
SECTION 2

SUMMARY PAGE

NCHRP Project 14-40
**“Comparison of Cost, Safety, and Environmental Benefits of Routine Mowing and
Managed Succession of Roadside Vegetation”**

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SECTION 4

RESEARCH PLAN

Introduction

Departments of Transportation (DOT) often struggle with the need to meet the safety design criteria for the specific roadways while being sensitive to the surrounding community's desire for more aesthetic treatments. Public interest generated in "greening" the roadways has caused a number of DOTs to favor alternative designs and maintenance operations while still complying with the minimum criteria recommended by the AASHTO guidelines. Many communities desire to use major intersections as gateway treatments to create a sense of place to attract tourism. This often includes more landscaping, i.e., trees.

There are many aspects of roadside design that relate to the placement of trees and other fixed landscape objects within the right-of-way (ROW). Some of these design approaches seem counter intuitive to traditional roadway safety concepts. However, there is a growing body of research that demonstrates that retaining and/or increasing the number of trees and other fixed landscape objects may actually have a neutral or positive effect upon roadside safety. Along with the research is a general movement toward user friendly streets. The design or re-design of urban areas has a definitive direction toward the incorporation of the most intensive landscape/streetscape development that budgets will accommodate. Urban transportation corridors are also public spaces with multiple users and functions. Design and maintenance practices incorporate trees and other fixed objects into the public space to create a greater 'sense of place' for communities. These emerging paradigms and practices include Smart Growth, Livable Streets, Great Streets, Complete Streets, and Walkable Communities to name a few. Inherent to these design philosophies is a strong implementation of context sensitive solutions (CSS) and Traffic Calming. These planning and design movements ensure that the urban roadways and roadsides are designed for the safety and accommodation of all users including motorists, bicyclists, pedestrians and transit riders. However, on roadsides bordering the fringe of development or rural, the roadside maintenance and operation parameters may change to accommodate differing types of adjacent development and users such as industrial and agricultural.

Whether rural, suburban, or urban, the roadside and median design that must comply with two basic safety concepts. These are:

- Nominal Safety- based upon compliance with standards, warrants, guidelines and sanctioned design procedures, and
- Substantive Safety – based upon actual crash frequency and severity of highways or roadways.

Within the context of roadway design, substantive safety is very important. Crash data is a critical design and mitigation component. If a tree or other fixed object location has a high crash incidence, even within the nominal safety parameters, then some sort of mitigation should be investigated. Nominal safety parameters include design speed, ADT, roadway geometry, roadside terrain and functional classification.

Roadside maintenance is key to maintaining the safety clear zone. The AASHTO *Roadside Design Guide* defines a **clear zone** as the total roadside border area, starting at the edge of the traveled way, available for **safe** use by errant vehicles. This area may consist of a shoulder, a recoverable slope, a non-recoverable slope, and/or a **clear** run-out area. Figure 1. Typical Safety Clear Zone. depicts a typical safety clear zone.

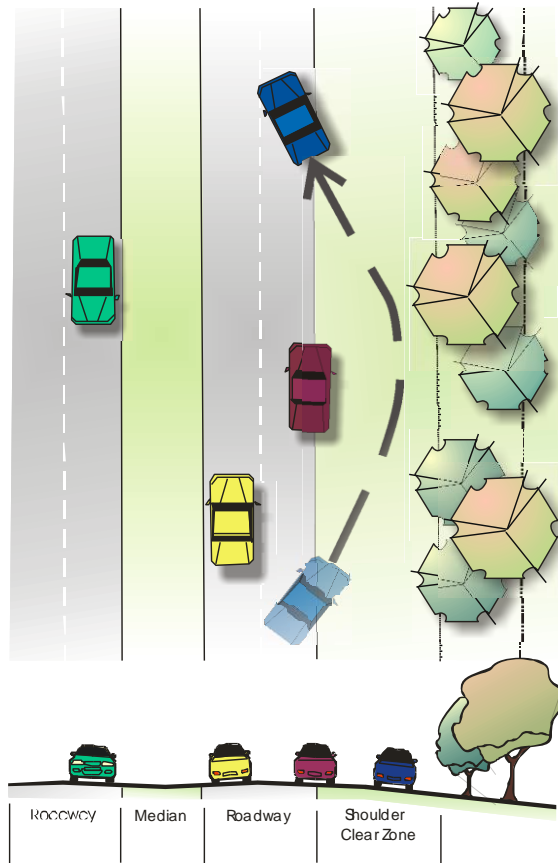


Figure 1. Typical Safety Clear Zone.

DOTs have historically incorporated roadside vegetation management operations that consist of mowing and herbicide treatments not only the safety clear zones, but also the remainder of the ROW from boundary to boundary. These practices have come into question as being a reasonable method of operation when considering cost and environmental concerns versus benefit. DOTs are seeking answers to support minimizing ROW maintenance without compromising safety.

Many factors are at the forefront of considering the benefits of managed succession of vegetation outside the safety clear zone. Some of these benefits may include reduced costs, ecosystem diversity, stormwater quantity and quality management, carbon sequestration, pollinator corridor development, wildlife habitat, and aesthetics.

The roadside maintenance practices have direct impact on the ecosystems services provided. As such, state transportation and environmental agencies are re-evaluating their approach to roadside vegetation management practices. An example is the Minnesota DOT and Department of Natural Resources. They have combined efforts to adjust mowing schedules to accommodate habitat for pheasant nesting

cycles. The Presidential Memorandum issued in June 2014 promotes the improvement of habitat for pollinators including honey bees, native bees, birds, bats, and butterflies. Many state and local DOTs recognize that changing mowing practices may be a pollinator-friendly practice.

In 2014, the Texas DOT (TxDOT) entered a Memorandum of Understanding with five other DOTs (Iowa, Kansas, Minnesota, Missouri and Oklahoma) and the Federal Highways Administration (FHWA). These states are all within the flyway of the migration path of a significant proportion of the US monarch population (roughly considered a broad tract of land following the I-35 corridor). This memorandum establishes a cooperative and coordinated effort to establish and share vegetation management best practices and the promotion of public awareness initiatives related to pollinators conservation. As part of this initiative, TxDOT and TTI are currently working with the Native Plant Society of Texas to plant monarch way stations at safety rest areas along I-35. As part of this project, TTI is producing public outreach materials consisting of videos and brochures to for dissemination at rest areas along the I-35 corridor.

The vision for the final product for NCHRP 14-40 is utilitarian, intuitive Guidelines aimed at instructing practitioners via an Interactive Tool with common scenarios associated with routine mowing and managed succession of roadside vegetation. These practical and user-friendly documents will provide recommendations on how to assign and weight values (including non-monetary values) of direct labor, equipment, materials, and management/planning costs, within the context of individual agencies and regional ecosystems. The selection of tools and techniques will include cost, environmental, driver safety benefits and other considerations. The NCHRP 14-40 project will help pull research out of the academic world and into practice.

Research Objective

The NCHRP 14-40 project aims to provide guidance for roadside vegetation management that identifies and quantifies the cost, safety, and environmental impacts of routine mowing compared with managed succession of vegetation for areas outside the safety clear zone. Managed succession is based on a strategic approach of selective control measures that utilize a combination of zero maintenance, targeted mowing, mechanical trimming and removal, and chemical and/or biological treatments.

This section of the proposal presents the project's research objective and deliverables as well as a detailed work plan that describes how we will achieve the project's objective. The proposed plan reflects the team's familiarity with current knowledge of roadside vegetation management practices. The objectives of this research are to (1) to identify and quantify the cost, safety, and environmental impacts of routine mowing compared with managed succession of vegetation for areas outside the safety clear zone and (2) develop Guidelines for recommended roadside vegetation management practices. The Guidelines will include an Interactive Tool that effectively evaluates potential costs and benefits of a managed succession approach to roadside vegetation management compared with routine mowing.

The Guidelines are intended to be a practical approach for those tasked with roadside vegetation management and should be broadly applicable to a wide range of conditions. With safety as a prime consideration, the Guidelines will provide recommendations on how to assign and weight values (including non-monetary values) of direct labor, equipment, materials, and management/planning costs, within the context of individual agencies and regional ecosystems. Specific details of the task efforts are discussed in the following sections. The results of this research will facilitate support for gaining more widespread acceptance of reduced mowing and managed succession of roadsides.

Overview of Team Structure and Qualifications

Through their extensive years of experience, members of the Project Team have demonstrated a wide range of capabilities related to roadside design, safety and management. Much of the existing research, policies, guidelines, and regulations focus upon the safety clear zone and not necessarily the remainder of the ROW in terms of vegetation management. Needed is expertise in pulling the technical material into a comprehensive, usable document. Principal Investigator (PI) for the Texas A&M Transportation Institute's (TTI) Project Team will be Beverly Storey.

We recognize that technical expertise alone is not enough for this project. The skills required for writing a technical report and writing a user-friendly document are quite different. More importantly, communications is a specialized field requiring expert professionals who are able to be a "bridge" between technical information and the end consumer of this information. The

Project Team understands the issues with regard to roadside safety and vegetation management. Members of the Project Team have extensive experience in sustainable roadside development, cost analysis, environmental and economic impacts, and development of guidance material to include guidelines, construction specifications, standard details, and decision matrices. They have produced the following (more information regarding projects available in Section 6):

- Texas Department of Transportation (TxDOT) 0-4949-1, *Successional Establishment, Mowing Response, and Erosion Control Characteristics of Roadside Vegetation in Texas*, 2004 – 2007 (Jett McFalls). Available at <http://d2dtl5nnlpfr0r.cloudfront.net/tti.tamu.edu/documents/0-4949-1.pdf>.
- NCHRP 25-25 Task 53, *Stormwater Treatment with Vegetated Buffers*, 2009 (Beverly Storey-PI, Jett McFalls). Available at [http://onlinepubs.trb.org/onlinepubs/nchrp/docs/NCHRP25-25\(53\)_FR.pdf](http://onlinepubs.trb.org/onlinepubs/nchrp/docs/NCHRP25-25(53)_FR.pdf)
- TxDOT 0-6860, *Develop Metrics of Tire Debris on Texas Highways*, 2015-2016 Raul Avelar-PI). Available at: <http://tti.tamu.edu/documents/0-6860-S.pdf>.
- TxDOT 0-6733-1, *Evaluation of Generic and Branded Herbicides: Technical Report*, 2012 (Jett McFalls –PI, Beverly Storey). Available at: <http://d2dtl5nnlpfr0r.cloudfront.net/tti.tamu.edu/documents/0-6733-1.pdf>.
- TxDOT IAC, *Erosion and Sediment Control Testing Program*, 1989 – present. (Jett McFalls-PI, Beverly Storey). Available at <http://www.txdot.gov/inside-txdot/division/maintenance/erosion-control.html>.
- TxDOT 0-6638, *Performance Testing of Coagulants to Reduce Stormwater Runoff Turbidity*, 2010-2013 (Jett McFalls-PI, Beverly Storey). Available at <http://tti.tamu.edu/documents/0-6638-1.pdf>.
- The Institute of Transportation Engineers' (ITE's) *Designing Walkable Urban Thoroughfares: A Context Sensitive Approach*, 2010 (Beverly Storey, contributing author) and *Phase III Outreach Materials*, 2011 (Beverly Storey, coauthor). Available at <http://www.ite.org/css/>.
- TxDOT Report 0-5731-1, *Synthesis and Study of the Roadside Vegetation Establishment Process*, May 2011 (Beverly Storey-PI, Jett McFalls). Available at <http://tti.tamu.edu/documents/0-5731-1.pdf>
- TxDOT 0-5748-1, *Water Retention Techniques for Vegetation Establishment in TxDOT West Texas Districts*, Mach 2010, (Jett McFalls-PI; Beverly Storey). Available at <http://tti.tamu.edu/documents/0-5748-1.pdf>.
- TxDOT 0-4548, *Recommendations, Procedures, and Guidelines for the Protection of Trees and Sensitive Landforms*, 2001-2003 (Beverly Storey). Available at <http://tti.tamu.edu/documents/0-4548-1.pdf>.

The Project Team brings valuable subject matter experience that will serve as the driving force behind the project.

- **Beverly Storey** is an associate research scientist with the TTI. She has over 23 years of diverse research in corridor management for visual and environmental quality, sustainable roadside development, stormwater management for regulatory compliance. Ms. Storey has served as principal investigator or key researcher on numerous research studies sponsored by NCHRP, FHWA, EPA, TxDOT and various state agencies. She has developed numerous national/ international surveys and compiled collected data to provide compendiums of best transportation agency practices. She has extensive experience in roadside landscape development including TxDOT's landscape and

aesthetic highway corridor master plans. These documents identified and prioritized landscape and aesthetic goals for the various TxDOT Districts and the representative cities using a context sensitive philosophy toward development, establishment of design guidelines, and creation of a mechanism for short term establishment and long term maintenance of landscape and aesthetic components. Ms. Storey led teams of multi-discipline professionals and community leaders through the process of analysis, conceptualization, design, and planning to create documents which provide guidance for future development. Ms. Storey is professional landscape architect and is a member of the TRB Committees AHD50 Roadside Maintenance and Operations, AFB50T Task Force on Context Sensitive Design/Solutions, the Smart Growth Network, past member AFB40 Landscape and Environmental Design, and is also past president of the Institute of Transportation Engineers (ITE) Brazos Valley Section.

- **Dr. Subasish Das** is an associate transportation researcher with the TTI. He has more than 7 years of national and international experience associated with transportation safety and operation. His major areas of expertise include database management, statistical analysis and machine learning with emphasis in safety and transportation operations, spatial analysis with modern web GIS tools, computer programming (R, python, VBA, html, and javascript), interactive data visualization, and deep learning tools for autonomous cars. He is the author or co-author of over 20 technical papers or research reports. One of his research reports won 2014 AASHTO RAC “Sweet Sixteen” High Value Research award. He has been engaged in many state and federal funded safety research projects. Dr. Das was an Eno Fellow. He is an active member of ITE, and ASCE. He recently served as vice-president of membership of Young Professionals in Transportation (YPT) Houston chapter. He is an active member of the TRB Committee for Library and Information Science for Transportation (ABG40).

Deliverables

Section 9 provides a timeline for the project, and Table 1. Deliverables. lists the anticipated deliverables. The task descriptions presented in the following section will be revised based on the panel’s review to form the Amplified Work Plan, which we will submit to NCHRP within 15 days of the contract beginning date.

Table 1. Deliverables.

Task	Deliverables per Request for Proposal	Month
—	Amplified work plan	1
2	Interim report 1 with annotated outline	10
4	Draft guidelines	21
5	Draft interactive tool	21
6	Draft final report	21
6	Revised final deliverables	24

Research Approach

The Project Team’s approach to developing comprehensive Guidelines for the managed succession of roadside vegetation includes active project management and an intensive work plan. Active project management will ensure effective communication between the research

team and the project panel. The work plan summarizes the individual tasks deemed essential for successful completion of this project.

Project Management

TTI will serve as the contractor for this project and will be the sole point of contact for contractual, administrative, and technical issues. The research team anticipates producing criteria ready for implementation and practice. The following management approach has been established to ensure the project stays on time and within budget:

- Texas A&M System's Sponsored Research Services (SRS) will handle the administrative aspects of this study. The SRS handles much of the research funding for TTI and is experienced in handling the administrative responsibilities.
- The PI, Beverly Storey (TTI), will be responsible for all technical activities of the research.
- Monthly progress reports will be submitted at the end of each calendar month following the published NCHRP requirements.
- Quarterly progress reports will be submitted at the end of each calendar quarter.
- The PI will maintain frequent communication through all stages of the project with the NCHRP technical representative. When appropriate and approved by the NCHRP technical representative, the PI may also communicate with panel members through email, telephone, and in-person meetings.

Work Plan

The Project Team will meet the project objectives and schedule for NCHRP 14-40 through two Phases and 6 Tasks. Prior to initiating Phase I the Project Team will submit an amplified work plan. A kick-off teleconference between the research team and NCHRP will be scheduled within 1 month of the contract's execution to discuss the amplified work plan. During Phase I, the Project Team will identify existing knowledge and gaps in that knowledge through a comprehensive review of the published literature and key reference documents to include relevant state DOT documents (Task 1), conduct a survey of practice to gather and organize information on current roadside vegetation management practices (Task 2). During Task 3 the Project Team will prepare the Interim Report that summarizes the findings from the previous tasks and a Phase II Work Plan that will recommend research efforts for the second phase of the project. Task 3 will include an annotated outline of the proposed guidelines. The Interim Report, the Phase II Work Plan, and Annotated Outline will be submitted for panel review. Task 3 will conclude with a panel meeting between members of the Project Team and the panel at a site selected by NCHRP.

After receiving feedback and approval from the NCHRP panel on the submitted documents, the Project Team will proceed with Phase II. The Project Team will develop the Guidelines (Task 4) and Interactive Tool (Task 5). The Project Team will present our ideas for Phase II and cooperatively work with the panel for their guidance on what would provide the most benefit within that task.

