Georgia Department of Transportation

ANNUAL IMPLEMENTATION REPORT

OFFICE OF RESEARCH
AUGUST 27, 2015

INTRODUCTION

This report marks the Office of Research (OR)'s fourth Annual Implementation Report to the Georgia DOT Research Advisory Committee (RAC). The report summarizes research implementation activities completed or in progress, since the last RAC meeting, under the GDOT Research and Development (R&D) program or the Transportation Pooled Fund (TPF) program. Contract research is normally funded with 80% federal State Planning and Research (SP&R) dollars and 20% state motor fuel dollars, while TPF projects are funded with 100% federal SP&R dollars. The report also summarizes implementation activities associated with the Strategic Highway Research Program 2 (SHRP-2) and take-homes from the 2015 TRB Annual Meeting.

All research activities are intended to solve a particular problem or provide useful information. Each research project approved for conduct includes, as a specific objective, implementation of its findings (*GDOT Research and Development Manual, 2013*). R&D projects contain work elements to ensure this implementation as much as possible.

The project implementation summaries are organized according to the Research Technical Advisory Group (RTAG)—Asset Management, Mobility, Policy/Workforce, or Safety—that the subject is most pertinent to. The projects discussed herein demonstrate that both federal and state research dollars are being well leveraged to conduct and implement research with tangible benefits to GDOT and the traveling public. GDOT's R&D program is in direct alignment with its strategic goals, and the implementation products enhance operations in a cross-section of major GDOT divisions. This in turn supports GDOT's overall mission to provide "a safe, connected and environmentally sensitive transportation system that enhances Georgia's economic competitiveness by working efficiently and communicating effectively to create strong partnerships."

Types of Research Implementation

This section provides brief descriptions of the types of implementation in GDOT's R&D program. Depending on the scope and deliverable(s) of each research project (RP), the implementation type may differ considerably from project to project. These types include:

- *Developmental*. In this most traditional type of implementation, the research produces a new or modified material, technology, policy, or process; and the product is implemented during and/or after the research project timeline. Progressive implementation of research products during the project timeline is encouraged as appropriate (see page 4 for an example).
- *Response*. The research provides an answer to a question or concern from any of the various stakeholders of GDOT's R&D program (see page 5 for an example).
- *Feasibility*. This type of implementation is guidance for GDOT on the feasibility of a new or modified material, technology, policy, or process. This type of research can be valuable in encouraging GDOT to move forward with further research and development on something or discouraging further study on it, eliminating further funding risks (see page 3 for an example).

HIGHLIGHTED IMPLEMENTATION ACTIVITIES

RESEARCH TECHNICAL ADVISORY GROUPS

ASSET MANAGEMENT

Feasibility Study to Determine the Economic and Operational Benefits of Utilizing Unmanned Aerial Vehicles (UAVs) (RP 12-38, Carla Sands), [Feasibility]

Unmanned Aerial Systems (UASs) are normally comprised of a portable control station for the human operator and one or more Unmanned Aerial Vehicles (UAVs). Several state DOTs have begun using UAS technology for different purposes, including tracking highway construction projects, structural inventories, road maintenance, monitoring roadside environmental conditions, and other surveillance, traffic management, and safety-related applications. This feasibility study aimed at identifying user requirements for each GDOT division or office that could potentially benefit from UAVs and matching these user requirements with corresponding UAV design characteristics and costs. Per the research, Construction, Engineering, Intermodal, and Permits and Operations are considered the four GDOT divisions with highest potential for benefitting from UAS technology.

The study results enabled GDOT to proceed steadily into the second phase of UAS research. The next project will determine the technological feasibility, benefits, and limitations of UAS deployment in a field-testing environment, as well as legal and social implications thereof.

Information Services in Social Networked Transportation: Governance and Intelligent Transportation Systems (ITS) (RP 12-26, Mark Demidovich), [Feasibility]

