



RESEARCH PROGRAM

ACTIVITIES REPORT

F.Y. 2015-2016



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 2015-2016, covering July 1, 2015 through June 30, 2016.



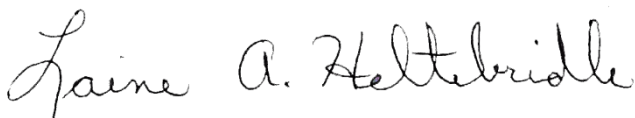
INTRODUCTION

Pennsylvania Department of Transportation (PennDOT) Bureau of Planning & Research | Research Program

The PennDOT Research Division serves an essential role to help maintain and improve the vast transportation network in Pennsylvania. The Research Division advances solutions to meet critical transportation-related challenges and respond to the needs of internal and external stakeholders including PennDOT's five deputates, 24 bureaus and administrative offices, 11 PennDOT Districts, 67 county maintenance units, as well as the traveling public, municipalities, and other governmental agencies.

The Research Division manages research project activities through partnerships with Pennsylvania academic institutions, private sector contractors, and non-profit organizations with an emphasis on applied research, performance monitoring and implementation activities. The Research Division provides the necessary oversight and investment to advance fundamental research in the areas of construction, design, maintenance, operations and safety, planning and policy and technology transfer.

The 2015-2016 Research PennDOT Research Division's Activities Report includes an overview of Pennsylvania's state-based research projects, participation in transportation pooled fund studies and national research initiatives, and efforts in technology transfer and program management.



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.