Phase II will use the findings from Phase I to develop the final Guidelines and Interactive Tool (Tasks 4 and 5). Using the findings from Phase I and Phase II along with additional feedback from the panel, the Project Team will develop the final guidance tools (Tasks 4 and 5) and final

report documenting the conduct of research (Task 6). The following subsections describe in more detail these individual tasks (Figure 2. Task Structure.).

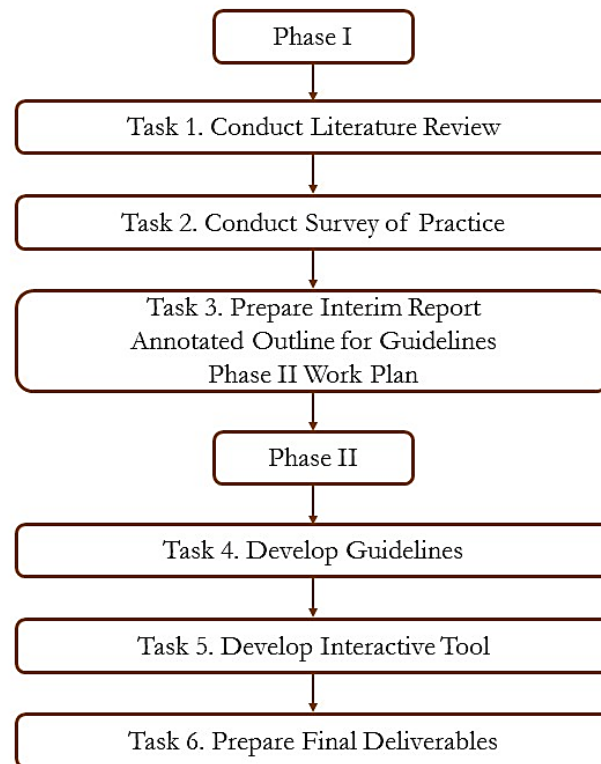


Figure 2. Task Structure.

Phase I

Task 1: Conduct Literature Review

Objective

The objective of this task is to identify the state-of-practice through a review of online documents and a review of the literature on the cost/benefit, safety, and environmental impacts of routine mowing compared with managed succession of vegetation for areas outside the safety clear zone.

Approach

Identifying the state of the practice requires familiarity beyond the national guidelines and standards. Agency manuals and guidance documents are important as well. We will conduct the literature search to identify recent reports or articles, and other resources that previous studies may not have considered. The search will also include any available performance metrics of transportation agencies that have implemented a reduced mowing schedule and/or managed succession. TTI's full-time librarian will conduct the literature search using both manual and computerized methods. Computerized searches will also be conducted in the Transportation Research Information Service (TRIS) and Transport databases. TRIS includes the capability to search several databases including the Highway Research Information Service database for domestic literature, the Highway Research in Progress database for ongoing research studies, and the International Road Research Database for relevant foreign literature.

In addition, this task will include consideration of key reference documents—such as the American Association of State Highway and Transportation Officials (AASHTO) *A Policy on Geometric Design of Highways and Streets* (commonly known as the *Green Book*) or the AASHTO *Highway Safety Manual*—to identify how the developed guidelines will fit (and should fit) with respect to these key documents.

The Project Team will conduct a review of existing relevant research, design guidelines and documented practices focusing at a minimum on the following areas:

- Safety implications of reduced mowing, e.g., sight distance issues, increased wildlife, proximity to access locations, presence of pedestrians and bicycles.
- Environmental benefits/impacts, e.g. pollinator corridors, stormwater quality and quantity management, wildlife habitat.
- Agency mowing protocols, e.g., zero maintenance, targeted mowing, mechanical trimming and removal, chemical and/or biological treatments.
- Cost differentials of managed succession as compared to routine mowing practices, e.g., direct labor, equipment, materials, and management/planning costs, and variances within the context of individual agencies and regional ecosystems.
- Institutional obstacles to reduced roadside maintenance.
- Cooperative opportunities.
- Invasive species/noxious weed issues.
- Ongoing maintenance requirements.
- Adjacent land use concerns.
- Roadway context, e.g., urban versus rural, roadway classification, roadway geometry.
- Public perception/outreach/stakeholder involvement.
- DOT performance metrics.
- Snow/ice/wind concerns.

The Project Team will apply the knowledge framework to efficiently mine the available information from the literature. The data compiled from Task 1 will be used to develop the Tasks in Phase II. The deliverable for Task 2 will be included in the interim report documenting the findings as part of Task 3.

Task 2. Conduct Survey of Practice

Objective

The objective of this task is to document current practices, institutional obstacles, issues and concerns agencies have regarding roadside mowing and managed succession including how they could utilize the findings from this research.

Approach

The survey of practice will be designed to optimize responses by balancing the length and the level of detail of the survey with the respondents' willingness to complete the survey with useful information. A draft survey will be reviewed by the project panel and a final survey instrument will be developed based the draft survey as well as the comments provided. The survey instrument will be formatted as an on-line survey using a web-based survey administration facilitator. The research team will follow all Institutional Review Board (IRB) for Human Subject Protocols for the survey as appropriate.

After receiving IRB approval, Project Team members will conduct the outreach accordingly and record the responses from participants. The Project Team will identify key agency/entity personnel for follow-up interviews. Once the follow-up states or agencies have been identified, researchers will conduct selected phone-interviews designed to further identify those managed succession practices that have been *successfully implemented* on both a state and local level.

Task 3: Prepare Interim Report, Phase II Work Plan, and Annotated Outline for Guidelines

Objective

The objectives of this task are to:

- Develop the Interim Report that will summarize the results of Tasks 1 and 2.
- Develop a Phase II Work Plan that addresses selected critical gaps identified as deserving further study.
- Develop an annotated outline for the Guidelines.
- Submit the Phase I Interim Research Report and the Phase II Work Plan.
- Participate in a panel meeting.

Approach – Interim Report

The developed Interim Report will summarize the results of Tasks 1 and 2 documenting our methodology and findings from these initial tasks.

Approach – Work Plan

The specific approaches to be used in Phase II will be explored as part of Task 3. The Project Team's initial ideas are presented in the Task 4 and Task 5 descriptions.

Approach – Annotated Outline for Guidelines

The Project Team will prepare an Annotated Outline for Guidelines base on the information collected in Tasks 1 and 2. The Guidelines will address the subject areas listed in the project objectives.

Approach – Panel Meeting

Members of the Project Team will meet with the project panel toward the conclusion of Task 3 at a time and location to be determined by NCHRP. During this meeting, the group will discuss the Interim Report, the Phase II Work Plan and Annotated Outline for the Guidelines. The meeting will set the direction for the remaining tasks of the study. We will not proceed with the remaining tasks until NCHRP has provided approval.

Phase II

The Project Team will refine the Phase II Work Plan based on feedback from the panel received either via written comments or during the panel meeting. While several ideas are presented within this proposal, the research approach proposed for Phase II could be changed based upon the panel's review of this proposal along with the findings from Tasks 1 through 3.

Task 4: Develop Guidelines

Objective

The objective of this task is to develop comprehensive Guidelines to assist DOTs, engineers, landscape architects, vegetation managers, and other personnel tasked with managing roadside

vegetation. The Guidelines will be based upon the review and comments of the interim report from the NCHRP.

Approach

During Task 4, the Guidelines will be developed using the findings from the studies conducted within Task 1 and Task 2, using the insights provided by the agency surveys and the literature review conducted in Phase I, and considering the comments provided by the panel during the panel meeting or by written comments on the Phase I Interim Report or the quarterly progress reports.

The Guidelines should reflect a system perspective where the anticipated use by various user groups for the corridor is considered. It is a goal of the research team to make the guidelines user friendly and application oriented. Guidelines will be developed for both the reconstruction and new construction situations and will address the subject areas listed in the project objectives. The Guidelines will also consider and discuss other possible impacts such as work zone traffic control, and vehicular breakdowns or crashes.

Task 5. Develop Interactive Tool

Objective

The objective of Task 5 is to develop an Interactive Tool using common scenarios associated with routine mowing and managed succession of roadside vegetation. This practical and user-friendly document will provide recommendations to transportation and environmental agencies regarding the cost/benefits of reduced roadside maintenance operations.

Approach

This study should build on existing best practices and ensure maximum flexibility and usefulness. The Interactive Tool development should at a minimum consider the following:

- The existence of comparable practices and equivalent developments in other areas, like highway safety and operation project analysis. Examples of tools to be considered include, as a minimum:
 - FHWA desktop tools like FHWA-TOPS (Source: <http://www.ops.fhwa.dot.gov/>) which provides supporting guidance for operations.
 - FHWA web-based BCA.Net tool.
 - NCHRP 03-110 *Estimating the Life-Cycle Cost of Intersection Designs*.
- In the benefit cost analysis (BCA) in HSIP efforts, several values are used for crash costs, and the tool needs to provide the opportunity for the user to select a customized set of crash costs (shown in Figure 3. HSIP BCA Worksheet by Minnesota DOT-Office of Safety Analysis.). The proposed interactive tool will be based on some baseline scenarios associated with routine mowing and managed succession of roadside vegetation. The tool will provide user friendly guideline to assign and weight values of different components like direct labor, equipment, materials, and management/planning costs so that tool users can make appropriate decision while comparing routine mowing with managed succession. The tool will consider maintenance of regional ecosystem and safety thresholds as priority.

HSIP worksheet			Control Section	T.H. / Roadway	Location	Beginning Ref. Pt.	Ending Ref. Pt.	State, County, City or Township	Study Period Begins	Study Period Ends	
				I-494	Portland Ave to Nicollet Ave	3+00.848	4+00.357	Hennepin Co.	1/1/2012	12/31/2014	
<div> <div>Accident Diagram</div> <div>Codes</div> </div>			1 Rear End 	2 Sideswipe Same Direction 	3 Left Turn Main Line 	5 Right Angle 	4,7 Ran off Road 	8,9 Head On/ Sideswipe - Opposite Direction 	Pedestrian	Other	Total
Study Period: Number of Crashes	Personal Injury (PI)	A									
		B									
		C	5								5
	Property Damage	PD	7	3							
Year (Safety Improvement Construction)		2018									
Project Cost (exclude Right of Way)			\$ 600,000		Type of Crash	Study Period: Change in Crashes	Annual Change in Crashes	Cost per Crash	Annual Benefit	<div>B/C= 1.66</div> <div>Using present worth values, B= \$ 998,370 C= \$ 600,000</div> <div>See "Calculations" sheet for amortization.</div> <div>Office of Traffic, Safety and Technology August 2015</div>	
Right of Way Costs (optional)					F			\$ 1,140,000			
Traffic Growth Factor			0.5%		A			\$ 570,000			
Capital Recovery					B			\$ 170,000			
1. Discount Rate			2%		C	-1.25	-0.42	\$ 83,000	\$ 34,583		
2. Project Service Life (n)			30		PD	-2.50	-0.83	\$ 7,600	\$ 6,333		
					Total					\$ 40,917	

Figure 3. HSIP BCA Worksheet by Minnesota DOT-Office of Safety Analysis.

- The need to address additional elements that are specific to this comparison BCS tool including the following examples:
 - Provision of standard methods for quantifying different benefit metrics, associated data requirements, and methods to monetize them using simple and transferable methods.
 - Methods for addressing variability in input data using a variety of approaches including sensitivity and probabilistic simulation based methods, if needed.
 - Integration of BCA with other processes and constraints for overall prioritization of projects for allocating right investments.
- The technical and consistency elements that should be integrated in BCA procedures used by different programs or sectors include:
 - Quantification of benefit metrics,
 - Provision of defaults values for valuation,
 - Methods for local adjustments,
 - Safety outcomes, and
 - Maintenance of regional ecosystem.

The Project Team will develop an Excel®-based smart interactive tool or web-based interactive tool to assist analysts in application of the Guidelines developed in Task 3. To accommodate various input data needs, this tool will have inputs for required data elements and optional data elements. The Interactive Tool will be configured so the users can use default values for some inputs such as direct labor, equipment, materials, and management/planning costs, or provide values for these inputs if desired. The Interactive Tool will compute several measures of

comparative cost-effectiveness, including benefit-cost ratio, and incremental benefit-cost ratio. The Project Team will prepare an instruction manual on the developed Interactive Tool.

Initial User Testing

Once a draft version of the Interactive Tool is developed, the Project Team will distribute the draft Tool to practitioners as per needed by the NCHRP panel team. The Project Team will request the assistance of the NCHRP panel team to identify the appropriate practitioners for this distribution. The Project Team will then develop and present a webinar to demonstrate use of the draft Tool to the practitioners and request their feedback. The demonstration will include presentation of the examples and case studies included in the Guidelines to be developed in Task 3. Attendees will have opportunities to provide verbal feedback and ask questions about the use of the Tool.

To further facilitate the provision of informative feedback, the Project Team will develop a questionnaire with questions like the following:

- Is the Tool user friendly?
- Can you collect the required input data with a reasonable level of effort?
- Are the default values provided for some of the input variables plausible for your area?
- What are the most valuable calculations that the Tool provides to assist you in making a right comparison?
- What additional calculations or features should be added to the Tool?
- What calculations or features should be removed or modified?

Second User Testing

The Project Team will review the feedback received from the initial round of user testing and revise the Interactive Tool accordingly. The Project Team will then conduct a second webinar to demonstrate the revised Interactive Tool to another group of interested practitioners. Ideally, this second group would include some attendees from the first webinar as well as some new attendees who had not previously used the Tool. The Project Team will solicit feedback on the revised Tool in the same manner as with the draft Tool, and then modify and finalize the Interactive Tool. After developing the final Tool, the Project Team will develop a User Guide for the Tool, to be included in the Guide developed in Task 3.

Task 6. Prepare Final Deliverables

Objective

The objective of this task is to prepare the final project documentation, which will include a final research report documenting the conduct of research, stand-alone Guidelines that includes an Interactive Tool.

Approach

Task 6 in this project is to prepare the final deliverables with a final report documenting the entire project's research efforts with a comprehensive description of the research activities, findings, results, and implementation recommendations. It will also include the following:

- Guidelines.
- Interactive Tool.

The final three months of the project will be dedicated to NCHRP review and comment (the first six weeks) and preparation of the revised final deliverables (the second six weeks). In addition to the deliverables identified above, the Project Team expects to make presentations at conferences and other meetings to disseminate the research findings, along with the submission of journal papers and other scholarly works. Because these activities will likely occur following the completion of the project, they are not included as formal deliverables during the research project.

Anticipated Research Results

The Project Team has significant experience in conducting research that leads to practical and implementable results. The team members' knowledge of the technical issues, agency practices, and institutional issues make them well suited to conduct research that will provide the types of results and implementation products that the sponsor desires.

Applicability to Improving Current Practice

The results from this research will further the state of the practice on managed succession that best serve the goals of sustainable roadside. The findings from this research can improve and result in a more consistent and efficient manner of selecting treatments. It will produce practical and immediately usable results for implementation by planning, design, and operations staff in state and city DOTs and metropolitan planning organizations. The NCHRP program is targeted to provide results-oriented research focused on improving roadway performance and safety. This proposal for the NCHRP 14-40 project meets that objective. This research project will produce results that agencies can use to select the most appropriate vegetation management technique that best suits the agency's specific needs.

Anticipated Products

The products from this research as detailed in the RFP include the NCHRP-designated products of the interim report, a final report that documents the conducts of the research, provides guidelines for determining the best approach for managed succession, and enables practitioners to readily assess varying roadside conditions for a best management practice via an interactive tool.

As part of the information dissemination, we expect to produce technical papers and presentation material (i.e., PowerPoint presentations) that will target potential users. We may submit papers presenting details of various portions of the research efforts to TRB for consideration of publication and presentation and AASHTO Standing Committee on the Environment for presentation at their conference. Frequently, when these organizations accept papers and/or abstracts, the research team makes an accompanying presentation at the organization's next conference. These presentations provide an opportunity for the research team to present the findings from their research. We will also prepare a shorter article for publications that do not have space available for the longer papers. This shorter article will include a summary of the research efforts, samples of the findings, and information on how to obtain the full report. We will offer it to appropriate journals as identified during the project.

Audience or "Market" for this Product

The key audiences for the research findings are transportation decisions makers and transportation practitioners (both public and private) with interests in roadside safety, vegetation

and environmental management, roadside maintenance and operations, and highway corridor development. The research results aim to demonstrate to state agencies the benefits of reduced mowing and managed succession. While the general public is not one of the intended audiences for the expected products from the research, their interest in designs that balance all potential users should influence how material is presented. For design decisions to be accepted, we must educate each of these groups on the relationships among environmental regulations, maintenance and operations, treatment life span, and safety. Transportation decisions must balance safety, performance capabilities, usability for each user group, and environmental compliance.

Assessment of Impediments to Successful Implementation

One impediment to implementation will be gaining acceptance of the document. For some practitioners to adopt the research findings and the research results will need to be included in the more established design guides. While the NCHRP 14-40 deliverables are the primary thrust for this research effort, the various information sources could be packaged into multiple formats, depending on the audience, to provide for more widespread distribution of the research findings. The formats can include, but are not limited to, fact sheets, brochures, informational briefs, newsletters, technical reports, primers, project summaries, exhibits of overview documents, tool kits, press releases, and presentations. The project team has a long history of taking transportation-related information and translating it into numerous formats for different audiences.