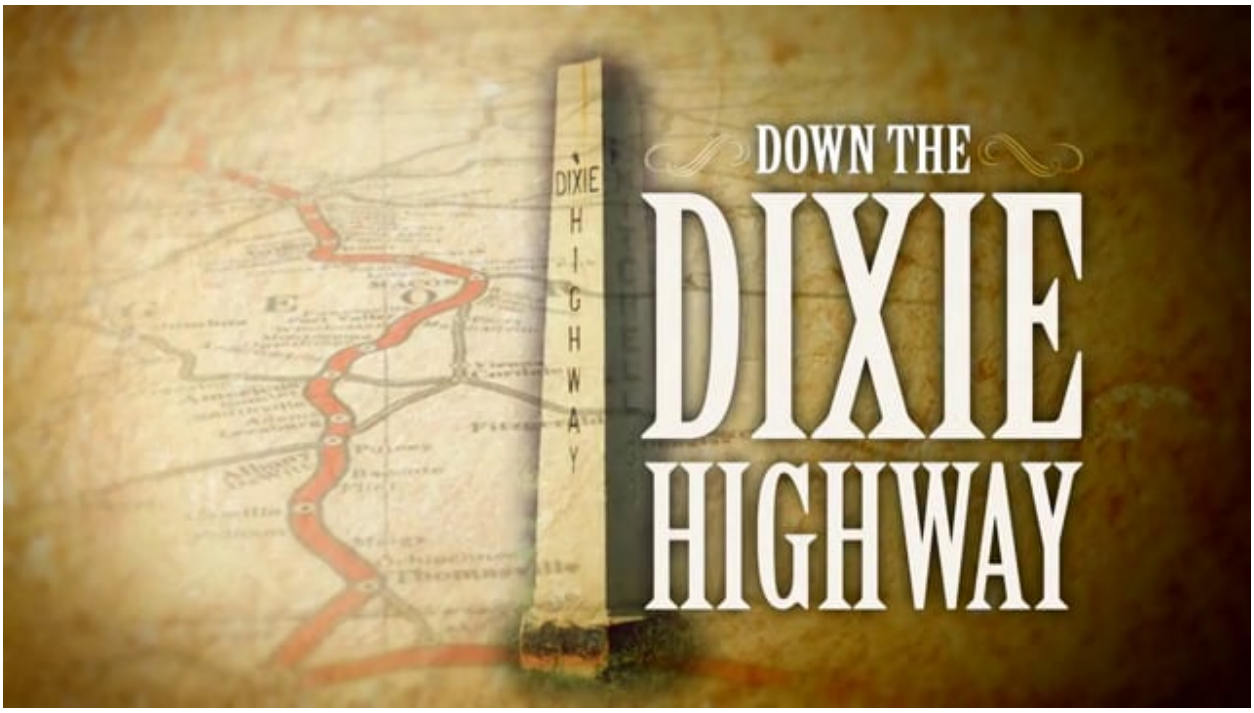
Transportation is traditionally understood as the physical displacement of people, goods, and vehicles. Information technology is often used to model the system or to optimize the system. Now, however, information is an essential element of the system. In the socially networked

paradigm, transportation is conceptualized as an information ecosystem in an institutional landscape.

This research project combined research in social networking and research in transportation to achieve useful insights into socially networked transportation (SNT). It analyzed information flows and institutions in surface transportation in order to promote new information services. It attempted to illuminate the evolving role of state DOT's as transportation becomes more information intensive. This research resulted in understanding foundational principles of and strategies for a SNT. The project led to the implementation of a graduate level course at Georgia Institute of Technology and an annual conference called Transportation Camp South that further disseminates SNT methods among a wider audience, from transportation researchers to practitioners.

MOBILITY

Dixie Highway Context Study (RP 11-33, Madeline White) [Developmental]



In 2012, it was documented that GDOT had over 150 programmed projects along the main branch of the Dixie Highway alone, with many more when secondary routes are considered. GDOT's Office of Environmental Services purposed to develop a streamlined process, or context, for handling this linear historical resource on future projects. Products of the context study included:

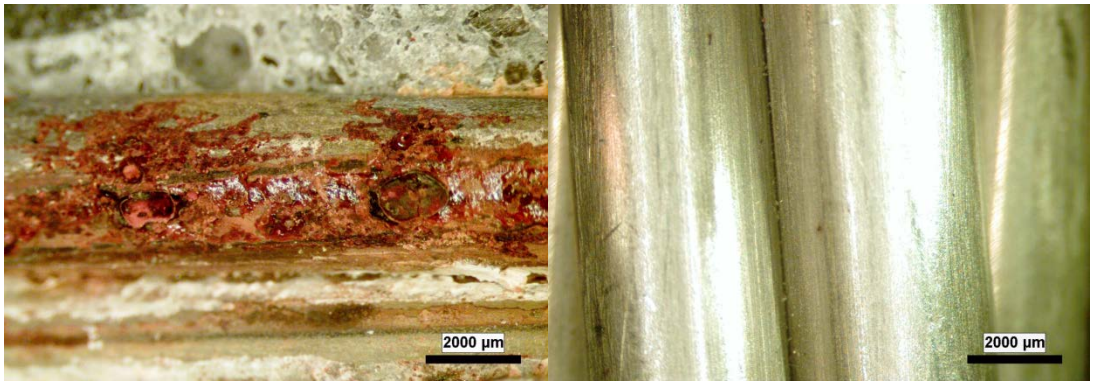
- Developmental history of the Highway, including GIS mapping of each alignment and establishing a methodology and criteria for evaluating the National Register of Historic Places (NRHP) eligibility of the Highway

- Programmatic Agreement (PA) to streamline Section 106 clearance on future projects along the Highway
- Public outreach initiatives as means to enhance the understanding of the Highway in the context of Georgia history and to encourage interest in the Highway thereby.