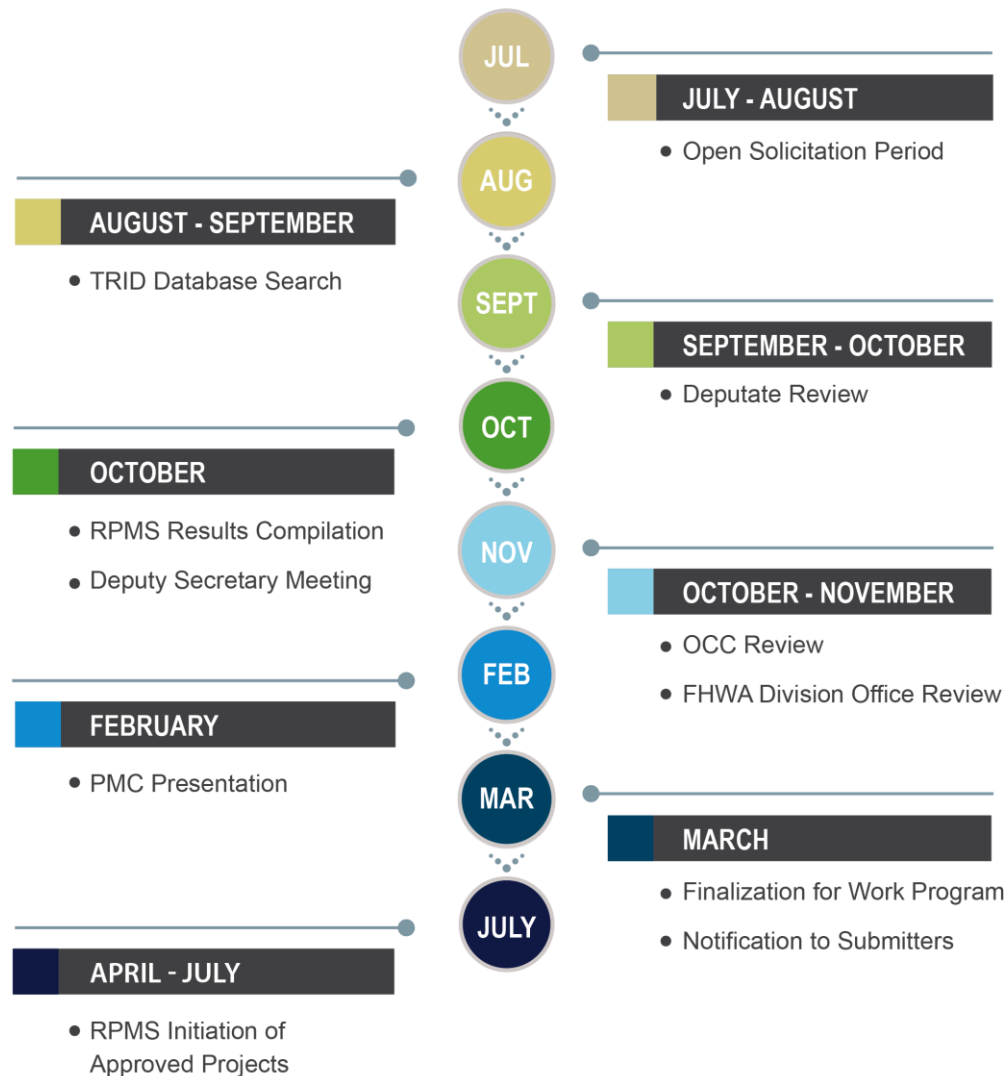
Research Program Overview

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



The F.Y. 2015-2016 research program of approximately \$3.0 million provided funding for 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. 2015-2016

Project Name	PennDOT Technical Advisor (TA)	Principal Investigator (PI)	F.Y. 2015-2016 Funds	Start Date	End Date
Research Invitation to Qualify (ITQ) Projects					
Approved Products for Low Volume Local Roads	Tom Welker	Pennsylvania State University (PSU) Mansour Solaimanian	\$108,980.13	6/20/2011	6/19/2016
Evaluation of Thin Hot Mix Asphalt Overlay	Neal Fannin	PSU Mansour Solaimanian	\$141,777.51	6/21/2012	6/20/2016
Bridge Deck Cracking: Effects on In-Service Performance, Prevention, and Remediation	Robert Watral	PSU Aleksandra Radlinska	\$33,467.00	8/6/2013	8/5/2015
Pennsylvania Statewide Transportation Operations Data Warehousing Business Plan	Doug Tomlinson	Michael Baker, Inc Todd Trautz	\$333,295.82	11/24/2014	5/24/2016
Request for Proposals (RFPs)					
PennDOT Local Technical Assistance Program (LTAP) Renewal 2	Lou Ferretti	Pennsylvania State Association of Township Supervisors (PSATS) - Carol Kilko	\$601,532.87	12/29/2014	12/28/2015
PennDOT Local Technical Assistance Program (LTAP) New	Lou Ferretti	PSATS Karen Atkinson	\$210,266.50	12/29/2015	12/28/2018
Memorandum of Understanding (MOU) Projects Letter of Understanding (LOU)					
LOU 1-16: F.Y. 2015-2016 Training	Lou Ferretti	PSATS Karen Atkinson	\$115,752.95	7/1/2015	6/30/2016
Pennsylvania State University (PSU) Projects - DGS Master Agreement					
Polymer Modified Cold Recycled Asphalt Evaluation and Methodology	Doug Schofield	Mansour Solaimanian	\$5,990.00	6/10/2013	7/27/2015
Evaluation of High Friction Surface Treatment (HFST) Binders	Alberto Medina	Mansour Solaimanian	\$31,331.66	7/1/2014	6/15/2016
Best Practices for the Design, Evaluation and Quality Control of High Percentage RAP Mixes	Tim Ramirez	Mansour Solaimanian	\$24,784.00	7/1/2014	12/1/2015