Leadership in Deploying the Research Product

The Project Team believes that successful implementation requires a continuous process of disseminating results. The Interim Report can serve as early communication of research findings. Dissemination of the Final Report and presentations to key organizations and professional societies will be another important activity. And lastly, leaders in the field will need to work beyond the life of the research project to help mainstream research findings and/or recognition of the NCHRP 14-40 report into existing reference documents. The successful application and implementation of the research findings and research products requires several leaders or champions. First, the NCHRP panel is in a leadership position to advance the findings from this project. The research team can also serve as leaders in introducing the research findings to the design community. And lastly, professional organizations will need to demonstrate leadership in their critique and adoption of the document. Organizations such as AASHTO, TRB, ITE, and others have outlets to include the research findings in published technical documents and conference session presentations.

SECTION 5

QUALIFICATIONS OF THE RESEARCH TEAM

Principal Investigator

Beverly J. Storey, P.L.A.

Associate Research Scientist
System Reliability Division, TTI
3135 TAMU, College Station, TX 77843-3135
Phone: 979-845-7217 | b-storey@tti.tamu.edu

Beverly Storey is an Associate Research Scientist with the System Reliability Division with over 23 years of diverse experience in corridor management for visual and environmental quality, sustainable roadside development, green infrastructure, stormwater management for regulatory compliance, and context sensitive solutions with a great interest in better understanding and managing the effects of design and implementation upon the natural systems within transportation corridors.

Ms. Storey has served as principal investigator or key researcher on numerous research studies sponsored by NCHRP, FHWA, EPA, and various state transportation agencies. She has developed numerous national/international surveys and compiled collected data to provide compendiums of best transportation agency practices. Ms. Storey has co-authored and taught numerous short courses regarding stormwater management for regulatory compliance and green infrastructure/low impact development for various sponsors such as the Lower Rio Grande Valley Texas Pollutant Discharge Elimination System (TPDES) Stormwater Task Force with Texas A&M University at Kingsville, TxDOT, Texas General Land Office, and the South Dakota Department of Transportation's Water Quality Enhancement Program for Construction. Ms. Storey has also provided on-site training and workshops throughout Texas for CSS with FHWA, and the Livable, Sustainable Communities workshops with EPA-HUD-DOT. She co-developed outreach materials and webinars for the Institute of Transportation Engineers' *Designing Walkable Urban Thoroughfares: A Context Sensitive Approach, A Recommended Practice*.

She has extensive experience in roadside landscape development including TxDOT's landscape and aesthetic highway corridor master plans. These documents identified and prioritized landscape and aesthetic goals for the various TxDOT Districts and the representative cities using a context sensitive philosophy toward development, establishment of design guidelines, and creation of a mechanism for short term establishment and long term maintenance of landscape and aesthetic components. Ms. Storey led teams of multi-discipline professionals and community leaders through the process of analysis, conceptualization, design, and planning to create documents which provide guidance for future development. Ms. Storey is professional landscape architect. She is a member of the TRB Committees AHD50 Roadside Maintenance and Operations, and AFB50T Task Force on Context Sensitive Design/Solutions, and the Smart Growth Network. She is a past member of AFB40 Landscape and Environmental Design and also past president of the Institute of Transportation Engineers Brazos Valley Section. Ms. Storey's research background in roadside use, preservation and management will be extremely valuable in this research effort.

Co-Principal Investigator

Subasish Das, Ph.D.

Associate Transportation Researcher
Roadway Safety Program, TTI
3135 TAMU, College Station, Texas 77843-3135
Ph. (979) 845-9958 | s-das@tti.tamu.edu

Dr. Subasish Das is an associate transportation researcher with the Texas A&M Transportation Institute (TTI). He received his Ph.D. in Civil Engineering from University of Louisiana at Lafayette in 2015, and holds a Master of Science in Civil Engineering from the same university in 2012. He has more than seven years of national and international experience associated with transportation safety engineering research projects. These projects include:

- Safety Impacts of Reduced Visibility in Inclement Weather. (Atlas TTI Competitive Research Project 2016)
- Collection and Estimation of Annual Average Daily Traffic (AADT) on Lower-Volume Roads (FHWA Office of Safety Project 2016)
- Analysis of the Shoulder Widening Need on the State Highway System (TxDOT 0-6840).
- Access Management in the Vicinity of Interchanges (NCHRP 07-23).
- Developing a method for estimating traffic volumes in Louisiana local roads (LTRC 14-3SA)
- A Comprehensive Study on Pavement Edge Line Implementation (LTRC 13-2P). This project won 2014 AASHTO High Value Research 'Sweet Sixteen' Award.

Dr. Das is the author or co-author of over 20 technical papers or research reports. He is an active member of ITE, and ASCE. He recently served as vice-chair of membership of Young Professionals in Transportation (YPT) Houston chapter. He is an active member of the TRB Committee for Library and Information Science for Transportation (ABG40). He is an active friend of TRB committees: Highway Safety Performance (ANB25), Safety Data, Analysis, and Evaluation (ANB20), Statistical Methods (ABJ80), and Vehicle User Characteristics (AND10).

Key Team Members – Texas A&M Transportation Institute

Jett A. McFalls, P.L.A.

Assistant Research Scientist
Environment and Planning, TTI
3135 TAMU, College Station, TX 77843-3135
Phone: 979-847-8709 | j-mcfalls1@tamu.edu

Jett McFalls is an Assistant Research Scientist and has been with the TTI's Environment and Planning Program since 1990. He is the manager of the Sediment and Erosion Control Laboratory (SEC Lab). The SEC Lab is a 19 acre, international facility that conducts water quality research including full-scale performance evaluations of erosion and sediment control products. He has served as principal investigator or co-principal investigator for numerous water quality research studies, including projects working with TxDOT, TCEQ and EPA. Mr. McFalls

also co-authored several erosion and sediment control training and certification courses for highway construction for various state DOTs.

Mr. McFalls is a professional landscape architect with a Bachelor of Science in Landscape Architecture from Texas A&M University. He is a member of ASTM D18 Soil and Rock Subcommittee. He is an active member of the International Erosion Control Association where he serves on three Subcommittees: Stormwater Management, Erosion and Sediment Control, and University Partners.

Raul E. Avelar, Ph.D., P.E., PMP

Associate Research Engineer
Roadway Safety Program, TTI
3135 TAMU, College Station, Texas 77843-3135
Ph. (979) 862-1651 | r-avelar@tamu.edu

Dr. Raul Avelar has 13 years of experience in safety research. His research spans statistical analysis of safety data, roadway operations, traffic control devices and pedestrian treatments. Dr. Avelar has played key roles in multiple projects in the United States and abroad for various sponsors including the FHWA, NCHRP, the Oregon DOT, and the Texas DOT. His work includes a statewide evaluation of tire-debris quantity, safety, and associated costs borne by maintenance agencies for TxDOT, and development of self-paced safety data analysis and fundamentals training for FHWA.

- Develop Metrics of Tire Debris in Texas Highways, TxDOT, 2016-2016 (PI)
- Safety Data and Analysis Fundamentals Training, HSA 16-06 / DTFH6116D00004, 2016-Present. (PI).
- AASHTO Highway Safety Manual, Second Edition, NCHRP 17-71, National Academies, 2015-Present.

Bahar Dadashova, Ph.D.

Associate Transportation Researcher
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3135 TAMU, College Station, Texas 77843-3135
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Dr. Bahar Dadashova has 6 years of experience in safety research. Her research is mainly focused on the statistical modelling of safety data, development of computational tools for roadway safety analysis. Dr. Dadashova has participated in various road safety transportation research projects both in Spain and the USA. She has recently joined task order teams for NCHRP 17-71, NCHRP 17-79 and an FHWA project on Safety Data and Analysis Fundamentals Training. She has also assisted in preparing the HSM training materials for the HSIP (Highway Safety Improvement Program) projects.

- AASHTO Highway Safety Manual, Second Edition, NCHRP 17-71, National Academies, 2015-Present.
- Safety Effects of Raising Speed Limits to 75 mph and Higher, NCHRP 17-79, National Academies, 2016-Present.

- Work Zone Crash Characteristics and Countermeasure Guidance, NCHRP 17-71, National Academies, 2012-2017.
- Safety Data and Analysis Fundamentals Training, HSA 16-06 / DTFH6116D00004, 2016-Present.
- External Factor Research and Program Support, HOTM707316083/ DTFH6112D00046. Battelle/TTI, 2016-Present.
- Review of Commercial Motor Vehicle Countermeasures and Study of Hardware Identification Methods, HSA 16-02 / DTFH6116D00004, 2016-Present.
- Innovative Tools and Techniques in Identifying Highway Safety Improvement Projects, TxDOT 0-6912, 2015-Present

Disclosure

The TTI team can confidently state that it will approach this research project with absolute objectivity in its endeavor to satisfy the research objective. All TTI staff members are employed as full-time faculty, researchers, or both with The Texas A&M University System. The subcontractors working with TTI on this project are also fully objective in their approach to this research.

None of the research team members have ownership in any legal entities nor do they receive remuneration of any kind from organizations that would constitute (or be perceived as constituting) a conflict of interest to this research project. Similarly, the research team members do not have properties, patents, or interests that would benefit in any way from the findings of this research.

The Texas A&M University System has policies (TAMUS Policies 15.01.03, 31.05, and 31.05.01) that require the full and complete disclosure of substantial interest (financial or otherwise) in any situation or entity that may (1) conduct business with any component of the A&M System or (2) require the employee to make decisions in conflict to the best interests of the A&M System.

Federal, State, Transit Agency, or Airport Employees

A letters from TTI supporting the agency's proposal for this project is included on the following page.



Texas A&M Transportation Institute
The Texas A&M University System
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979-845-1713
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April 5, 2017

Mr. Christopher J. Hedges
Director, Cooperative Research Programs
Transportation Research Board
500 Fifth Street, NW
Washington, DC 20001

Re: NCHRP Project 14-40
*Comparison of Cost, Safety, and Environmental Benefits of Routine Mowing and
Managed Succession of Roadside Vegetation*
SRS # 1706643, P2017334

Dear Mr. Jenks:

Please accept this proposal from the Texas A&M Transportation Institute to perform NCHRP Project 14-40, *Comparison of Cost, Safety, and Environmental Benefits of Routine Mowing and Managed Succession of Roadside Vegetation*.

Please contact the Principal Investigator, Beverly J. Storey, for additional technical details. The technical and administrative point of contact information is provided below:

Contract Administrator:

Chris Slape
Senior Contract Negotiator II
Texas A&M Sponsored Research Services
400 Harvey Mitchell Parkway S, Suite 300
College Station, Texas 77845-4375
Phone: 979-845-6280
srs-awards@tamu.edu

Principal Investigator (PI):

Beverly J. Storey
Associate Research Scientist
Texas A&M Transportation Institute
3135 TAMU
College Station, TX 77843-3135
Phone: 979-845-7217
b-storey@tamu.edu

The Texas A&M Transportation Institute heartily endorses Beverly J. Storey and the research team in this proposal. I am confident their abilities will help accomplish this project in a timely, thorough, and capable manner. We greatly appreciate your attention and consideration and look forward to producing useful and informative results for you.

Sincerely,


Gregory D. Winfree
Agency Director

TTI | Office of the Director

Figure 4. TTI Letter of Commitment.

SECTION 6

ACCOMPLISHMENTS OF THE RESEARCH TEAM

In this section of the proposal, the qualifications of the TTI team are outlined with descriptions of representative relevant projects and specific examples regarding the research team's ability to meet the objectives of this project. The TTI team's experiences in the development of guidance documents and research is extensive and are described in the projects listed below.

Texas A&M Transportation Institute

I-35 Corridor Pollinator Project

Sponsor: Texas Department of Transportation

Period of Performance: Ongoing Project

Personnel: Jett McFalls

Total Award Amount: \$79,962

The objective of this project is to inform the public of the TxDOT's efforts in promoting pollinators along Texas rights-of-way. Five 1 to 2 minute videos and two brochures will be developed and produced to highlight the TxDOT's past and current ROW management programs and their positive impacts on monarch butterflies and pollinators in general. These videos and brochures will be made available to the public at eight I-35 travel rest areas via existing informational kiosks; and online (via the World Wide Web). The rest areas are located in Hill, Bell, Medina, and La Salle counties. At each of these rest areas, plans are currently underway to establish monarch waystations maintained by the TxDOT in collaboration with local citizen science programs (e.g., The North Central Chapter of the Native Plant Society of Texas). The content of the informational materials will be designed for a 'captive' travelling audience; but will also provide broader information that can be accessed through the WWW.

Successional Establishment, Mowing Response, and Erosion Control Characteristics of Roadside Vegetation in Texas

Sponsor: Texas Department of Transportation

Period of Performance: 09/2004 to 08/2007

Personnel: Jett McFalls (PI), Beverly Storey

Total Award Amount: \$291,198

This project investigated whether TxDOT's standard seed mix needs modifications to better address the issue of invasive species while meeting regulatory compliance for erosion control. The research objectives investigated: (1) the successional process of roadside grasses using TxDOT's seed mix and seeding procedure on field laboratory test plots and actual roadsides, (2) erosion control properties of vegetation on 12 new plots seeded with TxDOT's standard seed mix and 10 existing plots originally seeded with a non-TxDOT seed mix, and (3) the impacts of mowing on establishing and established grass communities. To achieve these objectives, the researchers conducted field laboratory experiments and actual highway roadside surveys. The results indicate that roadsides as maintained and mowed environments cannot be easily adapted by tall grass species (native or introduced). Short, sod-forming grasses, however, could grow better on roadsides. It was found that grass species in TxDOT's standard seed mixes did not show invasiveness on investigated laboratory plots and actual roadsides. The researchers also found little connection between original seeded grass species and observed grass species several years after seeding. This implies that volunteer species either from adjacent lands or from seed

banks in the soil tend to dominate roadsides in the long term. All field laboratory plots controlled erosion very well. Yielded sediments were much below the TxDOT's minimum performance standards. Little literature was found on cost and benefit analysis about roadside management as a result of a lack of consistent cost database data held by state DOTs, which suggests future research on creating a database for comparing cost-benefit between the uses of natives and introduced grasses.

Synthesis and Study of the Establishment and Management of Roadside Vegetation

Sponsor: Texas Department of Transportation

Period of Performance: 09/2006 to 08/2010

Personnel: Beverly Storey (PI), Jett McFalls

Total Award Amount: \$510,000

The objective of this study was to provide a more diverse set of tools and options for TxDOT personnel that will help ensure timely vegetation establishment to meet the Texas Pollutant Discharge Elimination System (TPDES) regulatory requirements, minimize project delays, and help reduce long-term costs in vegetation development and management. To achieve these objectives, the researchers: (1) compared TxDOT's practices to that of other state DOTs and related fields, (2) identified methods for more rapid vegetation establishment for meeting the TPDES requirements using field demonstration plots seeded according to current TxDOT practices, (3) developed a tool to assist design personnel not familiar with the vegetation establishment process-*Vegetation Establishment Guidance for Decisions Assistance Tool* (VEGDAT), (4) developed the Roadside Vegetation Establishment Quick Reference Field Guide, and (5) developed example district standard sheets for vegetation establishment. Available at: <http://tti.tamu.edu/documents/0-5731-1.pdf>.

Urban Tree and Landscape Safety

Sponsor: FHWA

Performance Period: 06/2008 to 06/2009

Personnel: Beverly Storey (PI)

Total Award Amount: \$45,000

This project provided guidance for urban roadside trees and other fixed-objects regarding roadside safety that balances the urban context, community needs, other stakeholder concerns, and environmental constraints to achieve an appropriate context sensitive solution. This project examined all DOT and numerous municipal guidelines for tree and other fixed object placement within the right of way.

Develop Metrics of Tire Debris in Texas Highways

Sponsor: Texas Department of Transportation

Period of Performance: 01/2015 to 06/2016

Personnel: Raul Avelar (PI)

Total Award Amount: \$192,475

Dr. Avelar served as the principal investigator for this research project. The objective was to develop metrics quantifying the extent and characteristics of tire debris on Texas highways, as well as its safety and economic implications. Dr. Avelar developed a three-stage probability sample in order to minimize travel between sites and maximize the number of miles for data collection. This project required analyzing a large set of images from which the sizes of tire debris objects were to be estimated. A total of 1,498 objects were identified and their size

estimated. Dr. Avelar developed the analytical algorithm, designed the calibration and validation procedures, and directed the team that developed the computer code to batch-process the image database. Available at: <http://tti.tamu.edu/documents/0-6860-S.pdf>.

Preparing for EPA Effluent Limitation Guidelines

Sponsor: Texas Department of Transportation

Period of Performance: 09/2010 to 08/2013

Personnel: Jett McFalls (PI), Beverly Storey

Total Award Amount: \$736,243

This project was initiated in 2010 to prepare TxDOT for changes to the CGP regarding the monitoring and sampling of their construction site effluent to meet the anticipated numeric effluent limitation guideline requirements. The scope of the project was modified due to EPA's actions. However, in light of anticipated future numeric limits, the project's monitoring and testing experiments proceeded to 1) determine "typical turbidity" representative of TxDOT's construction site discharges, 2) collect performance data on innovative erosion and sediment control measures that might be expected to achieve the discharge standard, and 3) provide update to TxDOT's *Stormwater Managements Guidelines for Construction Activities*. Available at: <http://tti.tamu.edu/documents/0-6638-1.pdf>.