This interest has already been witnessed by the presentation of the Dixie Highway Context Study at the 2014 "Preserving the Historic Road" conference in Savannah. Positive feedback continues for the "Down the Dixie Highway" documentary, which was created in partnership between GDOT, Georgia Public Broadcasting (GPB), and New South Associates and aired on GPB April 7, 2015. Also in April 2015, the Bandy Heritage Center in Dalton, Georgia hosted a symposium focused on the Highway, which coincided with the 100th anniversary of the Dixie Highway Association.

Corrosion-Free Precast Prestressed Concrete Piles Made with Stainless Steel Reinforcement: Construction, Test and Evaluation (RP 11-34 & RP 10-26, Ben Rabun and Paul Liles) [Developmental and Response]

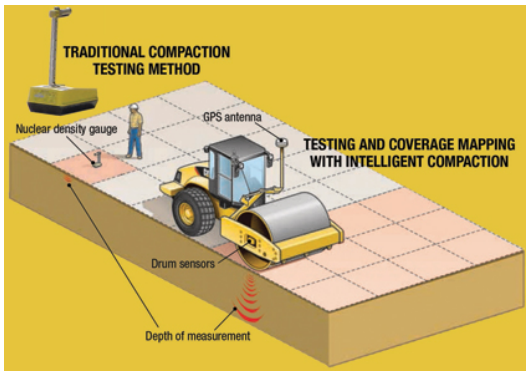
Earlier Research Project 10-26 identified deterioration mechanisms of concrete piles in Georgia's marine environment and proposed economical methods to mitigate corrosion of reinforcement in precast prestressed concrete piles (PPCP). A new high-performance marine concrete (HPMC) mix design and specification were proposed to achieve 75-100 year service lives in PPCP. In a follow-up project (RP 11-34), researchers compared performance of piles made with stainless steel strands to piles with conventional prestressing strands. The use of duplex high-strength stainless steel (HSSS) grade 2205 prestressing strand and austenitic stainless steel (SS) grade 304 spiral wire reinforcement was proposed in lieu of conventional prestressing steel to provide 100+ year service lives for prestressed concrete piles in the coastal Georgia region.



GDOT is expected to use stainless steel reinforced piles on a bridge to be constructed in Lincoln County as a result of this research. This research also encouraged Virginia DOT and Florida DOT to construct and test drive similar piles made with the same high strength stainless steel (2205 strands) that GDOT studied. In short, GDOT innovation has encouraged other states to initiate their own applied research for development of corrosion-free piles.

Accelerated Implementation of Intelligent Compaction (IC) Technology for Embankment Subgrade Soils, Aggregate Base, and Asphalt Pavement Material (TPF-5(128), Alfred Casteel) [Developmental]

