



# ***RESEARCH PROGRAM***

## ACTIVITIES REPORT

F.Y. 2016-2017



**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 2016-2017, covering July 1, 2016 through June 30, 2017.*

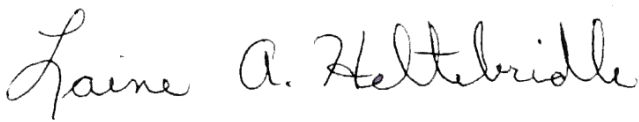


## **Dear Colleagues:**

The goal of this Research Program Activities Report is to share the types of projects that were underway at PennDOT during F.Y. 2016-2017. Details are provided on Pennsylvania-focused research projects, participation in transportation pooled fund studies, efforts in technology transfer and program management and PennDOT's Local Technical Assistance Program (LTAP) initiatives.

This report will demonstrate the broad diversity in the size, scope and content of the various research projects initiated under the Research Program. This undertaking is achieved through an organized approach in the decision-making process, sound judgement in resource allocation, partnerships with other DOTs and the federal government, and service to internal and external research clients.

The Research Division makes great strides to ensure that PennDOT's vision, mission and strategic objectives are supported by investments in project activities that attempt to solve real-world transportation issues addressing construction, design, maintenance, operations and safety, planning and policy and technology transfer.

A handwritten signature in black ink that reads "Laine A. Heltebride". The signature is written in a cursive, flowing style.