RESEARCH DIVISION ACTIVITIES REPORT

Project Name	PennDOT Technical Advisor (TA)	Principal Investigator (PI)	F.Y. 2015-2016 Funds	Start Date	End Date
PSU Projects continued					
Evaluation of Geotextile Separation to Prevent Migration of Subgrade Fines into Subbase	Kerry Petrasic	Ming Xiao	\$141,630.20	11/24/2014	9/15/2016
70 MPH Study	Bob Pento	Eric Donnell	\$107,941.00	12/4/2014	6/30/2016
Pennsylvania Consortium of Transportation Universities (PaCTU)	Andrea Bahoric	Martin Pietrucha	\$2,375.00	4/30/2015	8/28/2015
Assessment of Current Design Loads for Permit Vehicles	Charlie Carey	Jeffrey Laman	\$97,879.00	7/24/2015	5/23/2016
University of Pittsburgh (PITT) Projects - DGS Master Agreement					
50 KSI Steel H-Pile Capacity	Charlie Carey	Kent Harries	\$4,349.60	5/1/2014	6/30/2015
Remote Sensing for Bridge Scour Projects – Phase 3	Paul Koza	Ervin Sejdic	\$74,477.13	5/11/2015	5/31/2016
Bridge Waterproofing Details – Phase 2	Ronald Schreckengost	Qiang Yu	\$27,953.77	4/13/2015	6/12/2017
Interpreting Falling Weight Deflectometer (FWD) Data	Bill Dipner	Julie Vandenbossche	\$25,344.00	4/17/2015	4/16/2018
Noninvasive Assessment of Existing Concrete	Ronald Schreckengost	Piervincenzo Rizzo	\$124,432.60	2/3/2015	2/2/2016
Identifying Impediments and Solutions to Sidewalk Project Implementation in Pennsylvania	Chris Metka	Radisav Vidic	\$94,687.96	7/1/2015	9/30/2016
Improving Spatial Precipitation Distribution Map – Analysis for Bridge Inspections and Emergency Response	Jason Norville	Xu Liang	\$48,792.00	4/14/2015	11/13/2017
Temple University (TEM) Projects - DGS Master Agreement					
Effective Use & Application of Winter Roadway Maintenance Material Enhancers	William Davenport	Erica McKenzie	\$80,000.00	4/17/2015	10/16/2015

RESEARCH DIVISION ACTIVITIES REPORT

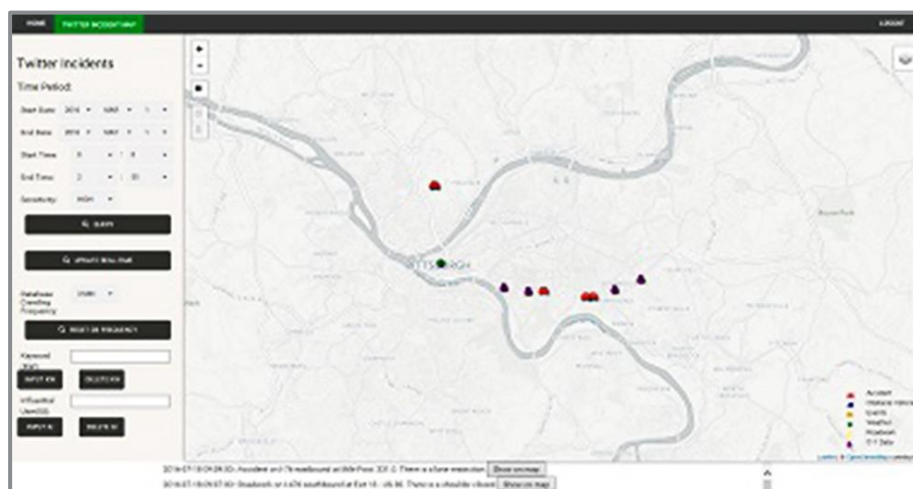
Project Name	PennDOT Technical Advisor (TA)	Principal Investigator (PI)	F.Y. 2015-2016 Funds	Start Date	End Date
University of Maryland (UMD) Projects - DGS Master Agreement					
I-95 Corridor Coalition Research and Technology Transfer Initiative	Andrea Bahoric	Kathy Frankle	\$118,000.00	5/2/2014	5/2/2017
Carnegie Mellon University (CMU) Projects - DGS Master Agreement					
Real-time Incident Detection Using Social Media	Mark Kopko	Sean Qian	\$68,467.91	5/11/2015	5/10/2016
Dynamic Network Analysis & Real-time Traffic Management for Philadelphia Metro Area	Emmanuel Anastasiadis	Sean Qian	\$19,000.00	10/2/2015	9/30/2016
Highway Corridor Transformation Research Study – Proof of Concept	Todd Kravits	Donald Carter	\$80,000.00	1/11/2016	9/30/2016
Other Contracting Mechanisms – Engineering and Construction Management System (ECMS)					
STIC Outreach 2015	Andrea Bahoric	McCormick Taylor Leanne Doran	\$96,155.13	2/19/2015	10/12/2017
Project Management	Kenita Honesty	McCormick Taylor Leanne Doran	\$2,005.91	3/11/2016	12/30/2016
Planning and Communications Support	Kenita Honesty	McCormick Taylor Leanne Doran	\$86,259.24	3/16/2016	10/31/2016