Bioretention for Stormwater Quality Improvement in Texas

Sponsor: Texas Department of Transportation

Period of Performance: 09/2007 to 10/2013

Personnel: Jett McFalls, Beverly Storey

Total Award Amount: \$564,364

This project summarizes five years of evaluating the applicability and performance of bioretention used as a best management practice (BMP) for highway environments in Texas. The project includes a literature review, pilot experiments, and roadside in situ demonstration. The demonstration site consisted of two different designs: (1) dry (or non-internal water storage) and (2) internal water storage types. The report includes drawing examples, designs and maintenance guidelines, a special specification, a planting plan guide, a summary of the site selection process, and performance data. Available at: <http://tti.tamu.edu/documents/0-5949-4.pdf>.

Stormwater Treatment with Vegetated Buffers

Sponsor: NCHRP 25-25 (53)

Period of Performance: 06/2008 to 09/2009

Personnel: Beverly Storey (PI), Jett McFalls

Total Award Amount: \$50,000

NCHRP 25-25 project provided data demonstrating the proven performance capabilities of vegetated buffers, filter strips, and grass swales as post-construction, primary stormwater treatments. The results of this project enable a sharing of suggested practices, provide a synthesis of recommended practice examples by transportation, environmental, and regulatory agencies regarding the utilization of vegetated buffers, filter strips, and grass swales as a primary stormwater treatment for post-construction rural roadside applications that will facilitate support for gaining more widespread acceptance by state regulatory agencies. Available at: [http://onlinepubs.trb.org/onlinepubs/nchrp/docs/NCHRP25-25\(53\)_FR.pdf](http://onlinepubs.trb.org/onlinepubs/nchrp/docs/NCHRP25-25(53)_FR.pdf)

Designing Walkable Urban Thoroughfares: A Context Sensitive Approach, Phase III Outreach Materials

Sponsor: FHWA/ITE

Period of Performance: 04/2008 to 10/2011

Personnel: Beverly Storey

Total Award Amount: \$58,865

This project built upon the ITE/FHWA *Designing Walkable Urban Thoroughfares: A Context Sensitive Approach Recommended Practice* and other context sensitive solutions (CSS) resources to expand understanding of CSS principles and practices within the transportation community as a whole related to designing walkable urban thoroughfares. The outreach materials included two case studies, web briefings, an ITE Journal article, presentations at various conferences, update to existing Fact Sheets and the development of two additional Fact Sheets, and a report on CSS Performance Measures. The outreach materials are intended to raise the bar for CSS implementation nationally by increasing awareness and by identifying tools and techniques that can be used to successfully implement CSS in design of walkable urban thoroughfares. Available at: <http://www.ite.org/css/>.

Design and Management Planning for Landscape, Aesthetics, and Environmental Development

Sponsor: Texas Department of Transportation

Period of Performance: 1995 to 2008

Personnel: Beverly Storey

Total Award Amount: \$880,000 bi-annual contract

The objective of this inter-agency agreement was to provide design support to TxDOT district personnel such as landscape architects, engineers, maintenance personnel, and vegetation managers. Many projects are planting designs; however, others include retaining walls, riprap, structural aesthetic treatments, landscape pavers, colored concrete, handicap accessibility renovations, erosion control solutions, embankment treatments, and storm water management features. All projects were taken from design development through completed construction documents with estimates. This project also included the development of Landscape and Aesthetic Corridor Master Plans. These master plans identified and prioritized landscape and aesthetic goals for the various TxDOT Districts and the representative cities, developed a philosophy toward landscape and aesthetic development sensitive to the environment, established design guidelines, and created a mechanism for short term establishment and long term maintenance of landscape and aesthetic components. Researchers led teams of multi-discipline professionals and community leaders through the process of analysis, conceptualization, design, and planning to create documents which provide guidance for future development within the highway corridors for the respective districts.

SDDOT Water Quality Enhancement Program for Construction

Sponsor: South Dakota Department of Transportation Water Quality Enhancement Program

Period of Performance: 2005

Personnel: Beverly Storey, Jett McFalls

Total Award Amount: \$98,000

This project for the South Dakota Department of Transportation produced design and construction manuals for erosion and sediment control, inspection checklist, and training course and manuals.

Minimizing Impacts to Existing Vegetation and Sensitive Landforms during Roadway Construction

Sponsor: Texas Department of Transportation

Period of Performance: 09/2002 to 08/2003

Personnel: Beverly Storey

Total Award Amount: \$68,700

This project surveyed existing techniques for tree and landform preservation/protection and weighed their suitability for application to the highway environment. It provides guidelines that include criteria for decision-makers to use in identification of safety as well as social concerns affecting the decision, determining what can be saved, why it might be saved, and the cost for different measures available. This report identifies the issues that affect tree and landform preservation and protection, recommends standards and a new specification procedure as part of a tree protection program for TxDOT, and includes guidelines that explain the standards.

Available at: <http://tti.tamu.edu/documents/0-4548-1.pdf>.

SECTION 7

OTHER COMMITMENTS OF THE RESEARCH TEAM

The TTI team is prepared to commit the necessary personnel to achieve the goals and objectives of this project in a timely and efficient manner. The following tables summarize the known commitments of each key staff member on this project. The research team has the time available to conduct this research project in a manner consistent with the schedule and budget provided in this proposal.

Table 2. Commitments of the TTI Project Team.

Commitments	Storey	Das	McFalls	Avelar	Dadashova
Other CRP* Projects	0	10%	0	15%	0
State/Local Projects	67%	20%	80%	25%	10%
Federal Projects	0	30%	0	30%	50%
Other Projects	0	0	0	5%	10%
Academic/Advisory	0	0	0	0	0
Total Committed	67%	60%	80%	75%	70%
Uncommitted	33%	40%	20%	25%	30%
Total % Time	100%	100%	100%	100%	100%

*Cooperative Research Program

SECTION 8

EQUIPMENT AND FACILITIES

Texas A&M Transportation Institute

About TTI

Since 1950, experts at the Texas A&M Transportation Institute (TTI) have developed solutions to the problems and challenges facing all modes of transportation. A member of The Texas A&M University System, TTI has a breadth and depth of programs, facilities and capabilities unsurpassed by any other higher-education affiliated transportation research organization in the United States.

The Institute's research and development program has resulted in significant breakthroughs across all facets of transportation. TTI research is widely known as an excellent value with a proven impact of saving lives, time and resources.

The Institute conducts about 600 research projects annually with over 200 sponsors at all levels of government and the private sector. In 2015, TTI had research expenditures totaling \$58 million.

The strategies and products developed through TTI's research have saved Texas and the United States billions of dollars and thousands of lives.

At any one time, the Institute has research projects under way in about 30 states and has conducted research in all 50 states. TTI researchers have worked in more than 40 foreign countries to enhance transportation infrastructure and promote a vibrant global economy.

TTI staff comes from more than 50 different countries and are known for their credibility and technical expertise. Many are recognized national and international leaders in their fields. The Institute also plays a key role in educating the next generation of transportation professionals. Over 40 TTI researchers hold joint academic appointments at Texas A&M University. In the laboratory and the classroom, through the Dwight Look College of Engineering and other colleges at Texas A&M University, TTI researchers help prepare students for transportation careers.

With expertise in areas such as engineering, planning, economics, policy, public engagement, landscape architecture, environmental sciences, computer science, and the social sciences, TTI researchers serve as objective transportation experts. They provide a resource to local, state, and national agencies and groups, helping them solve transportation challenges and make informed decisions.

TTI is home to nine state and national research centers, all approved by The Texas A&M University System Board of Regents. These centers help illustrate the depth and breadth of the Institute's capabilities. Center research emphasis areas range from transportation safety and economics, to railway, border mobility, and ports and waterways research.

With headquarters and laboratories on the Texas A&M campus in College Station, TTI also operates several facilities in Bryan, including roadside safety, visibility, pavements, environmental and emissions testing facilities at the university's RELIS Campus.

TTI has offices in Arlington, Austin, Dallas, El Paso, Galveston, Houston, San Antonio and Waco. Internationally, TTI has locations at the Texas A&M University Center in Mexico City and in Doha, Qatar, on the campus of Texas A&M University at Qatar.

For more information about TTI, visit the Institute's website at tti.tamu.edu.

Research Facilities

Research is how we will know more tomorrow than we do today; laboratories—on campus and in the field—are where we will make and validate those discoveries. TTI researchers have access to more than 300 full-scale laboratories and field-testing devices, from the High-Bay Structural Testing Facility to an instrumented vehicle designed to measure driver behavior behind the wheel.

TTI maintains state-of-the-art laboratories, buildings and outdoor test beds. The 67,000-square-foot Gibb Gilchrist Building, located in the Texas A&M University Research Park, was designed and built specifically to house TTI's transportation research programs. The CE/TTI Building, an 85,640-square-foot building on the main campus of Texas A&M University, houses a portion of TTI staff, many of whom are also faculty in Texas A&M's Dwight Look College of Engineering. The CE/TTI Building connects to several laboratories in the areas of pavements and materials, soils and aggregates, and structures. The new three-story, 66,700-square-foot TTI State Headquarters and Research Building houses additional TTI research programs and TTI's administrative offices. Other highlights of the building include the Visibility Research Laboratory, which features a 125-foot-long corridor and is used to measure highway visibility products including signs, pavement markings, and traditional and new lighting technologies, such as LEDs. The lab also measures specialized visibility-related materials, including photoluminescent devices, and is equipped with state-of-the-art photometric equipment used to develop new test methods and specifications to meet the needs of nighttime drivers.

TTI's expansive field-testing facilities are essential in providing real-world findings to state, national and international sponsors. TTI's Proving Grounds at the Texas A&M RELIS Campus, a 2,000-acre complex about 10 miles from the main campus, is home to many TTI testing facilities. At the Proving Grounds, more than 4,000 full-scale crash tests have been conducted on the 3.5-mile test track since TTI began such testing in 1965. Vehicles ranging from subcompacts to 80,000-lb tractor-trailer rigs have been used to test the effectiveness of roadside safety devices, crash cushions, and barrier systems.

The RELIS Campus facilities also include a drive-in Environmental and Emissions Research Facility used for research and testing designed to help lower vehicle emissions, improve air quality, and provide reliable information for state and national policy makers. This 7,500-square-foot facility can house tests using a full tractor-trailer rig or municipal bus. The Sedimentation and Erosion Control Laboratory is a 19-acre indoor/outdoor facility also located at RELIS that provides testing capabilities for technology, products, and devices used for erosion and sediment control, vegetation management, and stormwater-quality improvement.

The Proving Grounds test track is also used for human factors studies using an instrumented vehicle with an eye-tracking system to assess driver look behavior on the open road both in the daytime and at night. The same eye-tracking equipment is used within TTI's driving simulator, which provides a safe and controlled environment to further explore comprehension and

compliance in response to traffic control devices. In the simulated environment, it is possible to inexpensively test multiple variations of the design and placement of a new device.

TII operates real-world research implementation testing sites in seven cities across the state and has locations on the campus of Texas A&M University at Qatar and at the Texas A&M University Center in Mexico City, Mexico. As a member of The Texas A&M University System, researchers have access to other Texas A&M facilities, including the prestigious Sterling C. Evans Library and world-class computing resources to support them in their research endeavors.

Divisional Facilities

The **Sediment and Erosion Control Laboratory** (SEC Lab) has an overall goal to provide the transportation industry with a research and performance evaluation program for roadside environmental management that includes stormwater quality improvement, erosion and sediment control, and vegetation establishment and management. The Texas A&M Transportation Institute's Environment and Planning Program operates this 19-acre, full scale, indoor/outdoor facility. Through a research program with the TxDOT, the SEC Lab produces and maintains the TxDOT Approved Products List (APL) for all sediment and erosion control products used by TxDOT. The SEC Lab also conducts NTPEP performance tests for GA Test Method 11340, *Standard Test Method for Determination of Sediment Retention Device (SRDs) Performance in Reducing Sediment Loss from Rainfall-Induced Erosion during Perimeter Control Applications*.

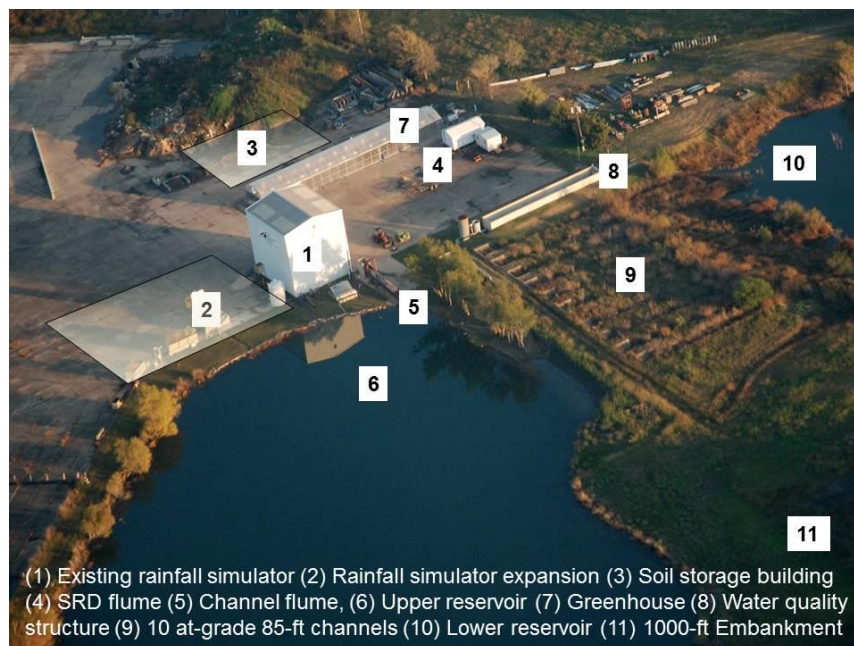


Figure 5. SEC Lab Aerial View.

The indoor rainfall simulator consists of five adjustable soil-filled test beds to match any desired slope up to 1.5:1 and provides water drop size distribution and impact velocity typical of storms common to Texas and the Gulf Coast regions of the country. The rainfall simulator is designed to subject test beds to the greatest, most destructive rainfall characteristics. Almost all of the water droplets reach terminal velocity before soil impact. Rain is dropped from a height of 14 feet causing the speed and erosive force of the water to approximate some of the most severe rainfall properties.



Figure 6. SEC Lab Rainfall Simulator.

In addition to the indoor rainfall simulator, the SEC Lab also houses:

- 25-foot-tall, L-shaped embankment of 1,000 linear feet has both clay and sand soil sections built with 2:1 and 3:1 slopes per highway specifications.
- Sediment retention device (SRD) flume with a 12 ft upper flume, 2 ft lower flume and a 4 ft wide soil-filled area is used to install the material according to manufacturer's specifications. A reservoir continually mixes a slurry of well-graded artificial sediment. Turbidity meters monitor influent and effluent concentrations. Flowmeters are also used to monitor influent and effluent flow rates.
- 30 ft outdoor, variable slope channel flume is used for testing the performance capabilities of flexible channel liner materials at a range of stress flows up to a maximum stress flow of 12 psf (575 Pa).
- 2,800-square-foot climate controlled greenhouse.
- 10 at-grade soil channels that are 85 feet long with a trapezoidal shape and 1:1 side slopes - four with a centerline gradient of 3% and six with a 7% gradient.
- Mobile rainfall simulator used to simulate natural rainfall and control rainfall rates at any remote location.
- 5,000-gallon portable water tank.
- Water quality testing structure designed to hold one-acre inch of water and capture and treat sediment laden water for various time periods. Samplers and flowmeters used in conjunction with this device, monitor settlement rates of sediment and also allow water to be slowly released, skimmed off the surface, or held for a designated time period and then released. One key feature of this device is a solar powered electronic butterfly valve that allows for precise capture and release of water in the structure.

Library Facilities

T'TI's Library Services group contributes to the broader mission of T'TI by providing resources to support research. The T'TI Library maintains a specialized collection of transportation reports, circulars, journals, and other publications. Library staff offers a full range of services to researchers to ensure that all projects are reinforced by the most thorough and complete academic and practical literature, including reference and research assistance, specialized online literature searches, and assistance locating and obtaining research source material. The library also provides a current-awareness service to T'TI researchers by circulating journal tables of

contents and announcing new library acquisitions through Check It Out, the library's monthly newsletter. TTI publications and software can be found using the TTI Catalog.

When documents are not available in the TTI library collection, the TTI library staff uses the resources available through the Texas A&M University Library. Currently the university library holdings include 4.5 million volumes, 936,270 eBooks, 5.7 million microform units, 221,431 maps, 21,000 linear feet of archival and manuscript collections, and 108,064 serial titles (including some 150 state, national, and foreign newspapers). The university library also offers access to more than 19,000 electronic journals and 500 electronic databases, and maintains an outstanding collection of science and engineering technical reports. Materials not owned by the university library can be obtained through interlibrary loan services.