**Mr. Laine A. Heltebride, 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.

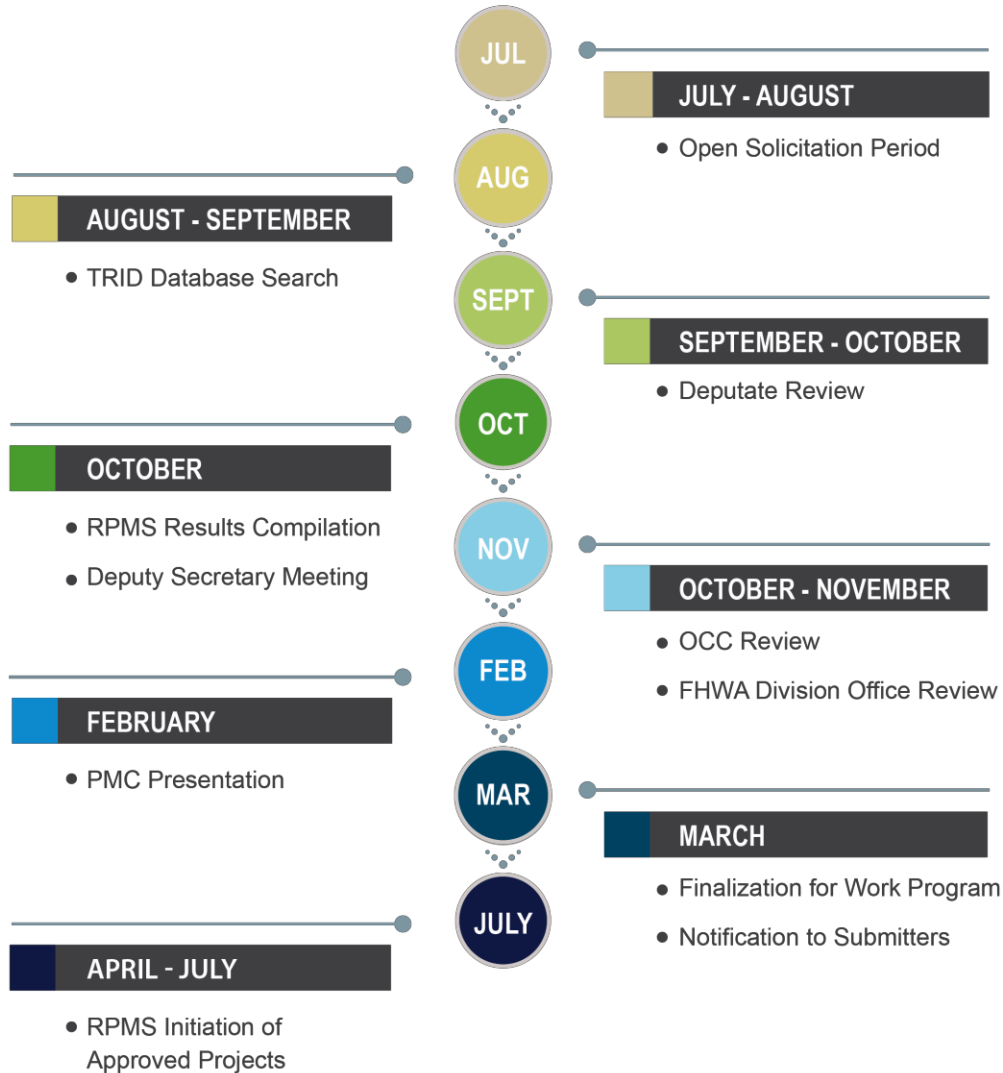
## **Research Program Overview**

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 \$3.2 million was provided to fund F. Y. 2016-2017 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. 2016-2017

Project Name	PennDOT Technical Advisor (TA)	Principal Investigator (PI)	F.Y. 2016-2017 Funds	Start Date	End Date
<b>Request for Proposals (RFPs)</b>					
PennDOT Local Technical Assistance Program (LTAP)	Brian Wall	Pennsylvania State Association of Township Supervisors (PSATS) Karen Atkinson	\$722,338.52	12/29/2015	12/28/2018
<b>Department of General Services (DGS) University Master Agreements</b>					
<b>Pennsylvania State University (PSU) Project</b>					
Evaluation of Geotextile Separation to Prevent Migration of Subgrade Fines into Subbase	Kerry Petrasic	Ming Xiao	\$58,688.80	11/24/2015	10/14/2016
<b>University of Pittsburgh (PITT) Projects</b>					
Bridge Waterproofing Details – Phase 2	Ron Schreckengost	Qiang Yu	\$136,850.37	4/13/2015	6/12/2017
Interpreting Falling Weight Deflectometer (FWD) Data	Bill Dipner	Julie Vandenbossche	\$25,343.00	4/17/2015	4/16/2018
Improving Spatial Precipitation Distribution Map – Analysis for Bridge Inspections and Emergency Response	Jason Norville	Xu Liang	\$25,903.00	4/14/2015	4/30/2018
Adopting a New Contrast Sensitivity visual screening into PennDOT's Driver Qualifications Program	Laura Krol	Ervin Sejdic	\$50,814.36	9/6/2016	4/30/2018
Identifying Impediments and Solutions to Sidewalk Project Implementation in PA	Chris Metka	Radisav Vidic	\$59,596.90	7/1/2015	9/30/2016
Evaluating Bicycle, Pedestrian, Transit and Economic Data Collection Needs and Measures of Effectiveness in PA	Chris Metka	Mark Magalotti	\$67,169.69	11/7/2016	2/6/2018



Project Name	PennDOT Technical Advisor (TA)	Principal Investigator (PI)	F.Y. 2016-2017 Funds	Start Date	End Date
<b>Temple University (TEM) Projects</b>					
Environmental and Cost Effectiveness of Partially Grouted Riprap for Scour Countermeasure	Peter Berg	Bechara Abboud	\$44,780.00	5/5/2014	6/5/2019
Winter Roadway Maintenance Material Enhancers (field) Evaluation	William Davenport	Benoit VanAken	\$208,000.00	3/25/2016	3/9/2018
Storm Water Control Management & Monitoring	Daryl St. Clair	Laura Toran	\$468,000.00	12/1/2016	11/30/2017
Effect of Warm Mix Asphalt (WMA) Low Mixing & Compaction Temperatures on Recycled Asphalt Pavement (RAP) Binder Replacement	Tim Culbertson	Ahmed Faheem	\$43,500.00	8/8/2016	4/7/2018
Highway Incident Detection Timeline	Jon Fleming	Joseph Coe	\$26,800.00	10/17/2016	10/16/2017
<b>Villanova University (VIL) Project</b>					
Pilot a Solution to Fix Non-Compliant Rumble Strips for Bicycle Safety	Daryl St. Clair	Seri Park	\$40,520.10	8/1/2016	1/2/2017
<b>PennDOT University Intergovernmental Agreement (IGA)</b>					
<b>University of Maryland (UMD) Projects</b>					
I-95 Corridor Coalition Research and Technology Transfer Initiative	Doug Tomlinson	Kathy Frankle	\$108,432.00	5/2/2014	5/2/2017
<b>Carnegie Mellon University (CMU) Projects</b>					
Dynamic Network Analysis & Real-time Traffic Management for Philadelphia Metro Area	Emmanuel (Manny) Anastasiadis	Sean Qian	\$38,000.00	10/2/2015	9/30/2016
Highway Corridor Transformation Research Study – Proof of Concept	Todd Kravits	Donald Carter	\$20,000.00	1/11/2016	9/30/2016