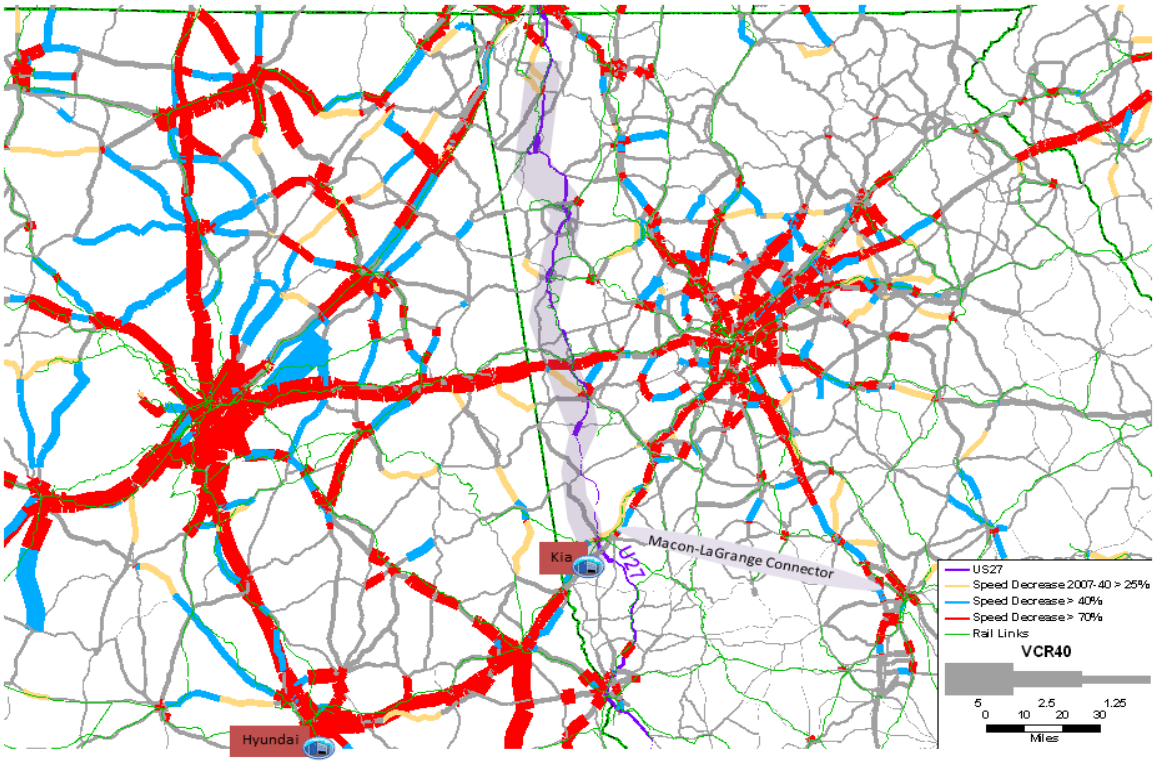
GDOT has participated in this study since 2009, beginning with a pilot project using IC of asphaltic concrete on a park-and-ride lot on US 19/41 in Clayton County. The IC requirements stated that the stiffness of the in-place graded aggregate base (GAB) was to be mapped and that all lifts of asphaltic concrete were to be compacted using IC rollers. The IC rollers were successful in identifying areas of weak base which contributed higher in-place air voids in the asphaltic concrete. A special provision has also been developed for using IC for soils and embankments. GDOT recently implemented IC for soil/embankment applications on three road projects Muscogee, Glynn, and Bartow Counties.



POLICY/WORKFORCE

Micro-Dynamics of Business Location and Growth and its Effects on the Transportation Network and Congestion in Georgia and the Southeast Region (RP 12-24, Kelly Gwin and Thomas McQueen) [Developmental]

This research investigated the linkages between the micro-foundations of industry dynamics and economic activity and the macro-congestion aspects of freight transportation. A major barrier to such understanding has been the difficulty of obtaining the necessary data for analysis. Recognizing this, the research focused on collecting and merging necessary data elements in sufficient detail to allow in-depth empirical analysis. This study provided a detailed estimate of impacts from Kia Motors Manufacturing Georgia (KMMG) on the region's economic and business development and the resulting transportation flows and logistics. The research's outcome has already been put to use in two major GDOT planning studies: (1) Georgia Statewide Freight and Logistics Plan, 2010-2050 (Task 4 Report); and (2) Macon-to-LaGrange Connection.



Implementing Communities of Practice in the Georgia Department of Transportation (RP 11-37, Jeff Conrad and Andrew Heath) [Developmental]

Communities of Practice (COPs) are groups of professionals within an organization who develop on-going, informal knowledge exchanges to learn and performing key job-related processes and skills. Research through experimental group studies investigated strategies by which GDOT can develop COPs to facilitate critical exchanges of knowledge, support organizational learning, and ultimately improve performance outcomes. The study also explored knowledge retention agency-wide. Researchers interviewed managers nearing retirement who were also associated with the various COPs observed in this project.

The study identified practices and functions of four COPs within GDOT: Environmental Services, Geographic Information Systems, Practical Design Training (PDT), and Roundabout and Alternative Intersection Design (RAID). The first two were non-treatment groups in place before the research project and the other two were treatment groups. SharePoint sites were created for the PDT and RAID COPs.

The following findings were observed by the research team between the treatment groups and non-treatment groups:

- All community members (whether in a treated or untreated group) reported an increase in the number of knowledge sources used.

