RESEARCH PROGRAM

ACTIVITIES REPORT

F.Y. 2017-2018

F.Y. 2017-2018

pennsylvania
DEPARTMENT OF TRANSPORTATION

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This is a report of research, innovation implementation, and technology transfer efforts carried out by the Pennsylvania Department of Transportation through the State Planning and Research Program of the Federal Highway Administration, U.S. Department of Transportation and the Pennsylvania Motor License Fund. The report describes activities during state fiscal year 2017-2018, covering July 1, 2017 through June 30, 2018.

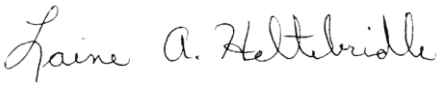
INTRODUCTION

Dear Colleagues:

I am pleased to present the F.Y. 2017-2018 Research Program Activities Report, which details the efforts accomplished over the year in Pennsylvania-focused research projects, transportation pooled fund studies, technology transfer and program management and PennDOT's Local Technical Assistance Program (LTAP).

PennDOT is committed to moving Pennsylvania forward by investing in research project activities that attempt to solve real-world transportation issues addressing construction, design, maintenance, operations and safety, planning and policy and technology transfer. This report will demonstrate the broad diversity in the size, scope and content of the various research projects initiated under PennDOT's Research Program.

As another successful year ends, we look forward to F.Y. 2018-2019 where the Research Program Management Section (RPMS) will continue to initiate research projects that will move Pennsylvania forward and enable PennDOT to meet its strategic goals while identifying projects that will build upon one another.



Mr. Laine A. Heltebridle, Bureau Director
Bureau of Planning & Research

Research Division Vision

To build relationships throughout the Department so that the Research Division is the go-to unit for research studies and innovation implementation.

Research Division Mission

The Research Division manages and coordinates research, education and technology transfer programs and projects on behalf of PennDOT. The Research Division strives to support PennDOT's strategic agenda by addressing vital transportation needs of the Commonwealth.