## RESEARCH DIVISION ACTIVITIES REPORT – F.Y. 2016-2017

Project Name	PennDOT Technical Advisor (TA)	Principal Investigator (PI)	F.Y. 2016-2017 Funds	Start Date	End Date
<b>Other Contracting Mechanism</b>					
<b>Electronic Construction Management System (ECMS) Projects</b>					
Project Management	Laine Heltebridle	McCormick Taylor Leanne Doran	\$17,229.74	3/11/2016	12/09/2020
Planning and Communications Support	Dan Hartman	McCormick Taylor Leanne Doran	\$423,799.48	3/16/2016	2/28/2017
Conduct of Research	Lisa Tarson	McCormick Taylor Joy Ruff	\$70,278.11	10/31/2016	09/30/2017
Implementation	Laine Heltebridle	McCormick Taylor Leanne Doran	\$4,694.57	2/15/2017	12/9/2020

## RESEARCH PROJECTS SPOTLIGHT

### Identifying Impediments and Solutions to Sidewalk Project Implementation in Pennsylvania

The purpose of this research was to evaluate the implementation issues of sidewalk projects that are funded with various federal funding programs administered by PennDOT. This evaluation identified specific problems through an audit of past and current projects in the Safe Routes to School (SRTS), Transportation Enhancements (TE), Pennsylvania Community Transportation Initiative (PCTI) programs, and the Transportation Alternatives Program (TAP). Projects selected included those that planned sidewalk installations but were not successful or were significantly delayed in the implementation phase of the project.



Source: Federal Highway Administration (FHWA)

#### Project Purposes:

- Identify how other states have avoided or mitigated implementation issues
- Provide recommendations to address identified implementation issues to assist PennDOT and project sponsors with implementation of TAP sidewalk projects

**Outcomes Included:**

- Identification of best practices for, and impediments to, the delivery of federally-funded, locally sponsored, sidewalk projects
- Insight on how state and local laws on installation and maintenance of sidewalks affect project delivery
- Insight on how the PennDOT project planning and programming process could be improved to better identify small projects that can be delivered on time and on budget,
- Improvements to the PennDOT TAP application process that will:
  - Improve local project selection
  - Speed project delivery
  - More effectively and efficiently allocate limited bicycle and pedestrian funds



*Source: University of Pittsburgh*

## Bridge Waterproofing Details – Phase 2

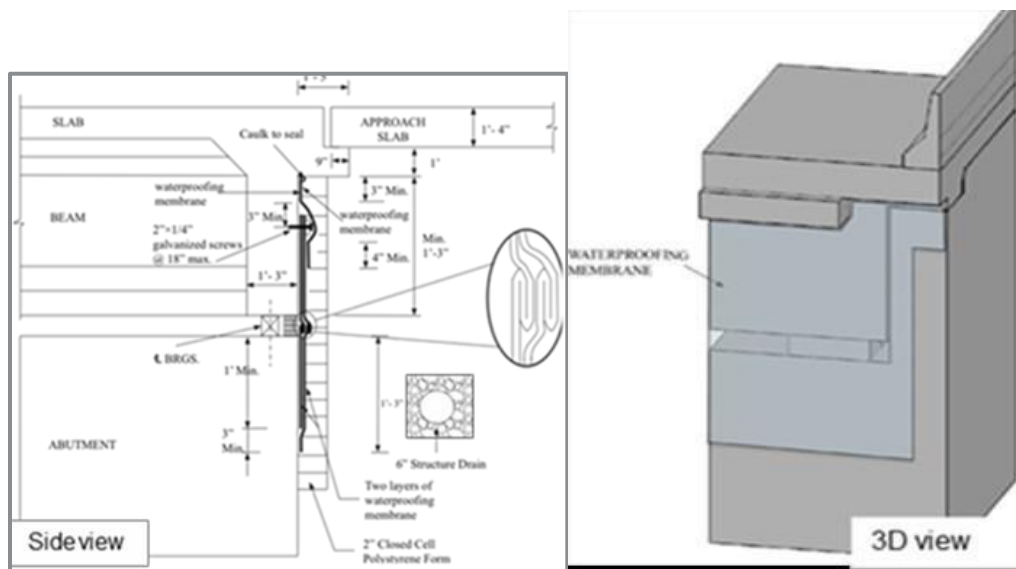
This research focused on improving waterproofing design and practice to ensure that the bridges in Pennsylvania deliver high-quality performance during their expected lifespan. In addition to improving the safety margin and robustness of the key components, this research is aimed to develop sensing systems to monitor the health of the substructure waterproofing system.