- Members of treatment groups demonstrated improvements over non-treatment groups in accurately identifying sources of knowledge. This was true whether the knowledge was documented or tacit.
- Treatment groups also reported greater reductions in problem-solving time and hence greater job effectiveness. These gains were highest among younger managers.
- The treatment group with members and their offices distributed throughout GDOT saw some of the biggest gains from the workshops and the development of the SharePoint site.

From an implementation perspective, all four groups continued to be active after the research project ended. The SharePoint sites were still active resources for the PDT and RAID groups. The RAID group had also dedicated a portion of a staff member's time to update and maintain the SharePoint site.

Innovative Project Delivery Using Alternative Financing Mechanisms: Assessment of Benefits, Costs, and Risks (RP 13-01, Darryl VanMeter) [Developmental]

USDOT and state DOTs around the country have been seeking private investments to address diminishing financial resources. However, different kinds of financial, political, legal, management, and organizational issues affect agencies' ability to attract private investments in highway projects. In this project, guided by GDOT Office of Innovative Delivery, researchers explored various strategies that have been used by state DOTs to facilitate adoption of private financing in highway projects.

The outcomes of this research have helped guide many decisions, including the current design-build finance contract being procured for the I-285/Georgia 400 interchange reconstruction. This construction project is the largest contract in GDOT, and potentially Georgia, history. Key elements of the research have been used to ensure market favorableness to GDOT's approach. The study also facilitated the delivery analysis for other potential public-private partnerships in the program. Because the design-build finance model is relatively new in U.S. and it cuts across traditional delivery approaches by introducing a private finance component that can be considered as non-debt to a state, the research helps characterize the risks and rewards with a careful consideration of market perceptions.

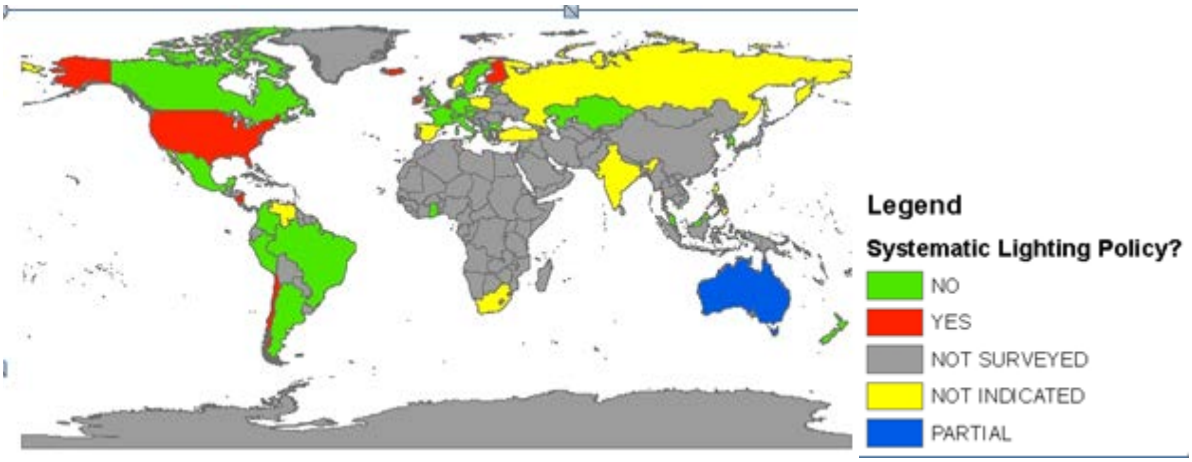
SAFETY

Evaluation of Current Practice for Illumination at Roundabouts (RP 12-01, Daniel Pass) [Developmental]

Over the past five years, GDOT has been a leading state agency for implementation of innovative intersections, which improve safety and reduce delays at lower costs and with fewer impacts than conventional intersections. The roundabout is a versatile and particularly beneficial type of innovative intersection. Fatal and serious injury crash reductions of nearly 80% have been documented from studies around the U.S. comparing roundabouts with conventional intersections. The number of roundabouts in GDOT's purview has increased over the past five years from a small handful to over 150. Consequently, the long-term costs

associated with illuminating these roundabouts have hindered the advancement of many projects. Also, local governments, particularly in rural areas, are bearing the burden of monthly operating and energy costs.

The objectives of this multi-phase research effort were to (1) define conditions where less or no roundabout lighting can provide safety benefits similar to full roundabout lighting; and (2) identify alternate technologies that could reduce long-term energy costs. Phase I of the research investigated the linkage between roundabouts' lighting conditions (full, partial, and no lightning) and nighttime crashes. The major finding was that fully illuminated roundabouts experienced 60% fewer crashes compared with roundabouts with no lighting. Thus, lighting is shown to be necessary for most conditions. The research further found that 70%-80% of the benefits gained from full illumination can be achieved with reduced lighting. Accordingly, lighting might be omitted on roundabout approaches.