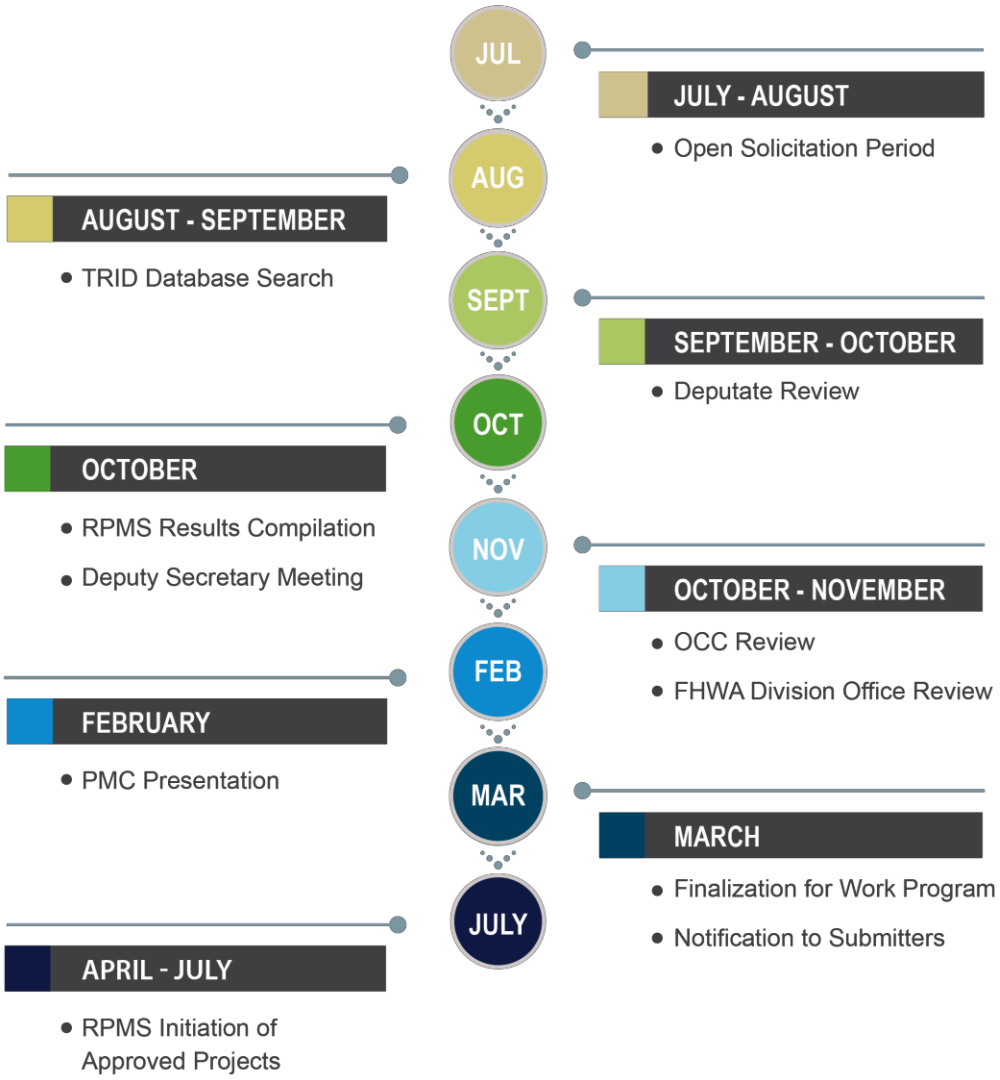
Research Program Overview

PennDOT's Research Program is developed, administered and managed by the Research Program Management Section (RPMS) of the Bureau of Planning and Research's Research Division. The RPMS has implemented an effective annual Research Program Solicitation Process, in accordance with the following steps:

1. Open Solicitation Period
2. Transport Research International Documentation (TRID) Search
3. Deputate Review of Topics Received During Solicitation Period
4. Results Compilation
5. Deputy Secretary for Planning Approval
6. Office of Chief Counsel (OCC) Review
7. FHWA Division Office Review
8. Program Management Committee (PMC) Presentation
9. Work Program Finalization
10. Notification to Submitters
11. Project Initiation

The RPMS staff works with the Bureau Directors, District Executives and Deputy Secretaries to prioritize all received Research Innovations Deserving Exploration and Analysis (IDEA) forms. From the amount of funding available to initiate new research projects, the staff ensures that the projects selected and initiated support PennDOT's key focus areas and that the Department obtains usable results from the projects as they are completed.

PennDOT Research Program Solicitation Process



Approximately $2.2 million was provided to fund F. Y. 2017-2018 important research projects that addressed the vital transportation needs of Pennsylvania in the areas of construction, design, maintenance, operations and safety, planning and policy and technology transfer.

These investments are detailed on the following pages.

RESEARCH PROJECTS: F.Y. 2017-2018

Project Name	PennDOT Technical Advisor (TA)	Principal Investigator (PI)	F.Y. 2017-2018 Funds	Start Date	End Date
Request for Proposals (RFPs)					
Pennsylvania State Association of Township Supervisors (PSATS)					
PennDOT Local Technical Assistance Program (LTAP)	Brian Wall	Karen Atkinson	$757,060.35	12/29/2015	12/28/2018
Department of General Services (DGS) University Master Agreements					
University of Pittsburgh (PITT) Projects					
Interpreting Falling Weight Deflectometer (FWD) Data	Bill Dipner	Julie Vandenbossche	$456,778.00	04/17/2015	04/16/2018
Stormwater Analysis and Water Quality Assessment of Urban Areas	Daryl St. Clair	Xu Liang	$81,021.00	02/14/2017	10/13/2018
Evaluating Bicycle, Pedestrian, Transit and Economic Data Collection Needs and Measures of Effectiveness in Pennsylvania	Chris Metka	Mark Magalotti	$67,790.08	11/07/2016	02/06/2018
Curb-Ramp Design (CRD) and Inspection System (CIS)	Rich Yakupkovic	Jon Pearlman	$35,400.00	06/05/2017	08/30/2019
Environmental and Cost Effectiveness of Partially Grouted Riprap for Scour Countermeasure	Mittal Patel	Bechara Abboud	$186,596.00	05/05/2014	07/31/2019
Temple University (TEM) Projects					
Winter Roadway Maintenance Material Enhancers (field) Evaluation	William Davenport	Benoit VanAken	$90,000.00	03/25/2016	04/06/2018
Storm Water Control Management & Monitoring	Daryl St. Clair	Laura Toran	$32,000.00	12/01/2016	11/30/2017