Concrete plate under cyclic loading - Source: University of Pittsburgh

### Project Purposes:

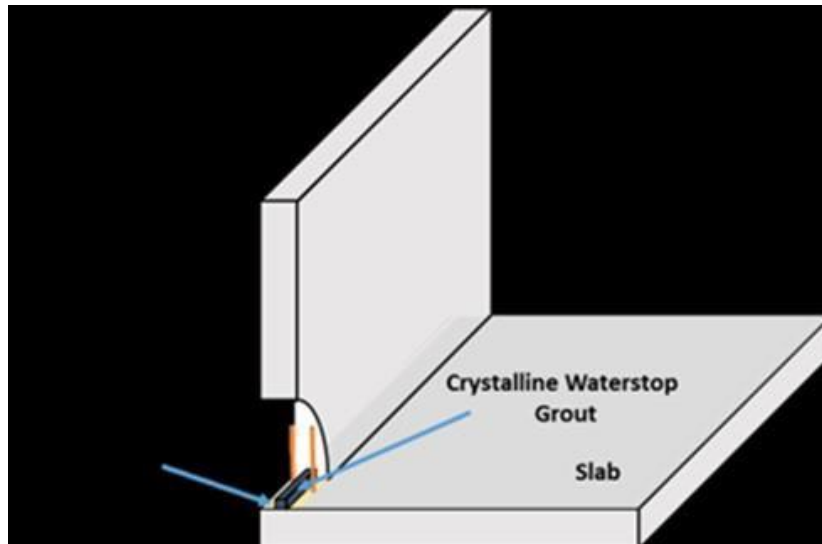
- Improving the design of abutment/beam adjunction
- Using high performance waterstops
- Mitigating the risk of membrane delamination
- Seeking stronger more durable header materials
- Developing a monitoring system to size the gap of expansion joint as well as to detect water leakage



Design I for abutment/beam adjunction - Source: University of Pittsburgh

**Anticipated Project Outcomes Included:**

- Enhanced Abutment/Beam Adjunction Design
- Use of Crystalline Waterstops
- Mitigation of The Delamination of Waterproofing Membrane
- Sensoring System and Header Materials



*Illustration of the external implementation of Krystol crystalline waterstop - Source: University of Pittsburgh*

## TRANSPORTATION POOLED FUND PROJECTS: F.Y. 2016-2017

Project Name	PennDOT Technical Advisor (TA)	Lead Agency	F.Y. 2016-2017 Funding
Development of Maintenance Decision Support System (MDSS)	Jason Norville	FHWA	\$25,000.00
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	Mark Burkhead	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 Winter Highway Operations Pooled Fund	Jonathan Fleming	Minnesota	\$25,000.00
ITS Pooled Fund Program (ENTERPRISE)	Douglas Tomlinson	Michigan	\$30,000.00
National Sustainable Pavement Consortium	Steve Koser	Virginia	\$25,000.00
Real-Time Quality Control Monitoring and Characterizations of Aggregate Materials in Highway Construction Using Laser Induced Breakdown Spectroscopy	Patricia Miller	Kansas	\$50,000.00
The Influence of Vehicular Live Loads on Bridge Performance	Charles Carey	FHWA	\$20,000.00
Next Generation Concrete Pavement Road Map	Neal Fannin	Iowa	\$15,000.00
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 Pavement Profiler Measurements	Colin McClenahan	FHWA	\$5,000.00
The Use of Bridge Management Software in Network Analysis of Big Bridges	Justin Bruner	Michigan	\$20,000.00
Technology Transfer Concrete Consortium (TTCC)	Steve Koser	Iowa	\$8,000.00
Statewide Geospatial Transportation Development of the All Road Network of Linear Referenced Data (ARNOLD)	Frank DeSendi	FHWA	\$75,000.00