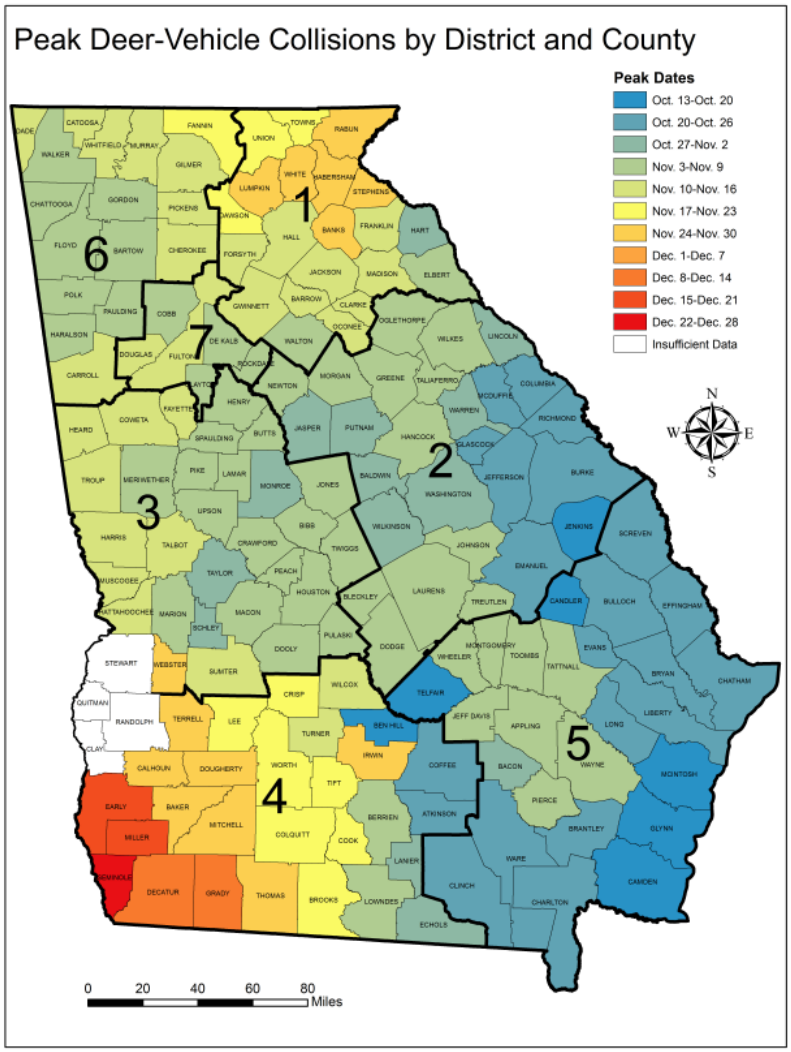
Subsequent phases of the research will (1) determine conditions where lighting can be omitted on the approaches; and (2) identify and evaluate alternate technologies, such as illuminated signs, solar-powered light-emitting diode raised pavement markers (LED RPMs), and lighted bollards, that could provide comparable benefits to conventional lighting but with much lower energy and maintenance costs. This research was recently featured in a widely-viewed TRB webinar, and a journal paper on it will be published in fall 2015.

Development and Evaluation of Strategies to Reduce the Incidence of Deer-vehicle Collisions: Phase III – Operational Field Trial, Part B (RP 12-35, Tom Cox) [Developmental]

Previous GDOT research led by the University of Georgia revealed that a 4-ft. fence with a 2-ft. outrigger angled at 45^{o} towards approaching deer is nearly as effective as an 8-ft. fence at preventing deer crossings. These crossings account for over 1 million deer-vehicle collisions (DVCs) per year, nearly 29,000 injuries, 200 fatalities, and over $1 billion in property damage. UGA researchers conducted an operational field trial of the outrigger design by retrofitting it to a 4-ft. right-of-way (ROW) fence on a 4-mile stretch of I-20 near Madison, Georgia. UGA evaluated effectiveness of the design in preventing DVCs and funneling deer to safe crossing points. Deer movements were monitored by tracking deer that were earlier captured and equipped with GPS collars and ear tags. By analyzing the fine-scale data collected by GPS

collars, GDOT was now able to evaluate changes in deer behavior and movement patterns relative to the I-20 right-of-way.