Project Name	PennDOT Technical Advisor (TA)	Principal Investigator (PI)	F.Y. 2017-2018 Funds	Start Date	End Date
Temple University (TEM) Projects					
Effect of Warm Mix Asphalt (WMA) Low Mixing & Compaction Temperatures on Recycled Asphalt Pavement (RAP) Binder Replacement	Tim Culbertson	Ahmed Faheem	$181,000.00	08/08/2016	04/07/2018
Highway Incident Detection Timeline	Jon Fleming	Joseph Coe	$88,200.00	10/17/2016	10/16/2017
Other Contracting Mechanism					
Electronic Construction Management System (ECMS) Projects					
Project Management	Laine Heltebridle	McCormick Taylor Leanne Doran	$4,786.21	03/11/2016	12/09/2020
Conduct of Research	Lisa Tarson	McCormick Taylor Joy Ruff	$14,276.28	10/31/2016	09/30/2017
Implementation	Laine Heltebridle	McCormick Taylor Leanne Doran	$22,069.79	02/15/2017	12/09/2020
2018 Research Symposium	Doug Zimmerman	McCormick Taylor Todd Scott	$57,039.98	11/06/2017	11/06/2018
Joint Statewide Connected and Automated Vehicle Strategic	Mark Kopko	Gannett Fleming, Inc. Eric Rensel	$112,383.34	07/10/2017	07/09/2018
PA Flex Beam	Bill Koller	Modjeski & Masters Scott Eshenaur	$55,764.85	11/07/2017	04/03/2019

RESEARCH PROJECTS SPOTLIGHT

Evaluating Bicycle, Pedestrian, Transit and Economic Data Collection Needs and Measures of Effectiveness in PA

The purpose of this research project was to evaluate PennDOT's current data collection procedures for bicycle and pedestrian projects and assess whether additional data collection could support Measures of Effectiveness (MOEs). Data collected for bicycles, pedestrians, transit, and economic factors was reviewed. Other types of data that would help evaluate bicycle and pedestrian project benefits or support MOEs were considered. This evaluation provided a planning framework for evaluating the benefits of projects constructed under the Surface Transportation Block Grant Program Transportation Alternatives Set-Aside (TA Set-Aside) and the Transportation Alternatives Program (TAP) to promote walking and bicycling.

Source: Frank Proulx, UC Berkeley SafeTREC.

Technician installing video camera.

Source: Ling et al. (2010).

Detection of pedestrians using automated video counting.

Source: Karla Kingsley, Kittelson & Associates, Inc.

Bicyclist riding over pneumatic tubes.

Source: Ciara Schlichting, Toole Design Group.

Technicians setting up a passive infrared counter.