RESEARCH PROJECTS SPOTLIGHT

Real-Time Incident Detection Using Social Media

Many incidents on roadway infrastructure are either not reported to Traffic Management Centers (TMCs) or reporting is significantly delayed because data has to flow from external systems (e.g., 911 systems). It is postulated that social media contains useful indicators that are complementary to other data sources and can be beneficial to the TMCs.

However, analyzing high-volume high-velocity data streams for relevant signals in a timely fashion is a challenge. The challenge is compounded by the low signal-to-noise ratio in social streams.



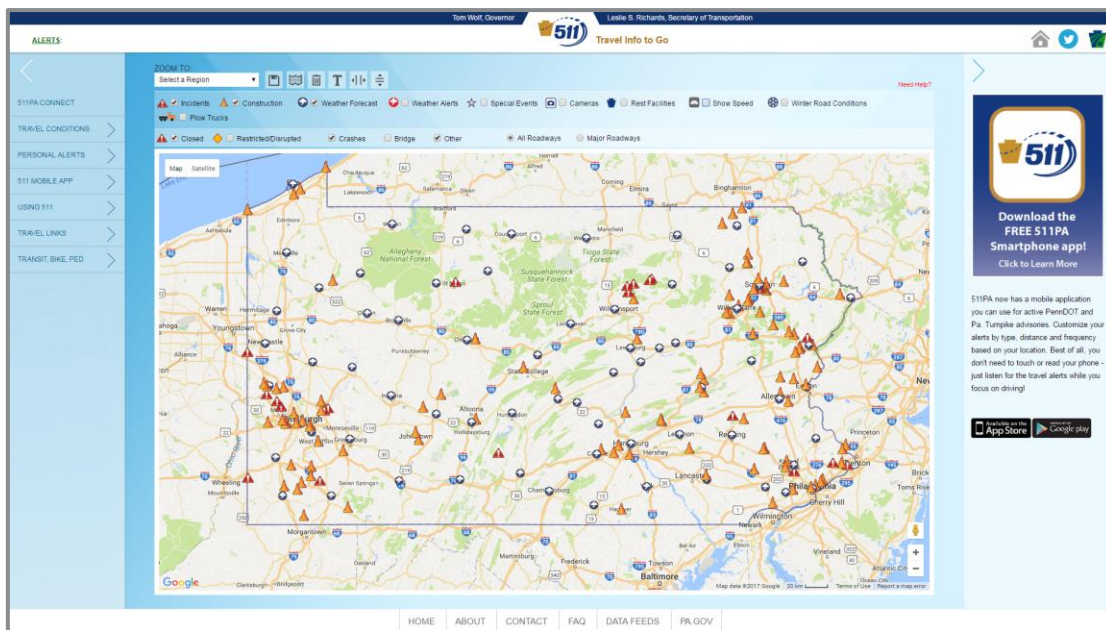
Source: PennDOT

Project Purposes:

- Analyze social media streaming data (Twitter and traffic radio streams as the test case) for real-time incident detection on the major road infrastructure of Pennsylvania.
- Determine the feasibility of creating a real-time capability of social media data analytics to alert TMCs about ongoing statewide incidents, broadly defined as significant disruption to the traffic flow on major road infrastructure.