Event Planning and Management

TTI's Event Management team has more than a decade of experience with all types of events, whether a professional conference, workshop, live/online project meeting, or live/online training/webinar. The team is accomplished at every aspect of meeting and event management, including planning, online and onsite registration, and food and equipment coordination. Staff members work with clients to identify and secure the best meeting venue and negotiate a fair and economical contract. The group oversees all tasks associated with registration (including collecting fees via credit cards and checks), building a website, working with sponsor contacts to develop program materials, and ensuring they are accurate and delivered on time. Staff members work with TTI graphic designers and editors to develop event brochures, announcements, programs, and exhibit materials. Print and mailing services are also provided. All aspects of financial management are also included as standard professional services. Events can be staffed in person if necessary.

Research Computing Support

TTI's Network and Information Systems (NIS) is a customer service organization focused on embracing new technologies and delivering a highly reliable and scalable infrastructure. This infrastructure allows the agency to achieve its strategic imperatives by having access to the latest information, tools and training, while protecting the agency's resources in accordance with all applicable regulations. NIS is divided into three functional areas:

- **Enterprise Software Applications Development and Support**—This team is responsible for designing, developing, implementing and integrating enterprise software applications in support of agency mission and goals. The team uses innovative development tools to develop state-of-the-art business applications and manages these applications through database administration, documentation, training and end-user support. In addition, the team assists in developing, administering and maintaining agency intranet and Internet websites. As an IT Solutions provider, the team offers technical guidance and support to research groups that require database and systems development expertise.
- **Enterprise Network Operations**—This team plans, sets up, and maintains the local- and wide-area networks that serve researchers and the agency as a whole. This includes maintaining the servers and associated hardware and software that support the agency's file and print, backup, database, web and SharePoint servers. The Network Operations team also performs 24-hour monitoring of all agency network infrastructure, servers, and domain name registration.

- Information Security—The information security officer administers TTI's information security program by developing and recommending policies, and establishing procedures and practices necessary to ensure the security of information resource assets against unauthorized or accidental modification, destruction or disclosure. The information security team directly supports agency research by providing researchers with a subject matter expert that can provide recommendations and guidance on best practice methods for protecting research data and other information assets against risk of loss, operational discontinuity, unauthorized disclosure, inaccessibility or damage. The team also helps researchers meet the information protection requirements of project sponsors.

Communications and Technology Transfer

TTI Communications has provided a full spectrum of communications services supporting transportation-related technology transfer for more than 20 years. Demonstrated excellence in technical writing, editing, and graphic design of print and online products; video and multimedia production; online webinar developments and meeting supports; and integrated social media/web marketing and technology transfer reflect the breadth and depth of its staff. TTI Communications is the ideal choice for creating advanced educational, technology transfer and marketing tools. Examples include:

- Brochures and technical publications.
- Exhibits.
- Digital presentations.
- Web and interactive media.
- Videos.
- Toolkits.
- Information clearinghouses.
- Outreach campaigns.

Graphic Design Services

TTI Communications artists shape ideas into effective visual presentations via print publications, web designs, identity packages and presentation graphics. These communications tools provide a dynamic and memorable approach to promoting transportation innovations and communicating concepts to a wide variety of audiences. Staff members include an art director and three full-time designers producing world-class products.

Video Capabilities and Facility

TTI video productions range from video summary reports demonstrating new innovations for the marketplace, to industry public service announcements, to full-length feature videos. TTI Communications owns a Panasonic Varicam, the industry standard for high-definition, 720p field acquisition. Standard-definition video is captured using a Sony DVW-700 Digital Betacam camera, which is state of the art for this format. Location support includes small and large jibs; dolly, boom and wireless microphones; complete lighting packages; and field video monitors for high and standard definition. A teleprompter is available for field and studio use.

TTI's video production facility features three high-definition video-editing suites and one standard-definition suite. Editing software includes Final Cut Pro and Avid Media Composer.

Special effects and motion graphics software includes Adobe After Effects and Apple Motion. TTI's licensed FirstCom music library has more than 300 CDs featuring music for every type of scene. TTI maintains a comprehensive sound effects library.

TTI produces interesting, watchable products that meet clients' communications needs. TTI Communications' video staff has won local, regional, and national recognition for its work. For more than 20 years, our videos have garnered multiple Telly Awards, Communicator Awards and MarCom Awards, among others.

Recent TTI video productions are located on TTI's YouTube channel:

<http://www.youtube.com/ttitamu>.

Photography

TTI Communications has a full-time photographer with more than 30 years of experience and an in-house photography studio. He has expertise in creative photography direction, in-studio, and on-location photography, as well as two decades of experience with transportation-related and aerial photography. A digital asset management system allows TTI Communications to maintain internal photo archives for its own use while sharing that photographic archive with external clients. TTI's database currently contains more than 40,000 transportation-related photos. The website portal provides easy access to this database and allows users to browse and search, download files to their computer, and share files or collections via email and web. Files are categorized for browsing purposes and easily searchable.

Public and Media Relations

TTI Communications employs media specialists with backgrounds in both broadcast and print. Along with monitoring media coverage of key transportation trends, this group coordinates media releases of key TTI research, responds to media requests for information and interviews, and produces short-form videos highlighting transportation research and safety initiatives. Staff writers regularly provide articles for transportation research publications and trade journals. Media monitoring systems in place include both Cision Broadcast and Vocus services. The Vocus system is also used to build media lists and distribute press releases and media advisories.

Web Development and Interactive Media

TTI Communications' web and web application developers have extensive experience creating effective, compelling, and easy to use online and mobile-friendly interactive products.

Web development is accomplished with modern web standards and techniques using open source and discipline-specific tools and web programming technologies including HTML5, CSS3, and advanced JavaScript applications. WordPress Content Management System (CMS) expertise facilitates rapid development of online training, video integration, data front ends, surveys, interactive maps, and intuitive interfaces that are effective, scalable, and allow content experts to update, review, and revise their websites' data and content at their convenience. Usability, audience-focused aesthetics, and accessibility are always top priorities for our online products and publications.

Mobile web apps and responsive web design are required for web products that will be used on tablets and phones. TTI Communications designs websites and web applications that conform

and optimize their content to comfortably fit the dimensions of the device being used to access them, whether a small smartphone or large display.

In-House Writing and Editorial Services

TTI writers and editors work with researcher/authors and their support staff to develop high-quality documents on a timely basis. Communicating complex ideas to the public, sponsors, news media and colleagues is a specialty of the writing and editing team at TTI Communications.

Writers offer a wide range of content development services and creative support specific to transportation-related subject matter. Editors are familiar with Federal Highway Administration (FHWA) and Cooperative Research Program (CRP) editorial requirements and review documents for grammar, mechanics, clarity, consistency and style based on the specified guidelines or using standard editorial practices. Editors also suggest editorial changes that help convey messages clearly and concisely to readers. As well as standard edits, we offer advanced services such as electronic in-file editing and formatting, editorial review for electronic accessibility, and responses to sponsor needs.

The team has extensive experience producing:

- Research reports and project summaries.
- Educational materials (online and print).
- Video scripts.
- Manuals, handbooks, guidebooks, and other technical publications.
- Presentation materials and papers for presentation/publication.
- Webpage content.
- News and information articles.
- Brochures and pamphlets.
- Speeches.
- Newsletters.

Printing and Distribution

TTI Communications offers traditional and digital print services as well as assistance with distribution of publications. Shared-drive accessibility enables TTI Communications staff to access working files stored by researchers from any TTI office.

The Processing, Printing, and Distribution Group uses advanced publishing hardware and software to produce high-quality publications, producing high-volume products such as technical research reports, newsletters, brochures, fact sheets, course materials, signs, posters, and project summaries run on preprinted shells. The IKON CPP™ 660 color printer/copier provides quality color copies at 65 sheets per minute, with multifold, stapler, and booklet finishing options. Its large capacity paper trays allow for quick volume printing. As the final publication step, TTI Communications offers complete distribution services to meet client needs.

TTI uses Adobe® Acrobat authoring software or direct coding to create electronically accessible products. Resulting electronic publications in portable document format (PDF) can be viewed in Adobe Acrobat Reader, which is a free viewing engine provided by Adobe. Documents coded using hypertext markup language (HTML) can be viewed directly as webpages. Documents

created as either PDF or HTML files can be linked to audio/video clips for illustration and made fully indexed and searchable by end users.

Deliverables Processing

How documents and contract deliverables are handled can be vital to the success of a project. TTI Communications is experienced in coordinating, tracking, and processing contract deliverables. TTI staff works with researchers, TTI's Research and Development Office, and sponsors to facilitate transmittal of contract deliverables and ensure timely response to sponsor inquiries. TTI staff keeps deliverables processing on track and assists researchers and support staff in managing deliverables and documenting contract fulfillment in response to sponsor requirements, simplifying the jobs of sponsor personnel and supporting contract fulfillment. Processing staff handles approvals and requests related to project deliverables and archives deliverables for historical purposes.

TTI Communications has specialized experience in providing customer service to sponsors through:

- Documenting completion of both written and physical deliverables, creating a basis for quick and easy sponsor review and approval.
- Answering inquiries and providing a central point of contact for sponsors regarding deliverables processing and problem solving.
- Maintaining quality control of written deliverables through professional editing services.
- Maintaining thorough record keeping and documentation.
- Providing one quick-response point of contact for deliverable information.

Communication and Marketing Plans

Working with research project teams, the staff has developed and executed communications and marketing plans for entire organizations, as well as task-specific plans for individual projects, tools, technologies, or groups. Some examples include the I-35 Traveler Information Outreach Plan for TxDOT; Texas Safe Routes to School Communications Plan; Look/Learn/Live Motorcycle Outreach Campaign; and a public outreach plan for the TxDOT Vehicle Titles and Registration Division. The Communications team will initiate the following activities to develop a communications or marketing plan for any specific program or technology: gap analysis, risk/benefit analysis, target audiences, market summaries, key messages, market analysis, barrier analysis, strengths/weaknesses/opportunities/threats (SWOT), performance measures and outcomes, and tools for marketing and communication.

Display Booths at Events

TTI Communications' graphic artists, writers, and communications specialists have developed content, designed, and staffed display booths at events over the last 10 years for a variety of transportation-related campaigns and programs, including the TxDOT-sponsored Drive Clean Across Texas and Motorcycle Safety Awareness campaigns, and the federal Transportation Model Improvement Program (TMIP).

Web Conferencing and Webinars

The TTI team is staffed and equipped to plan, develop, and host online web conferences, courses, and meetings through both the Cisco WebEx and Adobe Connect platforms. With

eight licenses during fiscal year 2015, up to 99 people may participate in an Adobe Connect meeting. TTI has one license for an event room that will accommodate 250 attendees. Over the last year, TTI has hosted 118 web meetings through Adobe Connect, which is also Americans with Disabilities Act (ADA) compliant.

WebEx is TTI's second suite of online meeting products and offers an incredible array of features including video conferencing with full-screen, multiple-feed, or side-by-side-with-screen sharing/viewing modes, and integrated audio that can be joined via telepresence or meeting room video systems. Users can switch presenters, share what is on their desktop or an application, annotate documents together, sketch ideas on a virtual whiteboard, record meetings, and organize or join meetings from a smartphone or tablet. All WebEx meetings, events, and training products are protected by the highly reliable and secure Cisco WebEx Cloud, a global, enterprise-scale network designed specifically for highly secure delivery of on-demand applications. The system offers a scalable architecture, consistent availability, and multilayer tenant security.

Summary

In summary, TTI and Texas A&M present an extensive array of personnel, facilities, equipment, networked computing hardware and software, and research services to support research projects covering the spectrum. Our present commitment and our historic record assure sponsors of responsible, productive research of outstanding quality.

SECTION 9

TIME REQUIREMENTS

The proposed contracting period for NCHRP Project 14-40 is 24 months. This period provides three months for review, revision, and approval of the final report. An estimated schedule of activities is presented in Table 3. Unless otherwise noted work plans and/or reports will be submitted on the last working day of the month.

Within 15 days after the contract beginning date, TTI will submit an electronic file of an Amplified Work Plan for review and acceptance by NCHRP. It will describe the activities to be pursued in the conduct of this research, including a work-flow diagram by task and time. The plan will clearly demonstrate the proposed accomplishment of the research within the specified time period and available funding.

Monthly progress reports will be submitted to NCHRP on or before the 15th of the month following the calendar month being reported. Each report will include summaries of work performed, an outline of scheduled work, discussions of any problems encountered, and the required progress and expenditure charts.

Quarterly progress reports will be prepared at the end of each calendar quarter. An electronic file will be provided to NCHRP. These reports will summarize the work performed in the previous quarter. The quarterly reports also will include the standard monthly report for the last month of the quarter being reported.

The interim report will be prepared at the conclusion of Task 3. The interim report will summarize the results of Tasks 1 and 2. Work on the remaining tasks of the project will not begin until authorized by the NCHRP.

The draft of the final report will be submitted at least 90 days before the end of the project to allow three months for review and revision of the final report. The substance of the panel's comments will be incorporated in the final report.

Table 3. Schedule.

Task	Phase	Months																							
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Amplified Work Plan	1	C A																							
1. Literature Review	1																								
2. Conduct Survey	1																								
3. Prepare Interim Report	1										I	R	P												
4. Develop Guidelines	2																					D			
5. Develop Interactive Tool	2																					D			
6. Prepare Final Deliverables	2																				C	D	R	R	F

Legend:

C = Panel Meeting via Phone.

A = Amplified Work Plan.

I = Interim Report

R = Review Period.

P = Panel Meeting at location selected by NCHRP.

D = Draft Final Report.

F = Revised Final Report.

SECTION 10

SUMMARY OF HOURS BY TASK

Table 4. Summary of Hours by Task.

Names of Principal Staff Members	Role in Study	Pct. Time Over Contract Period*	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6	TOTAL
Beverly Storey	Principal Investigator	26.25	272	176	176	264	80	128	1096
Subasish Das	Assoc. Trans. Researcher	13.6	104	96	80	40	224	24	568
Bahar Dadashova	Assoc. Trans. Researcher	12.93	80	80	96	40	224	20	540
Jett McFalls	Asst. Research Scientist	16.4	80	200	40	265	80	20	685
Raul Avelar	Assoc. Research Eng.	12.6	80	80	80	42	225	19	526
Michelle Benoit	Research Editor	2.25	-	-	25	20	20	29	94
Nancy Strata	Program Specialist III	1.53	10	10	10	10	10	14	64
Helen Olivarez	Admin. Associate V	0.84	5	5	5	5	10	5	35
Tobey Lindsey	Web Administrator	0.96	-	-	-	-	40	-	40
Chris Bratlien	Web Administrator	2.39	-	-	-	-	100	-	100
GRAND TOTAL			631	647	512	686	1013	259	3748

*Total hours divided by 174/month divided by contract months

SECTION 11 ITEMIZED BUDGET

NCHRP 14-40

Texas A&M Transportation Institute

Proposal 1706643

Phase I								
A. Salaries and Wages (Prime)			Task 1		Task 2		Task 3	
Name	Role in Study	Direct Hourly Rate	Hours	Cost	Hours	Cost	Hours	Cost
Beverly Storey	Principal Investigator	\$48.97	272	\$ 13,320	176	\$ 8,619	176	\$ 8,619
Subasish Das	Assoc. Trans. Researcher	\$31.40	104	\$ 3,266	96	\$ 3,014	80	\$ 2,512
Bahar Dadashova	Assoc. Trans. Researcher	\$31.40	80	\$ 2,512	80	\$ 2,512	96	\$ 3,014
Jett McFalls	Asst. Research Scientist	\$52.66	80	\$ 4,213	200	\$ 10,532	40	\$ 2,106
Raul Avelar	Assoc. Research Engineer	\$43.92	80	\$ 3,514	80	\$ 3,514	80	\$ 3,514
Michelle Benoit	Research Editor	\$38.23		\$ -		\$ -	25	\$ 956
Nancy Stratta	Program Specialist III	\$38.66	10	\$ 387	10	\$ 387	10	\$ 387
Helen Olivarez	Administrative Associate V	\$30.01	5	\$ 150	5	\$ 150	5	\$ 150
Tobey Lindsey	Web Applications Developer	\$31.98		\$ -		\$ -		\$ -
Chris Bratlien	Web Applications Developer	\$38.72		\$ -		\$ -		\$ -
Subtotal			631	\$ 27,362	647	\$ 28,728	512	\$ 21,258
B. Materials and Services (Prime)			Hours		Hours		Hours	
1. computer services				\$ 816		\$ 837		\$ 663
2. reproduction of reports/materials				\$ -		\$ -		\$ 250
Subtotal				\$ 816		\$ 837		\$ 913
C. Communications and Shipping (Prime)								
shipping reports/materials				\$ -		\$ -		\$ 100
Subtotal				\$ -		\$ -		\$ 100
D. Travel (Prime)								
For trips from College Station to Washington, D.C.								
Airfare: 1 trip x 2 people x \$600/trip				\$ 1,200		\$ -		\$ -
Rental Car: 1 trips x 2 days/trip @ \$65/day				\$ 130		\$ -		\$ -
Meals: 1 trip x 2 people x 1.5 days x \$69/day				\$ 207		\$ -		\$ -
Lodging: 1 trip x 2 people x 1 nights x \$242/person/night				\$ 484		\$ -		\$ -
Subtotal				\$ 2,021		\$ -		\$ -
E. Employee Benefit Plan & Payroll Taxes (Prime)								
Employee Fringe Benefits Estimates:								
Wages Only Staff	Rate	10.7%		\$ 1,425		\$ 922		\$ 922
Staff	Rate	17.5%		\$ 2,457		\$ 3,519		\$ 2,212
Total Fringe				\$ 3,882		\$ 4,441		\$ 3,134
Institutional Medical Insurance Cost								
Staff	Rate/person/month	\$ 745		\$ 1,537		\$ 2,017		\$ 1,439
Total Medical				\$ 1,537		\$ 2,017		\$ 1,439
Subtotal				\$ 5,419		\$ 6,458		\$ 4,573
F. Administrative Costs @ 48.5% of Modified Total Direct Costs								
				\$ 16,879		\$ 17,065		\$ 12,698
GRAND TOTAL PROJECT				\$ 52,497		\$ 53,088		\$ 39,542