Bicycle and Pedestrian Counting Technologies

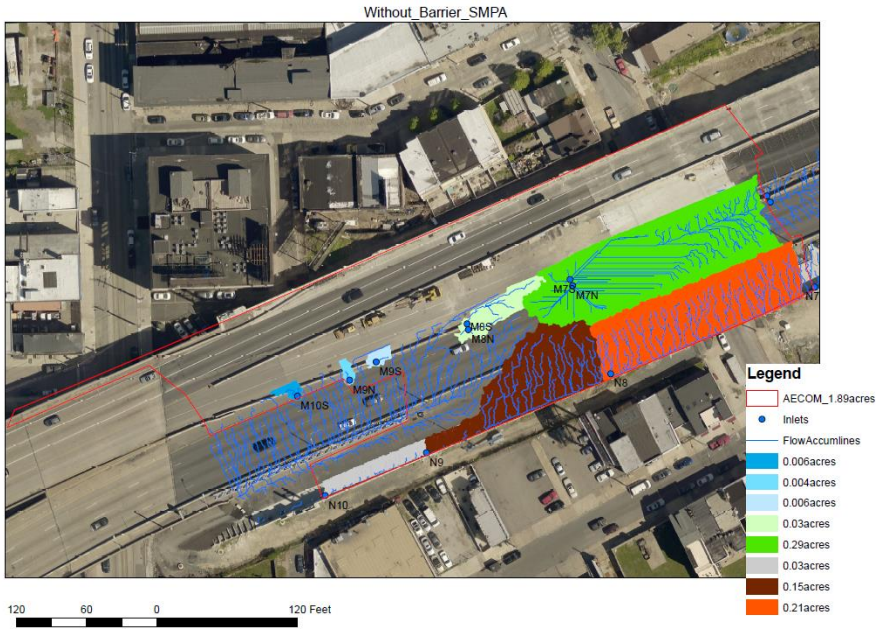
Source: University of Pittsburgh

Outcomes Included:

- Better understanding of the types of data collected on PennDOT bike/ped/transit projects, including any gaps or inconsistencies.
- Insight into the types of data collected by other states on their bike/ped/transit projects.
- Potential metrics and performance measures for TA Set-Aside projects.
- Guidance on types of data that would support decision making for the TA Set-Aside program.
- Guidance on data collection and usage for evaluation of projects.

Storm Water Control Management & Monitoring

The purpose of this research focused on the supply theoretical and practical expertise in monitoring proposed Stormwater management controls within and along the S.R. 0095 Girard Avenue Interchange improvements, specifically Section GR 2, which extends along I-95 from Schackamaxon Street to Columbia Avenue. Different soils, materials and bioswale designs were compared with respect to functionality and maintenance. Data was recorded and compiled for PennDOT so that the Department can implement future Environmental Protection Agency/Department of Environmental Protection Municipal Separate Storm Sewer System (MS4) & Chapter 102 regulations.



Drainage areas for Basin A calculated from flow routing of LiDAR evaluation surveys including rerouting due to highway barriers

Source: Temple University

Outcomes Included:

- Monitoring data from Stormwater Management Practices (SMPs) and baseline wells compiled and summarized for the monitoring period to inform SMP functionality.
- Plant monitoring data compiled and summarized for the monitoring period to inform SMP functionality and contrast maintained sites versus sites that are not maintained.
- SMP computer modeling and LiDAR scanning data compiled and summarized for the monitoring period to inform SMP functionality.
- SMP functionality, performance, and maintenance recommendations outlined based on the first year of monitoring.
- Recommendations for design, location, and installation of SMPs, and advisement regarding soil mixes and plant palates for future construction phases based on the first year of monitoring. Gaps in data analysis identified.

TRANSPORTATION POOLED FUND PROJECTS: F.Y. 2017-2018

Project Name	PennDOT Technical Advisor (TA)	Lead Agency	F.Y. 2017-2018 Funding
Storm Water Testing and Maintainability Center	Daryl St. Clair	Oregon	$25,000.00
Traffic Control Device (TCD) Consortium	Justin Smith	FHWA	$25,000.00
Roadside Safety Research or MASH Implementation	Raza Hassan	Washington	$50,000.00
Evaluation of Low Cost Safety Improvements	Jason Hershock	FHWA	$30,000.00
Research Program to Support the Research, Development and Deployment of System Operations Applications of Vehicle Infrastructure Integration (VII)	Mark Kopko	Virginia	$50,000.00
Clear Roads – Phase II	Jonathan Fleming	Minnesota	$25,000.00
Evaluating New Technologies for Roads Program Initiatives in Safety & Efficiency – ENTERPRISE (Phase II)	Douglas Tomlinson	Michigan	$30,000.00
National Sustainable Pavement Consortium	Steve Koser	Virginia	$25,000.00
Aurora Program	Jason Norville	Iowa	$25,000.00
Improving the Quality of Pavement Surface Distress and Transverse Profile Data Collection and Analysis	John Van Sickle	FHWA	$15,000.00
Improving the Quality of Highway Profile Measurement	Colin McClenahen	FHWA	$20,000.00
Technology Transfer Concrete Consortium (TTCC)	Steve Koser	Iowa	$8,000.00
Improving Specifications to Resist Frost Damage in Modern Concrete Mixtures	Steve Koser	Oklahoma	$17,500.00
Performance Engineered Concrete Paving Mixtures	Patricia Baer	Iowa	$15,000.00
Building Information Modeling (BIM) for Bridges and Structures	Paul Brandl	Iowa	$20,000.00
Enhanced Traffic Signal Performance Measures	Daniel Farley	Indiana	$30,000.00
2019 Innovations in Freight Data Workshop	Denise Soisson	Iowa	$14,000.00
Transportation Management Center (TMC)	Eric Sponsler	FHWA	$25,000.00
Strain-Based Fatigue Crack Monitoring of Steel Bridges Using Wireless Elastometric Skin Sensors	Gouzhou Li	Kansas	$25,000.00
Enhancements to the Intelligent Construction Data Management System (VEDA) and Implementation	Dan Clark	Minnesota	$25,000.00