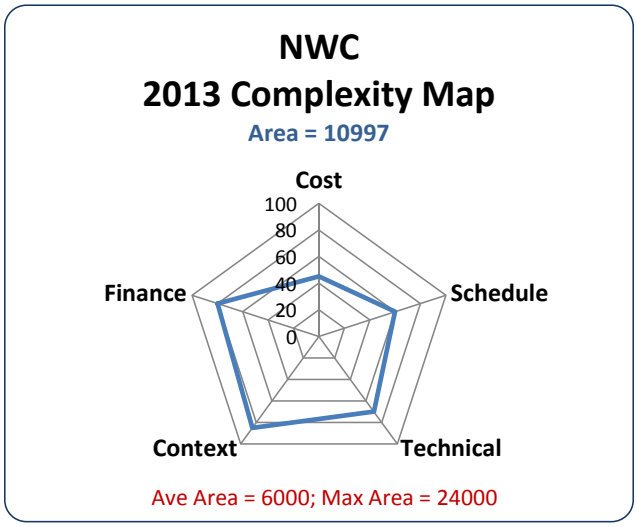
It was well-established by many studies that DVCs increase during the breeding season due to increased deer movements associated with breeding activity. From the research data and records of DVCs in Georgia, researchers observed high concurrence among timing of peak conception, peak rut movement, and peak DVCs. This study found that DVCs can be used as an index of breeding activity in white-tailed deer herds. For assessing the timing of the breeding season at a county or regional scale, DVC data may be more cost effective, more precise, and less susceptible to measurement biases compared to traditional methods. Also, DVC data is readily available at large geographic scales for numerous years. Finally, mapped peak occurrences of DVCs at the county level, like those shown in the figure below, can be readily distributed via mass- or social media outlets to warn motorists of time periods of greatest DVC risk.



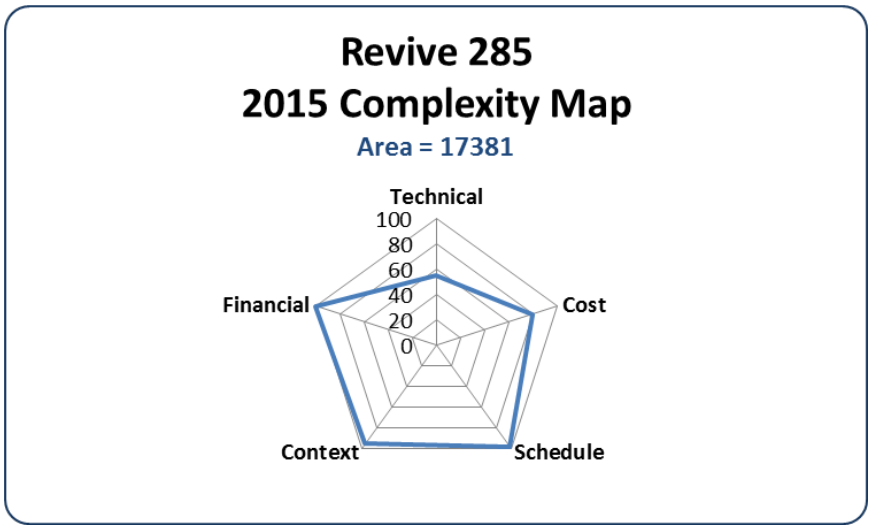
STRATEGIC HIGHWAY RESEARCH PROGRAM 2

Besides managing core GDOT research in direct alignment with GDOT strategic goals, OR also participates in strategic highway research at the federal level. An example of this strategic research is the Strategic Highway Research Program 2 (SHRP-2), an ongoing program that includes four research focus areas: Safety, Renewal, Reliability, and Capacity. GDOT has participated in the following SHRP-2 projects: L01/L06 (Organizing for Reliability), R09 (Risk Management), R10 (Managing Complex Projects), and R26 (Pavement Preservation).

