21 percent reduction in the Baltimore region.

These VMT reduction percentages appear to be high, which may be because the models were estimated without controlling for possible self-selection effects. The self-selection effect is a highly debated issue in land use and transportation-related research areas. Reduction in auto ownership and VMT and increased transit ridership in TOD areas could be in part because those who are in favor of non-motorized travel choose to move to TOD areas where they can easily access transit. However, it is yet to be determined how large the effect of self-selection is and what methods can be used to measure this effect. In this analysis, the research team did not capture the self-selection effect due to data limitations. However, socio-demographic variables were included in the models to partially address this issue.

In summary, the research team believes that programs and policies that are effective at reducing VMT, encouraging transit use, and consequently reducing congestion and pollution in urban areas such as TOD, should be strengthened. Future research may examine issues such as appropriate parking supply in TODs, built-environment factors that make certain TODs more successful than others, and implementation of the TOD analysis framework developed in this research project.

With an improved understanding on the relative effectiveness of different policy tools in improving transit ridership and reducing congestion and emissions, policy and decision makers will be able to allocate resources more appropriately and efficiently toward the ultimate goal of making urban areas more sustainable, livable, and economically viable for all residents and businesses. As a result of this study, SHA will also be able to incorporate the effect of TOD on a transportation system into the trip generation, distribution and model choice steps of the Maryland Statewide Transportation Model.

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To access SHA research reports: <http://www.roads.maryland.gov/pages/oprreports.aspx?pageid=367>

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