Project Name	PennDOT Technical Advisor (TA)	Lead Agency	F.Y. 2017-2018 Funding
Regional and National Implementation and Coordination of ME Design	Lydia Peddicord	FHWA	$10,000.00
Exploring Non-Traditional Methods to Obtain Vehicle Volume and Class Data	Gregory Dunmire	FHWA	$50,000.00
Development of an Integrated Unmanned Aerial Systems (UAS) Validation Center	Scott Snyder	Indiana	$25,000.00
Developing Implementation Strategies for Risk Based Inspection (RBI)	Michael Winslow	Missouri	$50,000.00
Structural Design Methodology for Spray Applied Pipe Liners in Gravity Storm Water Conveyance Conduits	Sheri Little	Ohio	$25,000.00

TRANSPORTATION POOLED FUND PROJECT SPOTLIGHT

Roadside Safety Research for Manual for Assessing Safety Hardware (MASH) Implementation

Many state DOTs have sponsored research on roadside safety issues that include crash testing of features in accordance with FHWA adopted standards (NCHRP Report 350 and MASH). Many of the research and functional problems are common to more than one state and so there is efficiency and cost effectiveness in pooling resources to conduct certain crash tests.

The objective of the transportation pooled fund research is to establish an ongoing roadside safety research program that meets the research and functional needs of participating states in a cost-effective and timely manner.

A committee of representatives from participating states formed a technical committee to identify common research needs, select projects for funding and oversee implementation of results. Specific research activities addressed within the program include the design, analysis, testing, and evaluation of crashworthy structures, and the development of guidelines for the use, selection and placement of these structures. The crashworthy structures addressed include bridge rails, guardrails, transitions, median barriers, portable concrete barriers, end treatments, crash cushions, culverts, breakaway support structures (e.g. sign supports, luminaire supports, mailboxes), and work zone traffic control devices.

This pooled fund research also addressed the influence of highway features such as driveways, slopes, ditches, shoulders, medians, and curbs on single vehicle collisions. The problems identified with these structures and features are addressed through in-service performance evaluation studies, computer simulation, full-scale crash testing, clinical analyses of real-world crash data, and benefit cost analysis. The specific identification, selection and prioritization of research issues is made by the technical committee on an annual basis, unless emerging issues require committee decisions in the interim.

LOCAL TECHNICAL ASSISTANCE PROGRAM (LTAP)

The Local Technical Assistance Program (LTAP) is a national technology transfer initiative sponsored by the Federal Highway Administration (FHWA). There is a national network of 58 LTAP Centers - one in each state, Puerto Rico and regional centers serving American Indian tribal governments dedicated to transferring transportation technology through training, technical assistance and other customer services to municipal elected officials and their staff.

The Pennsylvania Local Technical Assistance Program (LTAP) is housed in the Bureau of Planning and Research and has been in existence since 1983. PennDOT LTAP is designed to help Pennsylvania's municipalities, which maintain over 77,000 miles of roadways, make the best use of their roadway maintenance dollars. Also, PennDOT LTAP was created to share transportation knowledge, improve road maintenance and safety skills, and put research and technology into practice at the municipal level.