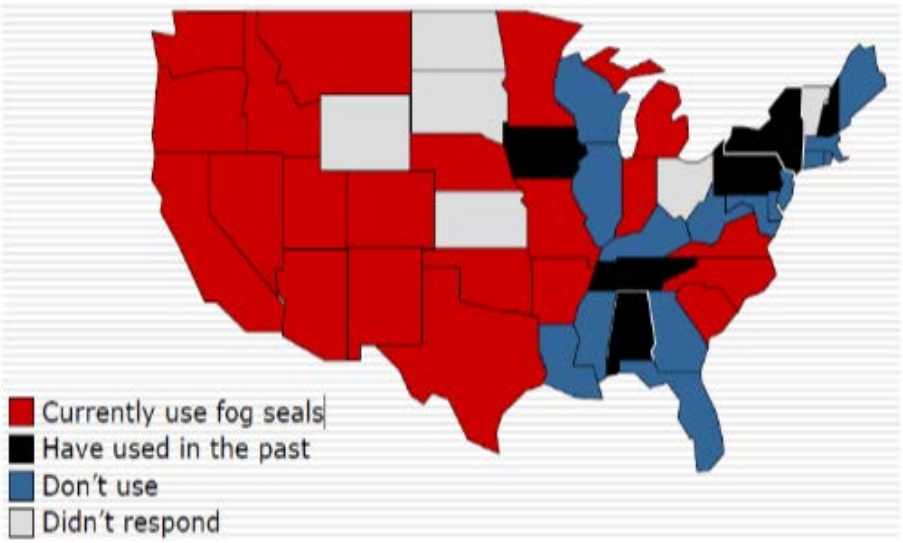
Projects L01/L06 and R09 have been completed and reported on to the RAC in 2013 and 2014, respectively. For Project R10, GDOT saw its implementation as a natural progression of its trend of incorporating design-build flexibility into future GDOT projects. FHWA selected GDOT as the Lead Adopter in using the Incentive Implementation Assistance Grant to deploy the R10 product, i.e. the *Guidebook for Project Management Strategies for Complex Projects*. GDOT completed a workshop on the Northwest Corridor (NWC) study October 2013 (see figure below).



The second workshop, focusing on the I-285/Georgia 400 interchange projects ("Revive 285"), was held in January 2015 (see figure below). Implementation of lessons learned from the two workshops and the adoption of best practices in the current R10 guidelines and toolboxes are being developed through RP 15-12, which will facilitate further internal training on this new initiative and enhance the existing processes and tools for delivery of complex GDOT projects.



Under Project R26, GDOT completed two of three proposed preservation projects (ultra-thin overlay; fog seal; cold-in-place recycling), respectively, and the third project has been scheduled. The ultrathin asphalt overlay (4.75 mm) was placed in Dahlonega in May 2014. Based on the results of this project and other research, OMAT has recommended that the use of this type of thin overlay be expanded. GDOT applied a fog seal for the first time (see figure below) on a friction course on I-475 north- and southbound. Six- and nine-month-post-construction project evaluations have yielded positive results. OMAT and the Office of Maintenance have approved another fog seal application for completion in the coming months.



TRB IMPLEMENTATION REPORT UPDATES

For the TRB Annual Meeting in January 2015, GDOT attendees were asked to identify things learned at the meeting that could be implemented by GDOT. GDOT attendees brought back nearly 29 implementation ideas aligned with all four of GDOT's strategic goals. The following

paragraphs provide updates of OR's specific involvement in several of the implementation ideas.

Session 860: "Ahead of the Curve Workshop" (David Jared and Binh Bui)
Proposed Initiative: Specialized, national-level training for research managers. "Ahead of the Curve" is a training program being developed to enhance the knowledge, skills, and abilities of research managers and those responsible for innovation. OR staff attended an inaugural overview of this training program, which is a joint project of AASHTO, FHWA, and TRB. Pilot modules are pending this year and would be highly beneficial to GDOT research managers.

Implementation Plan and Update. OR staff attended pilot modules offered in July 2015. OR recommends further implementation of this program's educational modules at future venues for new state DOT research managers and staff.

Committee ABG40, Library and Information Science for Transportation (LIST): *"Partner with State DOT Libraries to Implement a Data and Publication Archiving Project"* (Binh Bui)

Proposed Initiative: The GDOT Library has completed archiving of all reports on transportation research performed by GDOT. This initiative would help with archiving of other e-publications, e.g. other state DOT research reports and engineering reports published by various GDOT offices. GDOT's comprehensive library system currently uses a cloud database and search engine to maintain report data and specifications, and the additional reports could be added to this database and queried with the search engine, facilitating daily use by GDOT staff.

Implementation Plan and Update. OR staff have attended bimonthly webinars with Eastern Transportation Knowledge Network (ETKN) and LIST. OR staff assessed the current limitation/needs of the GDOT library system with outreach to other state DOTs' libraries in ETKN for collaboration on archiving and digitalization efforts. OR has also considered joining the Transportation Library Connectivity & Development Pooled Fund, TPF-5(237), to (1) leverage the cooperative community of libraries and archives; and (2) facilitate knowledge transfer to maintain optimal library services for GDOT operations.