A. Salaries and Wages (Prime)			Phase I		Phase II			
			Subtotal		Task 4		Task 5	
Name	Role in Study	Direct Hourly Rate	Hours	Cost	Hours	Cost	Hours	Cost
Beverly Storey	Principal Investigator	\$48.97	624	\$ 30,558	264	\$ 12,928	80	\$ 3,918
Subasish Das	Assoc. Trans. Researcher	\$31.40	280	\$ 8,792	40	\$ 1,256	224	\$ 7,034
Bahar Dadashova	Assoc. Trans. Researcher	\$31.40	256	\$ 8,038	40	\$ 1,256	224	\$ 7,034
Jett McFalls	Asst. Research Scientist	\$52.66	320	\$ 16,851	265	\$ 13,955	80	\$ 4,213
Raul Avelar	Assoc. Research Engineer	\$43.92	240	\$ 10,542	42	\$ 1,845	225	\$ 9,882
Michelle Benoit	Research Editor	\$38.23	25	\$ 956	20	\$ 765	20	\$ 765
Nancy Stratta	Program Specialist III	\$38.66	30	\$ 1,161	10	\$ 387	10	\$ 387
Helen Olivarez	Administrative Associate V	\$30.01	15	\$ 450	5	\$ 150	10	\$ 300
Tobey Lindsey	Web Applications Developer	\$31.98	0	\$ -		\$ -	40	\$ 1,279
Chris Bratlien	Web Applications Developer	\$38.72	0	\$ -		\$ -	100	\$ 3,872
Subtotal			1790	\$ 77,348	686	\$ 32,542	1013	\$ 38,684
B. Materials and Services (Prime)					Hours		Hours	
1. computer services				\$ 2,316		\$ 887		\$ 1,310
2. reproduction of reports/materials				\$ 250		\$ -		\$ -
Subtotal				\$ 2,566		\$ 887		\$ 1,310
C. Communications and Shipping (Prime)								
shipping reports/materials				\$ 100		\$ -		\$ -
Subtotal				\$ 100		\$ -		\$ -
D. Travel (Prime)								
For trips from College Station to Washington, D.C.								
Airfare: 1 trip x 2 people x \$600/trip				\$ 1,200		\$ -		\$ -
Rental Car: 1 trips x 2 days/trip @ \$65/day				\$ 130		\$ -		\$ -
Meals: 1 trip x 2 people x 1.5 days x \$69/day				\$ 207		\$ -		\$ -
Lodging: 1 trip x 2 people x 1 nights x \$242/person/night				\$ 484		\$ -		\$ -
Subtotal				\$ 2,021		\$ -		\$ -
E. Employee Benefit Plan & Payroll Taxes (Prime)								
Employee Fringe Benefits Estimates:								
Wages Only Staff	Rate 10.7%			\$ 3,269		\$ 1,383		\$ 419
Staff	Rate 17.5%			\$ 8,188		\$ 3,432		\$ 6,084
Total Fringe				\$ 11,457		\$ 4,815		\$ 6,503
Institutional Medical Insurance Cost								
Staff	Rate/person/month \$ 745			\$ 4,993		\$ 1,807		\$ 3,995
Total Medical				\$ 4,993		\$ 1,807		\$ 3,995
Subtotal				\$ 16,450		\$ 6,622		\$ 10,498
F. Administrative Costs @ 48.5% of Modified Total Direct Costs				\$ 46,642		\$ 18,995		\$ 23,853
GRAND TOTAL PROJECT				\$ 145,127		\$ 59,046		\$ 74,345

Phase II								
A. Salaries and Wages (Prime)			Task 6		Subtotal		Total	
Name	Role in Study	Direct Hourly Rate	Hours	Cost	Hours	Cost	Hours	Cost
Beverly Storey	Principal Investigator	\$48.97	128	\$ 6,268	472	\$ 23,114	1096	\$ 53,672
Subasish Das	Assoc. Trans. Researcher	\$31.40	24	\$ 754	288	\$ 9,044	568	\$ 17,836
Bahar Dadashova	Assoc. Trans. Researcher	\$31.40	20	\$ 628	284	\$ 8,918	540	\$ 16,956
Jett McFalls	Asst. Research Scientist	\$52.66	20	\$ 1,053	365	\$ 19,221	685	\$ 36,072
Raul Avelar	Assoc. Research Engineer	\$43.92	19	\$ 834	286	\$ 12,561	526	\$ 23,103
Michelle Benoit	Research Editor	\$38.23	29	\$ 1,109	69	\$ 2,639	94	\$ 3,595
Nancy Stratta	Program Specialist III	\$38.66	14	\$ 541	34	\$ 1,315	64	\$ 2,476
Helen Olivarez	Administrative Associate V	\$30.01	5	\$ 150	20	\$ 600	35	\$ 1,050
Tobey Lindsey	Web Applications Developer	\$31.98		\$ -	40	\$ 1,279	40	\$ 1,279
Chris Bratlien	Web Applications Developer	\$38.72		\$ -	100	\$ 3,872	100	\$ 3,872
Subtotal			259	\$ 11,337	1958	\$ 82,563	3748	\$ 159,911
B. Materials and Services (Prime)			Hours				Hours	
1. computer services				\$ 334		\$ 2,531		\$ 4,847
2. reproduction of reports/materials				\$ 585		\$ 585		\$ 835
Subtotal				\$ 919		\$ 3,116		\$ 5,682
C. Communications and Shipping (Prime)								
shipping reports/materials				\$ 200		\$ 200		\$ 300
Subtotal				\$ 200		\$ 200		\$ 300
D. Travel (Prime)								
For trips from College Station to Washington, D.C.								
Airfare: 1 trip x 2 people x \$600/trip				\$ -		\$ -		\$ 1,200
Rental Car: 1 trips x 2 days/trip @ \$65/day				\$ -		\$ -		\$ 130
Meals: 1 trip x 2 people x 1.5 days x \$69/day				\$ -		\$ -		\$ 207
Lodging: 1 trip x 2 people x 1 nights x \$242/person/night				\$ -		\$ -		\$ 484
Subtotal				\$ -		\$ -		\$ 2,021
E. Employee Benefit Plan & Payroll Taxes (Prime)								
Employee Fringe Benefits Estimates:								
Wages Only Staff		Rate 10.7%		\$ 671		\$ 2,473		\$ 5,742
Staff		Rate 17.5%		\$ 887		\$ 10,403		\$ 18,591
Total Fringe				\$ 1,558		\$ 12,876		\$ 24,333
Institutional Medical Insurance Cost								
Staff		Rate/person/month \$ 745		\$ 561		\$ 6,363		\$ 11,356
Total Medical				\$ 561		\$ 6,363		\$ 11,356
Subtotal				\$ 2,119		\$ 19,239		\$ 35,689
F. Administrative Costs @ 48.5% of Modified Total Direct Costs				\$ 6,907		\$ 49,755		\$ 96,397
GRAND TOTAL PROJECT				\$ 21,482		\$ 154,873		\$ 300,000

All facilities and equipment necessary to accomplish the required work are available.

The Texas A&M University System serves people of all ages, regardless of socioeconomic level, race, color, sex, religion, disability or national origin.

A. Clerical salaries are directly charged as the support required is significantly greater than the routine level of services provided by academic departments.

B1. Computer equipment usage fee and network support services is an established rate and is not charged indirect.

D. Travel M&IE is calculated at 75% on the first and last day of travel.

F. Excludes B1.

SECTION 12

DISADVANTAGED BUSINESS ENTERPRISE PLAN

TTI's HUB Program

TTI and The Texas A&M University System (TAMUS) are committed to making a good faith effort to use Historically Underutilized Businesses (HUBs) through a fair, open, and competitive bidding and procurement process. All employees are encouraged to solicit bids from HUB vendors and, resources and guidance are made available to enable principal investigators and support staff to locate qualified vendors and special interest groups that can assist.

TTI has an internal HUB program that satisfies the State of Texas and TAMUS requirements. This plan has been active for over 15 years and contains elements as described below.

Statement of Commitment

TTI is dedicated and committed to the State of Texas HUB Program to actively involve minority-owned, woman-owned, qualified disabled veteran-owned and small businesses in the procurement process for goods and services and ensure they receive equal opportunities for a fair share of state business. Use of a diverse HUB vendor base for all levels of expenditures is an emphasis of the program.

The Institute is further committed to the State Use Works Wonders Program for Texans with disabilities. TTI departmental purchasers are encouraged to consider the Texas Industries for the Blind and Handicapped and various Community Rehab Programs when acquiring items sold by the State Use Works Wonders Program.

The Texas A&M University Procurement Services Department, responsible for the procurement of goods and services in excess of \$10,000 for the Institute, encourages the use of and participation by HUBs in all procurement decisions. TTI division, program, and center staff process all delegated purchases, those less than or equal to \$10,000. On these purchases, department personnel are encouraged to fulfill good faith efforts by seeking bids from HUB vendors by phone, e-mail, and/or vendor websites.

Goal of TTI's HUB Program

The intent of TTI leadership is to establish and implement HUB program policies that foster fair and competitive business opportunities that maximize the inclusion of HUB owned and small businesses in agency procurement contracts.

Administration of TTI's HUB Program

TTI administers the HUB program as specified by State of Texas Government and Administrative Codes, TAMUS Policies, Agency Rules and Federal Guidelines when applicable. Plan strategies include both in-reach and outreach activities focused on executive management support, communication, vendor solicitation and recruitment, monitoring of program performance, and employee training. Continued management communication regarding the importance of the HUB program, vendor diversity, and employee training are essential in-reach activities required for the attainment of agency HUB performance goals. Performance goals are set at a minimum of 18.06 percent of expenditures for fiscal year 2017. A copy of TTI's HUB plan is available upon request from Donna Harrell at the Texas A&M Transportation Institute (d-harrell@tti.tamu.edu).

SECTION 13

APPENDICES

Appendix A: Resumes – Texas A&M Transportation Institute

Beverly J. Storey, P.L.A.

EDUCATION

- M.L.A., Landscape Architecture, Texas A&M University.
- B.S., Forestry, Texas A&M University.

EXPERIENCE

- Associate Research Scientist, System Reliability Division, Texas A&M Transportation Institute, 2016 - present
- Associate Research Scientist, Environment and Planning Program, Texas A&M Transportation Institute, 2012-2016
- Program Manager, Environmental Management Program, Texas Transportation Institute, 2007-2012.
- Associate Research Scientist, Environmental Management Program, Texas Transportation Institute, 2007-2012.
- Assistant Research Scientist, Environmental Management Program, Texas Transportation Institute, 2004-2007
- Associate Transportation Researcher, Environmental Management Program, Texas Transportation Institute, 2000-2004.
- Assistant Transportation Researcher, Environmental Management Program, Texas Transportation Institute, 1999-2000.
- Assistant Research Specialist, Environmental Management Program, Texas Transportation Institute, 1996-1999.
- Graduate Assistant Researcher, Environmental Management Program, Texas Transportation Institute, 1993-1996.

PROFESSIONAL REGISTRATION

- Registered Professional Landscape Architect in Texas, Registration No. 1996.

AFFILIATIONS

- Member, TRB Roadside Maintenance Operations Committee.
- Member, Transportation Research Board (TRB) CSS Task Force.
- Past Member, TRB Landscape and Environmental Design Committee.
- Member, Smart Growth Network.
- Member, Institute of Transportation Engineers, Texas Section.

ACADEMIC COURSES DEVELOPED

- *Making Mobility Improvements a Community Asset*, Graduate level course in CSS, University Transportation Center for Mobility, Texas A&M University.

WEBINARS

- *Case Study Successes in Designing Walkable Thoroughfares: Lancaster Avenue, Ft. Worth, Texas*, Institute of Transportation Engineers.

SHORT COURSES DEVELOPED AND TAUGHT

- *Construction Site Erosion and Sediment Control*. Texas Department of Transportation.
- *Introduction to Low Impact Development*. Southwest Region University Transportation Center.
- *Developing and Implementing Soil Erosion Management Plan at Construction Sites*. South Texas Environmental Institute at Texas A&M University Kingsville with the Lower Rio Grande Valley TPDES Stormwater Task Force.
- *How to Inspect Construction Sites and How to Enforce a TPDES Program*. South Texas Environmental Institute at Texas A&M University Kingsville with the Lower Rio Grande Valley TPDES Stormwater Task Force.
- *Low Impact Development Best Management Practices and Stormwater Management*. South Texas Environmental Institute at Texas A&M University Kingsville with the Lower Rio Grande Valley TPDES Stormwater Task Force.
- *Context Sensitive Solutions Workshops and EPA/DOT/HUD Sustainability/Livability Workshops*. Federal Highway Administration.
- *Erosion and Sediment Control Course ENV 102*, Texas Department of Transportation.
- *Erosion and Sediment Control Course ENV 103*. Texas Department of Transportation.
- *Erosion and Sediment Control Course with Train-the-trainer and Certification Program*. South Dakota Department of Transportation's Water Quality Enhancement Program.

SELECTED PUBLICATION

- P. Carlson, **B. Storey**, M. Poorsartep, C. Stevens, B. Ettelman, T. Lindheimer, M. Dastgiri, A. Khodakarami, J. Miles, D. Song, R. Lytton, X. Luo, Y. Deng, F. Gu, and S. Hurlbaas. *Advancing Innovative High-Speed Remote-Sensing Highway Infrastructure Assessment Using Emerging Technologies: Technical Report*. FHWA/TX-16/0-6869-1, Texas A&M Transportation Institute. 2017.
- J. Crawford, S. Sharma, S. Ranft, **B. Storey**, M. Le, Y. Rathod, A. Sanchez, J. Overman. *Implementation and Effectiveness of Sound Mitigation Measures on Texas Highways (HB 790)*. PRC 16-64 F. Transportation Policy Research Center, Texas A&M Transportation Institute. 2016.
- R. Baker, L. Cochran, N. Norboge, M. Moran, J. Wagner and **B. Storey**. *Alternative Fuel Vehicle Forecasts*. PRC 14-28F. Transportation Policy Research Center, Texas A&M Transportation Institute. 2015.
- J. Overman, **B. Storey**, E. Kraus, K. Miller, and Z. Elgart. *Introductory Guide to Integrated Ecological Framework*. FHWA/TX-13-0-6762-P1, Texas A&M Transportation Institute. 2014.
- J. Overman, **B. Storey**, E. Kraus, K. Miller, and Z. Elgart. *Maximizing Mitigation Benefits—Making a Difference with Strategic Inter-Resource Agency Planning: Year Two Technical Report*. FHWA/TX-13-0-6762-2, Texas A&M Transportation Institute. 2014.
- J. McFalls and **B. Storey**. *Sediment and Erosion Control Laboratory Facility Expansion*. FHWA/TX-13/5-9048-01. Texas A&M Transportation Institute. 2013.
- M. Li, P. Li, J. McFalls, **B. Storey** and G. Newman. *Developing the Sediment and Erosion Control Laboratory to Become a Hand-on Training and Education Center: Project Report*. Southwest Region University Transportation Center. 2013.