On a yearly basis, the PennDOT LTAP training and technology transfer program trains and assists municipal employees in effective and efficient maintenance procedures, essential safety practices and infrastructure management processes. Historically, PennDOT LTAP has augmented this training with one-on-one technical assistance sessions and the dissemination of pieces of information highlighting practical technological advances. PennDOT LTAP services include:

Training:

LTAP training takes many forms and is offered at little or no cost to municipalities. Training events include: scheduled workshop training, Roads Scholar courses, on-site roadshows and local product demonstrations.

Technical Assistance:

LTAP Engineers are available by phone, email and in person to help municipalities troubleshoot specific maintenance and safety problems on their roadways.

Newsletters and Technical Information Sheets:

The PennDOT LTAP newsletter is distributed twice a year to each Pennsylvania municipality, the Federal Highway Administration (FHWA), metropolitan and rural planning organizations and other LTAP centers. The newsletter covers new programs, practices, technologies, legislation, reminders, and money-saving tips applicable to municipal maintenance and safety efforts.

In F.Y. 2017-2018, PennDOT LTAP provided the following services to Pennsylvania municipalities:

- **4,528** individuals representing **715** Pennsylvania municipalities attended LTAP classes.
- **208** classes for **33** course titles were held throughout Pennsylvania.
- **109** classes addressed maintenance topics and **99** addressed safety topics.
- **372** one-on-one technical assistance sessions were provided.

Source: Local Technical Assistance Program (LTAP), Traffic Calming Road Scholar Course

Build a Better Mousetrap National Competition

For the past seven years, PennDOT LTAP has been involved in the Build a Better Mousetrap National Competition. The Build a Better Mousetrap National Competition highlights innovative solutions to everyday problems and issues that local and tribal transportation workers and other LTAP clients encounter.

The innovative solutions can include the development of tools, equipment modifications, and/or processes that increase safety, reduce cost, improve efficiency, and improve the quality of transportation.

Each year, PennDOT LTAP holds its own statewide Build a Better Mousetrap Competition. The statewide competition is open to all Pennsylvania municipal employees or crew who have designed and built an innovative gadget or developed an improved way to do a job. All entries are judged by a committee of municipal road employees in accordance with the following criteria:

- Cost savings/benefits to the community
- Ingenuity
- Transferability to others
- Effectiveness

PennDOT LTAP submits the winners of its Statewide Competition as nominees to a regional and national competition. Winners of the Build a Better Mousetrap National Competition are announced at the annual LTAP National Conference. All entries at the national level are posted on the LTAP program website and compiled into an electronic booklet.

The PennDOT LTAP Build a Better Mousetrap 2018 winner details are listed below.

Pennsylvania LTAP - Build a Better Mousetrap 2018 Winner

Elizabethtown Borough in Lancaster County received first-place honors in PennDOT LTAP's 2018 Build a Better Mousetrap Contest for a truck-mounted sign channels puller that removes stubborn sign channels easily. Built for less than $1,000 in materials, labor and equipment, the device mounts in the snowplow mounting brackets and uses the power supply on the truck to pull out sign channels. As the first-place winner, the Borough's invention will be entered in a regional competition with winners from Delaware, Maryland, Virginia, and West Virginia, as well as in the national LTAP Competition.

Source: Elizabethtown Borough, 2018 Lancaster County

Problem Statement:

Sometimes there are stubborn sign channels that will not come out with a manual puller. In the past, the Borough used snowplows to pull sign channels, but as trucks were replaced the plow hoist were no longer part of the truck.

Discussion of Solution:

Design and build a truck mounted sign puller that can be removed easily. The Borough designed the sign puller to mount in the snowplow mounting brackets and use the truck's power supply. By using the snowplow mounts, no changes were made to the vehicle. The borough wanted the ability to park along the curb with the flow of traffic and pull the sign channels. The puller was designed to extend from the front of the vehicle to reach the sign channels behind the curb.

Labor, Equipment, Materials Used:

Labor: Approximately 16 hours for two people to build.

Equipment:

Welder, metal band saw, drill

Materials:

3” square tubing, 2” square tubing, hydraulic pump with controller, hydraulic cylinder, hydraulic hose, UHMW, snow plow plug, miscellaneous hardware.