Anticipated Outcomes May Include:

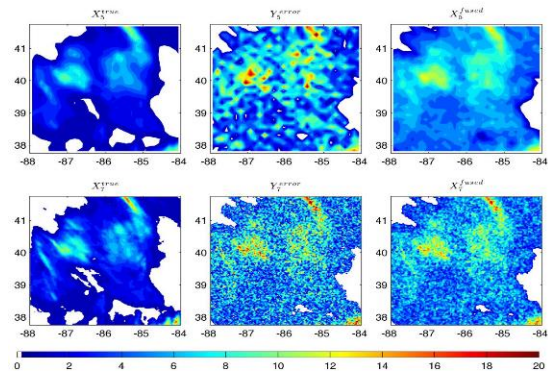
- Determining the extent to which information about incident management exists in social media, whether this information can be mapped (in time and space) precisely to the road network, how and where the trends can be leveraged for real-time incident detection.
- Demonstrating that software automation is able to find, geo-locate, time stamp, and display the information of incidents.
- Developing a prototype map-based website and incident database for TMCs to use in real-time.
- Studying the timeliness of incident detection from tweets. For each incident reported in Road Condition Reporting System (RCRS), identify the time gap between tweeted time (if applicable) and RCRS reported time.



Source: PennDOT's 511PA.com

Improving Spatial Precipitation Distribution Map – Analysis for Bridge Inspections and Emergency Response

This research focuses on improving hydrologic disaster forecasting and response by developing a multi-scale Hydrologic Disaster Forecasting and Responses (HDFR) system. Key to this system is the effective integration and fusion of NASA observations, with data at different scales from other sources, to form useful and reliable precipitation data and other hydrologic forecasts at multiple spatial scales.

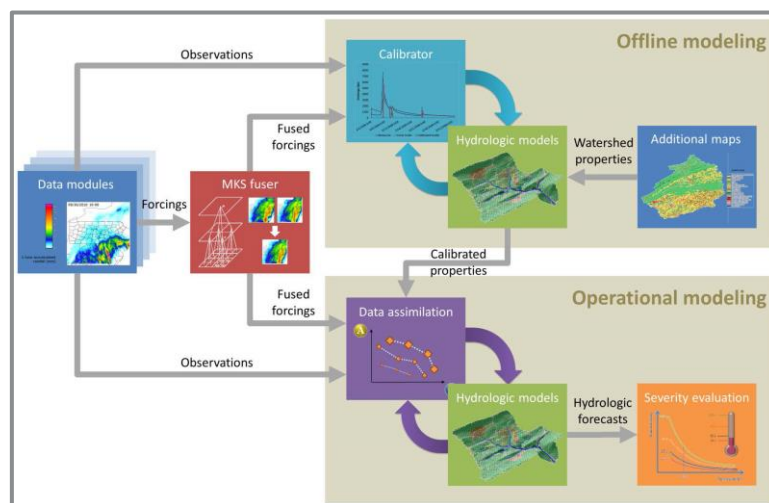


Comparison of precipitation images among the true (left), erroneous with both bias and noise (middle), and fused (right) for a storm. Source: PennDOT

Project Purposes:

- Develop a prototype system to automatically read in precipitation data (both forecasted and real measurements when they become available) from rain gauge network, NOAA NEXRAD system, and NASA satellites in near real-time.
- Fuse the data by using an extended Multiscale Kalman Smoother-based data fusion method.
- Compute the return periods of these precipitation events.