- J. McFalls, Y. Yi, **B. Storey**, M. Barrett, D. Lawler, B. Eck, D. Rounce, T. Cleveland, H. Murphy, D. Dalton, A. Morse, G. Herrmann. *Performance Testing of Coagulants to Reduce Stormwater Runoff Turbidity*. FHWA/TX-14/0-6638-1. Texas A&M Transportation Institute. 2013.
- J. McFalls, Y. Yi, M. Li, S. Senseman, and **B. Storey**. *Evaluation of Generic and Branded Herbicides: Technical Report*. FHWA/TX-13/0-6733-1. Texas A&M Transportation Institute. College Station, Texas. 2013.
- **B. Storey**, D. Foster, J. Johnson, and J. McFalls. *Development and Validation of a Testing Protocol for Carbon Sequestration Using a Controlled Environment*. Southwest Region University Transportation Center. 2012.
- **B.J. Storey**, J.R. Schutt, J.A. McFalls, K.D. Jones, A.P. Garza, W.J. Rogers, C. Robinson, T.A. Gaus, G. Marek, and K. Heflin. *Synthesis and Study of the Roadside Vegetation Establishment Process*. FHWA/TX-11/0-5731-1. Texas Transportation Institute. College Station, Texas. 2011.
- B.S. Bochner and **B.J. Storey**. *Designing Walkable Urban Thoroughfares: A Context Sensitive Approach – Phase III Outreach Materials*. 2011.
- Institute of Transportation Engineers. *Designing Walkable Urban Thoroughfares: A Context Sensitive Approach*. ITE Publication No. PR-036A, Washington, D.C., 2010.
- **B.J. Storey**, M. Li, J.A. McFalls, and Y. Yi. *Stormwater Treatment with Vegetated Buffers*. Project 25-25 Task 53, National Cooperative Highway Research Program. October 2009.
- J.A. McFalls, W. Rogers, C. Robinson, **B.J. Storey**, B.A. Stewart, M. Li, J. Schutt, and V. Saxena. *Water Retention Techniques for Roadside Vegetation Establishment in Arid Regions of Texas*. FHWA/TX-09/0-5748-1. Texas Transportation Institute. College Station, Texas. 2009.
- K.D. Jones, **B.J. Storey**, D. Jasek, and J. Sai. *Synthesis of New Methods for Sustainable Roadside Landscapes*. FHWA/TX-07/0-5330-1. Texas Transportation Institute, College Station, Texas. 2007.
- H. Landphair, J. McFalls, **B. Storey**, and M. Li. *SDDOT Water Quality Enhancement Program for Construction*. Report No. SD04-05-F. South Dakota Department of Transportation. 2006.
- **B. Storey**, A.B. Raut Desai, M. Li, H. Landphair and T. Kramer. *Water Quality and Performance of Compost Filter Berms*, FHWA/TX-06/0-4572-1. Texas Transportation Institute, College Station, Texas. 2006.
- D.L. Bullard, N.M. Sheikh, R.P. Bligh, R.R. Haug, J.R. Schutt, **B.J. Storey**. *Aesthetic Concrete Barrier Design*. National Cooperative Highway Research Program Report 554. Transportation Research Board, Washington, D.C. 2006.
- D.L. Bullard, N.M. Sheikh, R.P. Bligh, R.R. Haug, J.R. Schutt, **B.J. Storey**. *Aesthetic Concrete Barrier and Bridge Rail Design*. 474630-5. Texas Transportation Institute, College Station, Texas. September 2005.
- **B. Storey**, *Lubbock Landscape and Aesthetic Master Plan, Lubbock District, Texas Department of Transportation*, Texas Transportation Institute, College Station, Texas. 2004.
- J. Schutt, **B. Storey**, R. Rabinowitz. *Recommendations, Procedures, and Guidelines for the Protection of Trees and Sensitive Landforms*. FHWA/TX-04/0-4548-1. Texas Transportation Institute, College Station, Texas. 2003.

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- P.L. Ellis, C.W. Gilliland, J.H. Overman, **B.J. Storey**, N. Volkman. *Preliminary Review Environmental Process Guidebook*, Product 4001-P1. Texas Transportation Institute, College Station, Texas. 2003.
 - **B. Storey**, J.A. McFalls, S.H. Godfrey. *Use of Compost and Shredded Brush on Rights-of-Way for Erosion Control: Final Report*. Texas Transportation Institute. TxDOT 1352-2F. 1996.
 - **B. Storey** and S. Godfrey. "Highway noise barriers: 1994 survey of practice". *Transportation Research Record 1523*. Transportation Research Board. 1997.
 - **B. Storey**, S.H. Godfrey. *Highway Noise Abatement Measures: 1994 Survey of Practice*. Texas Department of Transportation. TX-95/1994-4. 1995.

Subasish Das, Ph.D.

EDUCATION

- Self-Driving Car Nanodegree, Udacity (expected 2018)
- Ph.D., Systems Engineering, University of Louisiana at Lafayette, Lafayette, LA (2015)
- M.S., Statistics, University of Louisiana at Lafayette, Lafayette, LA (completed thirty-six semester hours of graduate course work for the degree, 2015)
- Specialization in Data Science, John Hopkins University (Coursera maintained) (2015)
- M.S., Civil Engineering, University of Louisiana at Lafayette, Lafayette, LA (2012)
- B.S., Civil Engineering, Bangladesh University of Engineering & technology, Dhaka (2007)

EXPERIENCE

Texas A&M Transportation Institute, College Station, TX

- Associate Transportation Researcher, August 2015 – Present.

University of Louisiana at Lafayette, Lafayette, LA

- Research Assistant, January 2010 - July 2015.

Hennessey LLC, Dubai, UAE

- Quantity Surveyor May 2008 – June 2009.

Mak Estate Developments Ltd., Dhaka, Bangladesh

- Project Engineer, June 2007 - May 2008.

RECOGNITIONS, HONORS, AND AWARDS

- 2015– Eno Leadership Development Fellow.
- 2015 – Gulf Region ITS (GRITS) Scholarship
- 2015 – Best Paper Award (2nd Place) in University of Louisiana Graduate Research STEM Core
- 2015 – Data Incubator Data Science Fellowship Semi-finalist
- 2014– 2014 SASHTO Outstanding Graduate Research Award
- 2014 – 2014 AASHTO High Value Research Sweet Sixteen Award
- 2013 – 2013 Gulf Region ITS (GRITS) Scholarship First Place Award
- 2012 – Travel award for 9th Postgraduate Academic Forum of Beihang University, China
- 2012 – University of Louisiana Engineering Designing Leader
- 2011-2014– Deep South Institute of Transportation Engineers Scholarship

PROFESSIONAL SERVICE ACTIVITIES

Professional Society Memberships

- Vice Chair for Membership, Young Professionals in Transportation (YPT) Houston Chapter, September 2015- Present.
- American Society of Civil Engineers (ASCE), Associate member, January 2012- Present.
- Institute of Transportation Engineers, Member, August 2011- Present.
- Gulf Region Intelligent Transportation Society, Member, August 2014- Present.

COMMITTEE MEMBERSHIPS

Transportation Research Board

- Library and Information Science for Transportation (ABG40), Member: 2016 – 2020, Friend: 2015-2016.
- Alcohol, Other Drugs, and Transportation (ANB50), Friend, May 2014 – Present.
- Safe Mobility of Older Persons (ANB60), Friend, May 2014 – Present.
- Safety Data, Analysis and Evaluation (ANB20), Friend, May 2014 – Present.
- Statistical Methods (ABJ80), Friend, Friend, May 2014 – Present.

University Committees/Activities

- University of Louisiana ITE Chapter, Treasurer, August 2011- July 2015.

RESEARCH PROJECTS (2015-current)

- Collection and Estimation of Annual Average Daily Traffic (AADT) on Lower-Volume Roads. FHWA Project; 2016-2019. Role: Co Principal Investigator.
- Safety Impacts of Reduced Visibility in Inclement Weather. Atlas TTI Competitive Research Project 2016. Role: Principal Investigator.
- Technical Support for Focus Approach to Roadway Departure (RwD) Safety. FHWA Project; 2016-2019. Role: Key Researcher.
- Pedestrian and Bike Scalable Risk Assessment Methodology (ScRAM). FHWA Project; 2016-2019. Role: Key Researcher.
- NCHRP 17-76: Guidance for the Setting of Speed Limits. 2016-2018. Role: Key Researcher.
- Safety Impacts of Reduced Visibility in Inclement Weather. TTI-Atlas Competitive Research Project; 2016. Role: Principal Investigator.
- Improper Passing-Related Crashes on Rural Roadways. TTI Strategic Research Project; 2016. Role: Principal Investigator.
- Analysis of the Shoulder Widening need on the State Highway System. Project No. 0-6840-1; 2016. Role: Key Researcher.
- Is Age a Factor in Crashes at Channelized Right-Turn Lanes? An Exploration of Potential Relationships. Atlas Research Project; 2016. Role: Key Researcher.
- User Sentiment Analysis with Louisiana Social Media Data for Better and Effective Crash Countermeasures. LTRC 2014 TIRE Award Project; 2015. Role: Key Researcher.
- Developing a method for estimating AADT on all Louisiana roads. Louisiana DOT Project; 2015. Role: Key Researcher.

PEER-REVIEWED RESEARCH REPORTS (2011-Current)

- Safety Impacts of Reduced Visibility in Inclement Weather. Atlas Project; 2017 (in press).
- Synthesis of Methods for Estimating Pedestrian and Bicyclist Exposure to Risk at Area Wide Levels and Specific Transportation Facilities. Publication No. FHWA-SA-17-041; 2017.
- Analysis of the Shoulder Widening need on the State Highway System. Report No. 0-6840-1; 2016 (in press).
- Is Age a Factor in Crashes at Channelized Right-Turn Lanes? An Exploration of Potential Relationships. Report No.: ATLAS-2016-XX, 2016.

- User Sentiment Analysis with Louisiana Social Media Data for Better and Effective Crash Countermeasures. Report No. 14-4TIRE; Oct, 2015.
- Developing a method for estimating AADT on all Louisiana roads. Report No. FHWA/LA.15/14-3SA; Dec, 2015.
- A Comprehensive Study on Pavement Edge Line Implementation. Report No. FHWA/LA.13/508; Apr, 2014.
- Developing Crash Modification Factor for Louisiana. Report No. FHWA/LA.12/506; Oct, 2013.
- Safety Improvement from Edge Lines on Rural Two-Lane Highways. Report No. FHWA/LA.11/487; May, 2011.

PEER-REVIEWED PUBLICATIONS (2013-current)

- **Das, S.,** K. Dixon, X. Sun, A. Dutta, and M. Zupancich. Trends in Transportation Research: Exploring Content Analysis in Topics. *Transportation Research Record: Journal of the Transportation Research Board*, 2017 (accepted).
- **Das, S.,** K. Dixon, R. Avelar, and K. Fitzpatrick. Using Machine Learning Techniques to estimate non-motorized trips for rural roadways. The 96th Transportation Research Board Annual Meeting Compendium Paper, 2017.
- **Das, S.,** K. Dixon, R. Avelar, and X. Sun. Identifying Patterns in Wrong Way Driving Crashes using Multiple Correspondence Analysis. *Accident Analysis and Prevention*, 2017 (under review).
- **Das, S.,** X. Sun, and A. Dutta. Text Mining and Topic Modeling on Compendium Papers from Transportation Research Board Annual Meetings. *Transportation Research Record: Journal of the Transportation Research Board*, Volume 2552, 2016, pp. 48-56.
- **Das, S.,** and X. Sun. Association knowledge for fatal run-off-road crashes by Multiple Correspondence Analysis. *LATSS Research*, Volume 39, Issue 2, 2016, pp. 146–155.
- **Das, S.,** and X. Sun. Factor Association with Multiple Correspondence Analysis in Vehicle-Pedestrian Crashes. *Transportation Research Record: Journal of the Transportation Research Board*, Volume 2519, 2015, pp. 95-103.
- **Das, S.,** X. Sun, F. Wang, and C. Leboeuf. Estimating likelihood of future crashes for crash-prone drivers. *Journal of Traffic and Transportation Engineering*, Volume 2 Issue 3, 2015, pp. 145-157.
- Khattak, M., A. Khattab, H. Rizvi, **S. Das,** and M. Bhuyan. Imaged-based Discrete Element Modeling of Hot Mix Asphalt Mixtures. *Materials and Structures*, Volume 48, Issue 8, 2015, pp. 2417–2430.
- Sun, X., **S. Das,** Z. Zhang, F. Wang, and C. Leboeuf. Investigating Safety Impact of Edgelines on Narrow, Rural Two-Lane Highways by Empirical Bayes Method. *Transportation Research Record: Journal of the Transportation Research Board*, Volume 2433, 2014, pp. 121-128.
- **Das, S.,** X. Sun, Y. He, F. Wang, and C. Leboeuf. Investigating the Safety Impact of Raised Pavement Markers on Freeways in Louisiana. *International Journal of Engineering Research & Innovation*, Volume 5 Issue 2, 2013, pp. 74-80.
- Sun, X., **S. Das,** N. Fruge, R. Bertinot, and D. Magri. Four-Lane to Five-Lane Urban Roadway Conversions for Safety. *Journal of Transportation Safety & Security*, Volume 5 Issue 2, 2013, pp. 106-117.

EDUCATION

- B.L.A., Landscape Architecture, Texas A&M University, May 1990.

EXPERIENCE

- Assistant Research Scientist, Environmental Management Program, Texas A&M Transportation Institute, Texas A&M University, College Station, Texas, 2007-present.
- Associate Transportation Researcher, Environmental Management Program, Texas Transportation Institute, Texas A&M University, College Station, Texas, 1999-2007.
- Research Associate, Environmental Management Program, Texas Transportation Institute, Texas A&M University, College Station, Texas, 1990-1999.

MEMBERSHIPS/APPOINTMENTS

American Society of Testing Materials (ASTM)

- D 18.25 Soil/Rock Subcommittee Member

International Erosion Control Association

- Member, 1992-present.
- President South Central Chapter, 2005-2008
- Stormwater Management Subcommittee Member
- Erosion & Sediment Control Subcommittee Member
- University Partners Subcommittee Member

Texas Transportation Institute

- H.B. Zachary Researcher of the Year – 1997
- Most Distinguished Technical Paper Award (IECA) - 1998

PROFESSIONAL LICENSES

- Registered Landscape Architect, Texas No. 1955.

SELECTED PRESENTATIONS

Professional Society Meetings

- “Proposed Test Protocol for Evaluating the Sediment Control Removal Efficiency of SRDs” International Stormwater Conference (StormCon), Long Beach, CA, August 2010
- “Proposed Test Protocol for Evaluating the Performance of Sediment Control Devices for Roadside Stormwater Runoff” Transportation Research Board Annual Meeting, January 2010
- “Erosion Control for Construction Sites.” Texas Vegetation Management Association Annual Conference, College Station, Texas. October 2010.
- “Revised Universal Soil Loss Equation 2” California Stormwater Quality Association, San Diego, CA, October, 2009
- “TxDOT/TTI Hydraulics, Sedimentation & Erosion Control Laboratory” National Roadside Vegetation Managers Association (NRVMA), San Antonio, TX, September, 2009

- “Roadside Sediment Control Device Evaluation Program” AASHTO National Stormwater Conference, San Diego, CA, June 2008
- “Stormwater BMP Issues for Erosion and Sediment Control.” Texas Department of Transportation Design and Bridge Conference. Corpus Christi, Texas. 2007.
- “Revisions to the Protocol for Performance Testing of Erosion Control Products and Flexible Channel Liners” International Erosion Control Association, Orlando, FL, 2002
- “Performance Testing of Erosion Control Products – What Have We Learned After Five Complete Evaluation Cycles?” - Winner of the 1998 Most Distinguished Paper Award - International Erosion Control Association, Reno, NV, 1998
- “The 1996 Performance Results for Slope Protection Products, Hydraulic Mulches, and Flexible Channel Liners” Transportation Research Board Annual Meeting, Washington D.C., 1997
- “Flexible Channel Liner Study at the TxDOT/TTI Hydraulics and Erosion Control Laboratory” International Geosynthetics Conference, Long Beach California, October, 1997
- “Control at Highway Construction Sites: Guidelines for Texas” Transportation Research Board Annual Meeting, Washington, D.C., October 1996
- “Development of Standard Specifications for TxDOT” International Erosion Control Association, Reno, NV, 1994
- “Texas Department of Transportation and Texas Transportation Institute Field Testing Program” International Erosion Control Association, Reno, NV, February, 1992

RESEARCH REPORTS

- *Synthesis and Study of the Roadside Vegetation Establishment Process.* B.J. Storey, J.R. Schutt, J.A. McFalls, K.D. Jones, A.P. Garza, W.J. Rogers, C. Robinson, T.A. Gaus, G. Marek, and K. Heflin. FHWA/TX-11/0-5731-1. Texas Transportation Institute. College Station, Texas. 2011.
- *Stormwater Treatment with Vegetated Buffers.* B.J. Storey, M. Li, J.A. McFalls, and Y. Yi. Project 25-25 Task 53, National Cooperative Highway Research Program. October 2009.
- *Water Retention Techniques for Roadside Vegetation Establishment in Arid Regions of Texas.* J.A. McFalls, W. Rogers, C. Robinson, B.J. Storey, B.A. Stewart, M. Li, J. Schutt, and V. Saxena. FHWA/TX-09/0-5748-1. Texas Transportation Institute. College Station, Texas. 2009.
- *Successional Establishment, Mowing Response, and Erosion Control Characteristics of Roadside Vegetation in Texas.* M. Li, J.R. Schutt, J.A. McFalls, E.K. Bardenhagen, C. Sung, L.A. Wheelock. Texas Transportation Institute. TxDOT 0-4949-1. 2008
- *SDDOT Water Quality Enhancement Program for Construction.* H. Landphair, J. McFalls, B. Storey, and M. Li. Report No. SD04-05-F. South Dakota Department of Transportation. 2006.
- *Estimating Pollutant Loads for Stormwater Quality.* H.C. Landphair, J.A. McFalls, D. Thompson. Texas Transportation Institute/Texas Tech University. TxDOT 0-1837. August 2003
- *Erosion Control and Engineering Properties of Native Vegetation Compared to Bermudagrass.* J.A. McFalls, J.R. Schutt, H.C. Landphair. Texas Transportation Institute. TxDOT 0-1504-2. August 2002.