Cost:

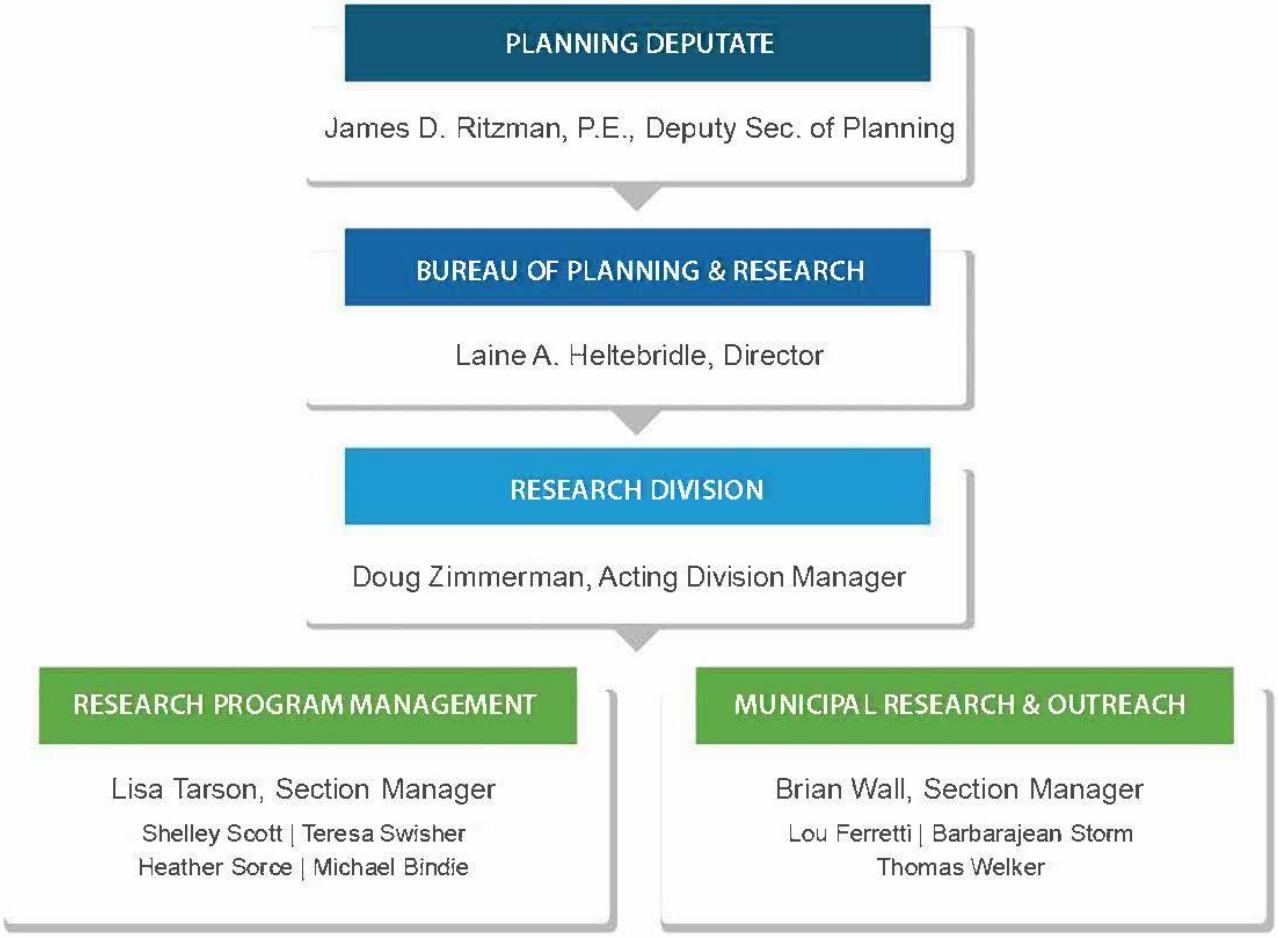
$985.55

Savings/Benefit to the Community:

The sign puller provides a cost savings to the Borough and its residents, allows for it to be used on multiple vehicles and for multiple purposes, saves time and provides for additional safety to residents and employees.