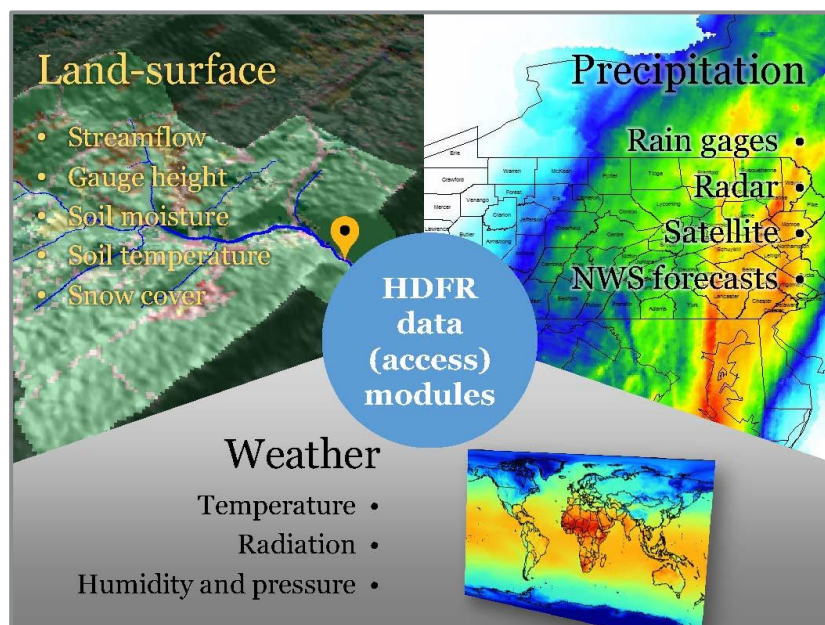
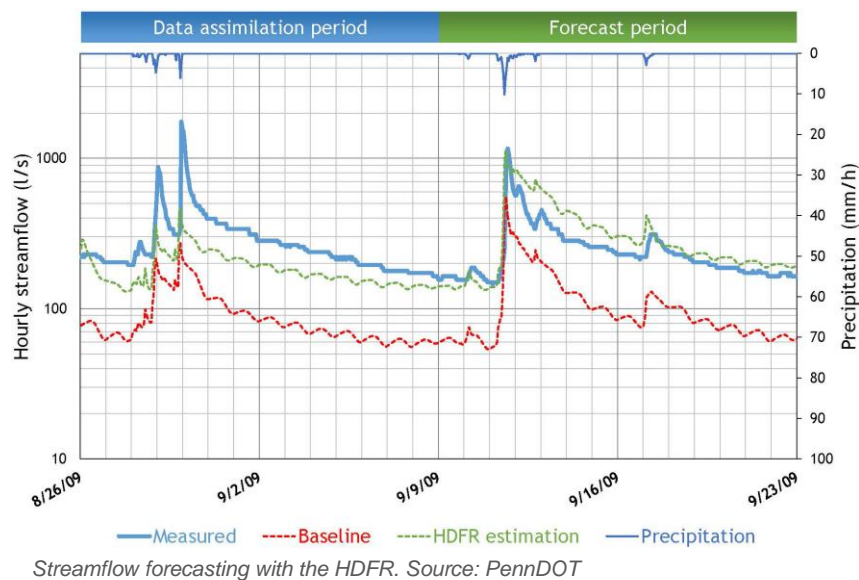
The prototype system includes software modules for Intensity-Duration-Frequency (IDF) curves, and severity assessment analyses based on the IDF curves.



Framework of Hydrologic Disaster Forecasting and Response (HDFR). Source: PennDOT

Anticipated Project Outcomes Include:

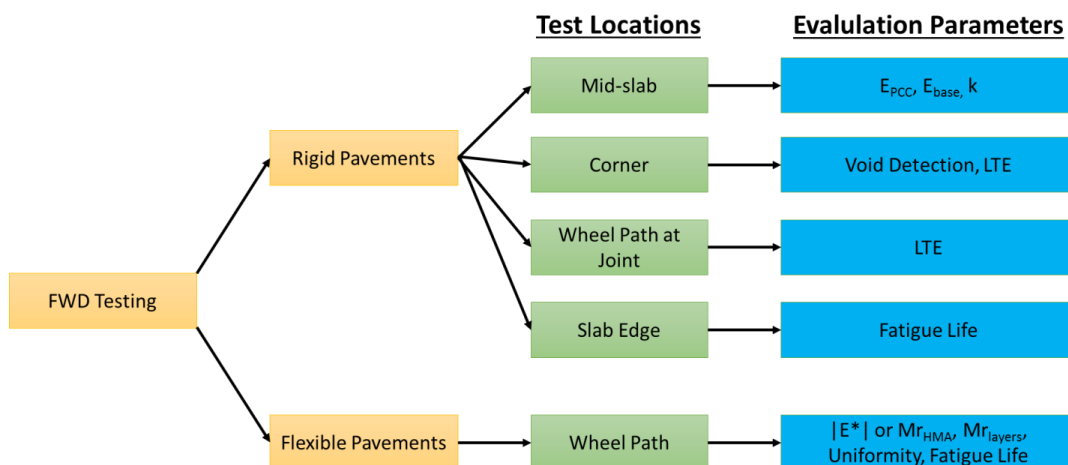
- IDF curves for precipitation for identified bridge locations
- IDF curves for streamflow for identified bridge locations
- IDF curves for snow depth and surface temperature for test areas
- A prototype system that is able to automatically read in the various precipitation data, estimate the return periods of identified precipitation events, and identify bridges requiring post-event damage inspections