## RESEARCH DIVISION ACTIVITIES REPORT – F.Y. 2016-2017

Project Name	PennDOT Technical Advisor (TA)	Lead Agency	F.Y. 2016-2017 Funding
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	Dan Clark	Minnesota	\$25,000.00
State Responses to Energy Sector Developments	Haley Cole	Texas	\$20,000.00
Axle and Length Classification Factor Analysis and Effects on Annual Daily Traffic (AADT)	Jeremy Freeland	Wisconsin	\$12,500.00



## TRANSPORTATION POOLED FUND PROJECTS SPOTLIGHT

### Clear Roads Winter Highway Operations

The Clear Roads Pooled Fund project brings together transportation professionals and researchers from around the country to drive innovation in the field of winter maintenance. By evaluating materials, equipment and methods in real-world conditions, the project identifies the most effective techniques and technologies to save agencies money, improve safety and increase efficiency.

Primary Activities include:

- Evaluating winter maintenance materials, equipment and methods under real-world conditions.
- Developing specifications and recommendations.
- Studying and promoting innovative techniques and technologies that will save agencies money, improve safety and increase efficiency.
- Supporting technology transfer by developing practical field guides and training curriculum to promote the results of research projects.

Since getting under way in 2004, Clear Roads Pooled Fund project has grown to include 29 member agencies, each contributing \$25,000 annually to fund research and technology transfer efforts.

Representatives from the participating departments of transportation meet twice a year to discuss and prioritize projects, share effective practices, and review research results.



Source: [clearroads.org](http://clearroads.org)

On average, approximately nine (9) large projects are authorized per year. As these projects take 1-2 years to develop and complete, PennDOT is constantly providing input to additional projects like Liquid only plow routes, Carbide vs. Ceramic plow blades, application rate studies and various AVL studies. All projects are available on the following website: Clear Roads.org. Also, the projects are conveyed to our managers who can go in and research issues that are particular to their operations to see how other states addressed the issues.

The intangible benefits of having a community to share and discuss winter operations is invaluable. Three (3) recently completed projects that were funded under this pooled fund project have been released or will be released pre-winter as follows:

- Winter Operator Training modules (used by PennDOT for their video and power point content) \$124,000 for the project
  - This supplement slides and provides video content for our Snow Academy
  - Each District has 25% of operators and 100% of temporary operators attend the training each year
  - Without the pooled fund developing this and negotiating the price, PennDOT would either not have the material or would have to pay in excess of the \$124,000 to have a consulting service provide it
- Winter Operators video on plowing complex traffic patterns (video and flip chart/instruction) \$100,000 for the project
  - This year MTLD is providing this video to all Counties and Districts to assist new operators and also experienced operators as well as Foreman, Assistant and County Managers with a tool to figure out how to plow our new traffic patterns like RoundABOUTs, Diverging Diamond, specialized interchanges etc.
  - This information helps assist our winter operations in both the design of the new traffic patterns as well as how to efficiently plow these complex patterns
- Clear Roads support of the Pacific Northwest Snowfighters (PNS) Pooled Fund \$10,000
  - PennDOT uses the specifications and laboratory results from the PNS as a requirement for exotic de-icing manufacturers in Bulletin 15.
  - Without the PNS, PennDOT would expend in excess of \$10,000 per year to perform lab testing and criteria for the inclusion of exotic winter materials in to our programs as well as the ability of Municipalities to use liquid fuel funds to purchase the materials.

## **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 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 programs train and assist 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.

The following services were provided to local municipalities by PennDOT LTAP for F.Y. 2016-2017, the PennDOT LTAP has provided the following:

- In all, **4,073** individuals representing **699** municipalities attended LTAP classes
- **239** classes for **36** course titles were held throughout the Commonwealth
- Of classes held, **156** addressed maintenance topics and **83** addressed safety topics
- **405** 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, the 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/TTAP clients encounter.

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

Each year, PennDOT LTAP holds its own statewide Build a Better Mousetrap Competition. The statewide competition is open to all Commonwealth 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/TTAP National Conference. All entries at the national level are posted on the LTAP/TTAP program website and compiled into an electronic booklet.