The Borough received a quote for a truck mounted sign puller at a cost of $5,000, which prohibited the vehicle to be equipped with a snowplow. Materials for the sign puller cost $985.55 and by creating the sign puller, the same truck can be used for snow plowing and sign pulling. The sign puller will fit all Borough trucks, since they all have the same snow plow. Without the sign puller, the Borough crew would need to go and physically investigate the problem and then return for a loader or backhoe to pull the sign channel. The sign puller allows sign channels to get replaced much faster, safer and can be done with the flow of traffic. The puller can also be used to pull catch basin grates.

PENNDOT RESEARCH DIVISION F.Y. 2017-2018



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ITEMS TO LOOK FORWARD TO IN THE UPCOMING F.Y. 2018-2019 RESEARCH ACTIVITIES REPORT

Research Collaboration Event

2018 Research Symposium

PennDOT's Research Program Management Section hosted a 2018 Research Symposium on September 27-28, 2018. This 2-day event was built upon the May 5, 2015 symposium that was hosted by the Pennsylvania Consortium of Transportation Universities (PaCTU), PennDOT and FHWA. The 2015 event afforded participants the opportunity to identify top transportation issues and discuss how emerging technologies may offer solutions for the future. From the outcomes of the 2015 event and direction from FHWA for a more successful collaboration between research universities, PennDOT and FHWA, the Research Division hosted the 2018 Research Symposium.

The Research Program Management Section established a steering committee to identify the event's goals and objectives, potential format and themes, outcomes and next steps. It was identified that the event should bring PennDOT and university researchers together to talk about research gaps and new research ideas that could address PennDOT's strategic needs.

New Contracting Mechanisms

Impactful Resilient Infrastructure Science and Engineering (IRISE) Consortium

The Impactful Resilient Infrastructure Science and Engineering (IRISE) Consortium is a research initiative housed in the Department of Civil and Environmental Engineering in the University of Pittsburgh's Swanson School of Engineering. Under IRISE, University of Pittsburgh researchers work with colleagues in government and the private industry sector to identify and conduct needed research that explores methods for producing durable, longer-lasting transportation infrastructure. The work includes the gathering of data and use of knowledge, decision making and interventions to preserve infrastructure and improve mobility, accessibility and quality of life.

The University and members of the Consortium wish to collaborate to foster a partnership among government, industry, non-profits, and academia to further the goal of organizing and furthering capabilities concerning lifecycle management of the physical aspects of transportation infrastructure and transportation asset management through the encouragement of research and development activities.

IRISE is governed and guided by a Steering Committee. The Steering Committee consists of individuals representing organizations that have provided funding support.

The Pennsylvania State University (PSU) awarded a University Transportation Research Center (UTC) grant from the United State Department of Transportation (USDOT) in 2018

The Pennsylvania State University (PSU) was awarded a University Transportation Research Center (UTC) grant from the United State Department of Transportation (USDOT) in 2018. The UTC Program is Congressionally-mandated and has been in existence since 1987. The program awards grants to colleges and universities across the United States and advances state-of-the-art transportation research and technology and develops the next generation of transportation professionals.

Each UTC is a consortium of two (2) and four (4) year colleges and universities that come together to form a unique center for transportation excellence in a specific research topic area. PSU partnered with Lehigh University, University of Delaware, Morgan State University, George Mason University, Virginia Tech and West Virginia University to form a seven (7) university consortium whose specific research area is asset management and multi modal transportation infrastructure. This new UTC, consisting of the previously mentioned institutions, is known as the Center for Integrated Asset Management for Multi-Modal Transportation Infrastructure Systems (CIAMTIS).

Part of a UTC award requires the UTC to obtain matching funds from non-Federal sources. With that in mind, PennDOT is partnering with CIAMTIS to produce a collaborative approach on a multitude of research, education and technology transfer activities. The partnership will provide sufficient flexibility to accommodate the needs of PennDOT, while being commensurate with the goals of the overall USDOT UTC program initiatives. Another benefit of this partnership is the financial savings for both participants. The projects that PennDOT decides to participate in will cost half the amount it would normally cost because of the 50/50 cost sharing between PSU and PennDOT. This will lead to more research that will benefit both partners.

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