- *Design Methods, Selection, and Cost Effectiveness of Stormwater Quality Structures.* J.A. McFalls, H.C. Landphair, D. Thompson. Texas Transportation Institute/Texas Tech University. TxDOT 0-1837-1. 2001
- *Recommendation for an Integrated Weed Management Program for Ornamental Plantings on Texas Highways.* J.R. Schutt, J.A. McFalls. Texas Transportation Institute. TxDOT 7-2979. November 1996
- *Use of Compost and Shredded Brush on Rights-of-Way for Erosion Control: Final Report.* B. Storey, J.A. McFalls, and S.H. Godfrey. Texas Transportation Institute. TxDOT 1352-2F. 1996.
- *Performance of Flexible Erosion Control Materials and Hydraulic Mulches.* J.A. McFalls, H.C. Landphair, S.H. Godfrey. Texas Transportation Institute. TxDOT 1914-1. April 1993

COURSES DEVELOPED AND TAUGHT

- *Training Course on Developing and Implementing Soil Erosion Management Plan at Construction Sites.* J.A. McFalls, B.J. Storey. South Texas Environmental Institute at Texas A&M University Kingsville with the Lower Rio Grande Valley Stormwater Task Force. 2009-present.
- *Training Course on How to Inspect Construction Sites and How to Enforce a TPDES Program.* B.J. Storey and J.A. McFalls. South Texas Environmental Institute at Texas A&M University Kingsville with the Lower Rio Grande Valley Stormwater Task Force. 2009-present.
- *Training Course on Erosion and Sediment Control, ENV 102.* J.A. McFalls, H. Landphair, B.J. Storey, M. Li. TxDOT. 2003-2007.
- *Training Course on Erosion and Sediment Control and Associated Train-the-Trainer and Certification Program.* H. Landphair, M. Li, J.A. McFalls, and B.J. Storey. South Dakota Department of Transportation's Water Quality Enhancement Program. 2005-2006.

Bahar Dadashova, Ph.D.

EDUCATION

- PhD in Mechanical Engineering, Universidad Politécnica de Madrid, Spain (2014).
- Master of Sciences in Mathematical Engineering, Universidad Carlos III de Madrid, Spain (2009.)
- Bachelor of Sciences in Economics, Azerbaijan State Economic University, Azerbaijan (2004).

EXPERIENCE

- Associate Transportation Researcher, Traffic Operations Group – Roadway Safety, Texas Transportation Institute, Texas A&M University, College Station, Texas, 2015 - Present.
- Fellow Researcher, University Institute of Automobile Research, Universidad Politécnica de Madrid, Spain (2009 - 2014).

MEMBERSHIPS/APPOINTMENTS

- Institute of Transportation Engineers (ITE)
- American Statistics Association (ASA)
- Royal Statistical Society (RSS)

SELECTED PRESENTATIONS

- Dadashova, B., Arenas-Ramírez, B., Mira-McWilliams, J., González-Fernández, C. and Aparicio-Izquierdo, F. (2017). Simulation-based Model Comparison Methodology with Application to Road Accident Models. Communications in Statistics-Simulation and Computation, (just accepted).
- Dadashova, B., Ramírez, B.A., McWilliams, J.M. and Izquierdo, F.A. (2016). The Identification of Patterns of Interurban Road Accident Frequency and Severity Using Road Geometry and Traffic Indicators. Transportation Research Procedia, 14, pp.4122-4129.
- Dadashova B., Arenas, B., Mira, J., and Aparicio, F. (2016). Methodological development for selection of significant predictors explaining fatal road accidents. Accident Analysis & Prevention, vol. 90, 82-94.
- Dadashova B., Arenas, B., Mira, J., and Aparicio, F. (2014). Bayesian model selection of structural explanatory models: Application to road accident data. Procedia - Social and Behavioral Sciences, vol. 160, pp. 55-63.
- Dadashova, B., Arenas, B., Mira, J., and Aparicio, F. (2014). Explanatory and prediction power of two macro models. An application to van-involved accidents in Spain. Transport Policy, vol. 32, pp. 203–217.
- Dadashova, B., Arenas, B., Mira, J., and Aparicio, F. (2012). Dynamic Statistical Model Selection: Application to Traffic Accident Analysis in Spain. Procedia - Social and Behavioral Sciences, vol. 48, pp. 642–652.

- Dadashova, B., Arenas, B., Mira, J., and Aparicio, F. (2012). Application of dynamic models to traffic accidents involving vans in Spain during the period of 2000–2009. *Securitas Vialis*, vol. 4(3), pp. 127–136.

RESEARCH REPORTS

- Safety Effects of Raising Speed Limits to 75 mph and Higher, NCHRP 17-79, National Academies, 2016-Present.
- AASHTO Highway Safety Manual, Second Edition, NCHRP 17-71, National Academies, 2015-Present.
- Safety Data and Analysis Fundamentals Training, HSA 16-06 / DTFH6116D00004, 2016-Present.
- External Factor Research and Program Support, HOTM707316083/ DTFH6112D00046. Battelle/TTI, 2016-Present.
- Innovative Tools and Techniques in Identifying Highway Safety Improvement Projects, TxDOT 0-6912, 2015-Present.
- Safety Evaluation of U-Turn Design, TxDOT 0-6894-TM5 (2017).
- Work Zone Crash Characteristics and Countermeasure Guidance, NCHRP 17-61, National Academies (2017).
- Review of Commercial Motor Vehicle Countermeasures and Study of Hardware Identification Methods, HSA 16-02 / DTFH6116D00004, (2016).
- Commercial and Industrial Driveway Regulations: A Synthesis of State Guidance. FHWA 0-6806 (2015).
- Methodology for the determination of accident risk and injuries of drivers and vehicles through indirect methods of estimating exposure (MIRAS). University Institute of Automobile Research (INSIA), Universidad Politécnica de Madrid (UPM). Research project funded by General Directorate of Traffic (DGT), Ministry of the Interior, Spain, 2015.
- Development of integrated methodology for evaluating the modal shift externalities with respect to environmental and road safety (MODLATRAM). INSIA, Universidad Politécnica de Madrid. Ministry of Public Works and Transport (MFOM), Spain, 2015.
- Data collection study and speed indicator construction in Spanish roads. INSIA, Universidad Politécnica de Madrid. DGT, Ministry of the Interior (MI), Spain, 2014.
- Development and application of integrated methodology for the study of van- involved traffic accidents (FURGOSEG). INSIA, Universidad Politécnica de Madrid. Ministry of Public Works and Transport (MFOM) and Ministry of Innovation and Science (MICINN), Spain, 2011.
- Automobile Vehicle Safety for intelligent, efficient and safe transport (SEGVAUTO). INSIA, Universidad Politécnica de Madrid. Madrid Community and European Union, 2014-2018.
- Estimation of the future tendency of the traffic victims in Spanish roads. Arenas, B., Aparicio, F., Mira, J., and Dadashova, B. Research study prepared for DGT (in Spanish), Ministry of the Interior (MI), Spain, 2010.
- Development and implementation of an integrated methodology to analyze the impact of freight transport to the road accidents and their consequences (MIEVA). INSIA, Universidad Politécnica de Madrid. Ministry of Public Works and Transport (MFOM), Spain, 2009.

EDUCATION

- Ph.D., Civil Engineering, Oregon State University, 2012
- M.Sc., Civil Engineering, Oregon State University, 2010
- B.Sc., Industrial Engineering, Universidad Centroamericana, El Salvador, 2004

EXPERIENCE

- Associate Research Engineer, Texas A&M Transportation Institute, College Station, Texas, March 2016 – Current.
- Associate Research, Texas A&M Transportation Institute, College Station, Texas, July 2013 – March 2016.
- Post-doctoral Research Associate, Texas A&M Transportation Institute, College Station, Texas, October 2012 – July 2013.
- Research Assistant & Instructor, School of Civil and Construction Engineering, Oregon State University, October 2007 – June 2012.
- Coordinator for Industrial Engineering, Facultad de Ingeniería y Arquitectura, Universidad Centroamericana “José Simeón Cañas”, El Salvador, Central America, January – August 2007.
- Lecturer, Department of Processes and Systems Technology, Universidad Centroamericana JSC, El Salvador, Central America, July 2006 – July 2007.
- Project Manager, Bonal S.A., El Salvador, Central America, 2006.
- Traffic Analysis Unit Lead, Bonal S.A., El Salvador, Central America, 2005-2006.

AFFILIATIONS

- Institute of Transportation Engineers, Member, 2008 – Present
- Project Management Institute, Member, 2016 – Present
- Transportation Research Board Committees:
 - Statistics Committee, Friend, 2013-present
 - Operational Effects of Geometrics Committee, Friend, 2009-present
 - Traffic Flow Theory & Characteristics, Friend, 2010-present
 - Highway Capacity and Quality of Service Committee, Friend, 2011-present
 - Safety Performance Committee, Friend, 2012-present
 - Low Volume Roads Committee, Friend, 2012-present

PROFESSIONAL REGISTRATION AND CREDENTIALS

- Professional Engineer (Civil), Texas – Registration No. 122,224
- Project Management Professional– PMP Credential Number 1,962,995

SELECTED PUBLICATIONS (2012-2017)

- Dixon K., K. Fitzpatrick, and R. Avelar. "Operational and Safety Tradeoffs – Reducing Freeway Lane and Shoulder Width to Permit an Additional Lane". *Transportation Research Record, the Journal of the Transportation Research Board*. No. 2588 / 2016. pp. 89-97. ISSN 0361-1981. DOI 10.3141/2588-10.
- Avelar R., K. Fitzpatrick, K. Dixon, and T. Lindheimer. "The Influence of General Purpose Lane Traffic on Managed Lane Speeds: An Operational Study in Houston, Texas". *Transportation Research Procedia*. Volume 15/2016. pp 548-560. DOI 10.1016/j.trpro.2016.06.046
- Fitzpatrick K., K. Dixon, and R. Avelar. "Evaluating Operational Implications of Reduced Lane and Shoulder Widths on Freeways". *Journal of Transportation Engineering*. American Society of Civil Engineers. June 2016. DOI 10.1061/(ASCE)TE.1943-5436.0000884.
- Avelar R., K. Dixon, and G. Schertz. "Identifying Low Volume Road Segments with High Severe Crash Frequencies". *Transportation Research Record, Journal of the Transportation Research Board*. Low-Volume Roads 2015. Volume 1. No. 2472/2015. pp. 162-171. ISSN 0361-1981.
- Avelar R., K. Fitzpatrick, and J. Robertson. "Investigating Maximum Intensities for Yellow Rapid-Flashing Beacons at Night". *Transportation Research Record, the Journal of the Transportation Research Board*. No. 2485 / 2015. pp. 33-41. ISSN 0361-1981. DOI 10.3141/2485-05.
- Dixon K., R. Avelar. "Validation Technique Applied to Oregon Safety Performance Function Arterial Segment Models". *Transportation Research Record, the Journal of the Transportation Research Board*. No. 2515 / 2015. pp. 115-123. ISSN 0361-1981.
- Avelar R. and P. Carlson. "Link Between Pavement Marking Retroreflectivity and Night Crashes on Michigan Two-Lane Highways". *Transportation Research Record, the Journal of the Transportation Research Board*. Volume 2404 / 2014. pp. 59-67. ISSN 0361-1981.
- Avelar R., K. Dixon, L. Brown, M. Mecham, and I. van Schalkwyk. "Influence of Land Use and Driveway Placement on Safety Performance of Arterial Highways". *Transportation Research Record, the Journal of the Transportation Research Board*. Volume 2398 / 2013. pp. 101-109. ISSN 0361-1981.
- Fitzpatrick K., J. Robertson, and R. Avelar. "Closed-Course Study of Driver Detection of Pedestrians Beyond Flashing Beacons Within a Sign Assembly". *Transportation Research Record, the Journal of the Transportation Research Board*. Pedestrians 2014. No. 2464 / 2015. pp. 144-153. ISSN 0361-1981.
- Fitzpatrick K., M. Brewer, and R. Avelar. "Driver Yielding at Traffic Control Signals, Pedestrian Hybrid Beacons, and Rectangular Rapid Flashing Beacons in Texas". *Grant Mickle Award: Outstanding Paper in Operations and Maintenance*. *Transportation Research Record, the Journal of the Transportation Research Board*. No. 2463 / 2014. pp. 46-54. ISSN 0361-1981.
- Avelar R., K. Dixon, and P. Escobar. "Evaluation of Intersection-Related Crash Screening Methods Based on Distance from Intersection". *Transportation Research Record, the Journal of the Transportation Research Board*. No. 2514 / 2015. pp. 177-186. ISSN 0361-1981. DOI 10.3141/2514-19.

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- Brewer M., K. Fitzpatrick, and R. Avelar. "Pedestrian and Driver Behavior Before and After Installation of Rectangular Rapid Flashing Beacons or Pedestrian Hybrid Beacons". Transportation Research Record, the Journal of the Transportation Research Board. Transportation Research Record, the Journal of the Transportation Research Board. No. 2519 / 2015. pp. 1-9. ISSN 0361-1981. DOI: 10.3141/2519-01.

AWARDS

- 2016 New Researcher Award, Texas A&M Transportation Institute and Trinity Enterprises
- 2016 Patricia F. Waller Award, Transportation Research Board.
- 2015 D. Grant Mickle Award, Transportation Research Board.
- 2015 Outstanding Paper Award, TRB Committee on Safety Data Analysis and Evaluation ANB20.
- 2014 Outstanding Paper Award, TRB Committee on Pedestrians ANF10.

Appendix B: Executed Liability Statement

Cooperative Research Programs Liability Statement

Revised May 2006

Project NCHRP 14-40

Fiscal Year 2017

The signature of an authorized representative of the responding agency is required on the following unaltered statement in order for the TRB to accept the agency's response for consideration. **Responses submitted without this executed and unaltered statement by the response deadline will be summarily rejected.** An executed, unaltered statement indicates the agency's intent and ability to execute a contract that includes the provisions below.

Proposing Agency: Texas A&M Transportation Institute

Name: Julie Bishop

Title: Associate Executive Director

Signature: 

Date: 4/5/2017

CONTRACTOR LIABILITY

- (a) The parties agree that the contractor and its employees and agents ("Contractor") will be primarily responsible for performing the work required under the contract, and shall therefore be legally responsible for, and shall indemnify and hold the Academy harmless for all claims asserted against the Academy, its committee members, officers, employees, and agents, by any third parties, whether or not represented by a final judgment, if such claims arise out of or result from Contractor's negligent or wrongful acts in performing such work, including all claims for bodily injury (including death), personal injury, property damage, and other losses, liabilities, costs, and expenses (including but not limited to attorneys fees).
- (b) With respect to entities of State government that are subject to State law restrictions on their ability to indemnify and hold harmless third parties ("Restricted State Entities"), the obligation to indemnify and hold harmless the Academy in Paragraph (a) shall apply to the full extent permitted by applicable State law. In addition, each Restricted State Entity executing this contract represents and warrants that no part of any research product or other material delivered by such Restricted State Entity to the Academy ("Work Product") shall include anything of an obscene, libelous, defamatory, disparaging, or injurious nature; that neither the Work Product nor the title to the Work Product will infringe upon any copyright, patent, property right, personal right, or other right; and that all statements in the Contractor's proposal to the Academy and in the Work Product are true to the Contractor's actual knowledge and belief, or based upon reasonable research for accuracy.
- (c) The term "wrongful act" as used herein shall include any tortious act or omission, willful misconduct, failure to comply with Federal or state governmental requirements, copyright or patent infringement, libel, slander or other defamatory or disparaging statement in any written deliverable required under the contract, or any false or negligent statement or omission made by Contractor in its proposal to the Academy.
- (d) The obligations in paragraph (a) of this clause to indemnify and hold harmless the Academy shall not extend to claims, damages, losses, liabilities, costs, and expenses to the extent they arise out of the negligent or wrongful acts or omissions of the Academy, its committee members, officers, employees, and agents.
- (e) Both the Academy and Contractor shall give prompt notice to each other upon learning of the assertion of any claim, or the commencement of any action or proceeding, in respect of which a claim under this paragraph may be sought, specifying, if known, the facts pertaining thereto and an estimate of the amount of the liability arising therefrom, but no failure to give such notice shall relieve the Academy or Contractor of any liability hereunder except to the extent actual prejudice is suffered thereby.
- (f) The Academy and Contractor agree to cooperate with each other in the defense of any claim, action, or legal proceeding arising out of or resulting from Contractor's performance of the work required under this contract, but each party shall control its own defense. The Academy shall also have the option in its sole discretion to permit Contractor or its insurance carrier to assume the defense of any such claims against the Academy.
- (g) The obligations under this clause survive the termination, expiration, or completion of performance under this contract.

Figure 7. Executed Liability Statement.