*The PennDOT LTAP Build a Better Mousetrap 2017 winner details are listed below.*

### **Pennsylvania LTAP - Build a Better Mousetrap 2017 Winner**

Whitehall Township, Lehigh County received first-place honors in PennDOT' LTAP's 2017 Build a Better Mousetrap Contest. The township received the top honor for a salt shed entrance curtain built to reduce the exposure of stored salt to rain and thus prevent it from contaminating stormwater runoff. The shed entrance curtain was built for less than \$1,200 in materials, labor and equipment and helps to meet the township's goals in ensuring good housekeeping and pollution prevention in municipal operations under minimum control measure #6 that is part of the Municipal Separate Storm Sewer System (MS4) permit requirements of the National Pollutant Discharge Elimination System, or NPDES. As the first-place winner, Whitehall Township's invention will be entered in a regional competition, as well as, in the national LTAP/TTAP competition.

#### **Problem Statement:**

MS4-MCM #6 Pollution Prevention/Good Housekeeping requires Municipal Operations to reduce or eliminate contaminants from entering Stormwater runoff. Salt is stored in an existing shed at loading opening can be exposed to rain causing Stormwater runoff to be contaminated with salt.



*Source: Whitehall Township, 2017*

#### **Solution:**

Design/Build an economical, functional, repairable shed opening cover from readily available materials while saving space.

#### **Labor, Equipment, Materials Used:**

Total labor time, including gathering materials and fabricating: 1 day

#### **Equipment:**

Scissor lift, Skilled tradesman and Laborer

**Materials:**

(2) 20'x20' Tarps, (12) 2x4 Lumber, (20) 1x4 Lumber, (4) 10' Tracks, (6) Barn Rollers, (9) Track Hangers, (1) Aluminum Capping, (12) Closure Pins and an assortment of screws

**Cost:**

Labor: \$2,600, which includes total cost for employee including fringe benefits

Materials & Equipment: \$1,690

Equipment: \$500

**Savings/Benefit to the Community:**

With readily available materials, Whitehall Township created a functional and repairable shed opening cover. It was created to help the Township with the reduction and/or elimination of salt contaminants from entering Stormwater runoff. Due to the available materials, the shed opening cover came with a cost savings as well as an environmental benefit to the Township.

## PENNDOT RESEARCH DIVISION F.Y. 2016-2017

### PLANNING DEPUTATE

James D. Ritzman, P.E., Deputy Sec. of Planning

### BUREAU OF PLANNING & RESEARCH

Laine A. Heltebridle, Director

### RESEARCH DIVISION

Doug Zimmerman, Acting Division Manager

### RESEARCH PROGRAM MANAGEMENT

Lisa Tarson, Manager  
Shelley Scott | Teresa Thompson  
Heather Heslop | Michael Bindie

### MUNICIPAL RESEARCH & OUTREACH

Brian Wall, Manager  
Lou Ferretti | Barbara Jean Storm  
Thomas Welker

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## Acronyms

DWRI: Department Wide Research Initiatives  
FHWA: Federal Highway Administration  
F.F.Y.: Federal Fiscal Year  
FWD: Falling Weight Deflectometer  
F.Y.: Fiscal Year  
HDFR: Hydrologic Disaster Forecasting and Response  
HMA: Hot Mix Asphalt  
IDEA: Innovations Deserving Exploration and Analysis  
IDF: Intensity-Duration-Frequency  
ITQ: Invitation to Quality  
LOU: Letter of Understanding  
LTAP: Local Technical Assistance Program  
MOU: Memorandum of Understanding  
NOAA: National Oceanic and Atmospheric Association  
NEXRAD: Next Generation Radar  
OCC: Office of Chief Counsel  
PA: Pennsylvania  
PennDOT: Pennsylvania Department of Transportation  
PI: Principal Investigator  
PMC: Program Management Committee  
RCRS: Road Condition Reporting System  
RFP: Request for Proposals  
RPMS: Research Program Management Section  
STIC: State Transportation Innovation Council  
TA: Technical Advisor  
TMC: Traffic Management Center  
TRID: Transport Research International Documentation  
TTAP: Tribal Technical Assistance Program  
TPF: Transportation Pooled Fund  
US DOT: United States Department of Transportation

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TECHNOLOGY MAINTENANCE  
TRANSFER CONSTRUCTION  
INNOVATIONS ! SAFETY

 **PENNDOT**

REAL TIME  
INCIDENT  
DETECTION

LTAP

POOLED  
FUND  
PROGRAM

IDEA

OPERATIONS

APPROVED PRODUCTS

PAVEMENT  
EVALUATION

CLEAR ROADS

POLICY

DESIGN

KEY  
FOCUS

TRANSPORTATION

RESEARCH

AREAS

IMPLEMENTATION

PLANNING