HDFR Data (Access) Modules. Source: PennDOT

Interpreting Falling Weight Deflectometer (FWD) Data

Falling Weight Deflectometer (FWD) testing is a pavement evaluation strategy that measures the deformation response of a pavement subjected to a dynamic load and is a valuable tool for obtaining the necessary inputs required to select and design rehabilitation strategies.



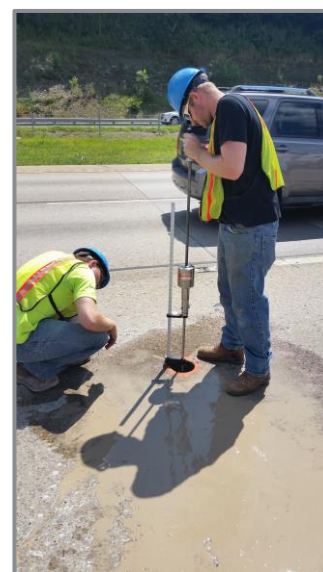
Source: PennDOT

Project Purpose:

- Develop a design methodology for interpreting FWD data for Jointed Plain Concrete Pavement and Hot Mix Asphalt (HMA) pavements so that the most effective rehabilitation strategies can be identified through a proper structural assessment, and appropriate inputs can be established for AASHTO's Mechanistic-Empirical Pavement Design Guide procedures.

Anticipated Project Outcomes Include:

- Determination of the appropriate rehabilitation treatment and/or construction design to extend the life of a pavement through a more accurate assessment of the condition of the existing pavement and subgrade.
- Tools necessary for interpreting falling weight deflectometer data for use in rehabilitation decisions and overlay design.



Source: Univ. of Pittsburgh, 2016

TRANSPORTATION POOLED FUND PROJECTS: F.Y. 2015-2016

Project Name	PennDOT Technical Advisor (TA)	Lead Agency	F.Y. 2015-2016 Funding
Development of Maintenance Decision Support System (MDSS)	Jason Norville	FHWA	\$25,000.00
Traffic Control Device (TCD) Consortium	Justin Smith	FHWA	\$25,000.00
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	\$40,000.00
Clear Roads Winter Highway Operations Pooled Fund	Jonathan Fleming	Minnesota	\$25,000.00
ITS Pooled Fund Program (ENTERPRISE)	Douglas Tomlinson	Michigan	\$30,000.00
Technology Transfer Intelligent Compaction Consortium (TTICC)	Daniel Clark	Iowa	\$7,000.00
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
Support Services for Peer Exchange	Andrea Bahoric	Oregon	\$7,000.00
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	\$50,000.00
Transportation Management Center (TMC)	Eric Sponsler	FHWA	\$25,000.00

Project Name	PennDOT Technical Advisor (TA)	Lead Agency	F.Y. 2015-2016 Funding
Develop and Support Transportation Performance Management Capacity Development Needs for State DOTs	Doug Zimmerman	Rhode Island	\$10,000.00
Strain-Based Fatigue Crack Monitoring of Steel Bridges Using Wireless Elastometric Skin Sensors	Gouzhou Li	Kansas	\$10,000.00
No Boundaries Roadway Maintenance Practices	Jonathan Fleming	Ohio	\$10,000.00
Enhancements to the Intelligent Construction Data Management System (VEDA) and Implementation	Dan Clark	Minnesota	\$10,000.00
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
Roadside Safety Research for MASH Implementation	Mark Burkhead	Washington	\$50,000.00

TRANSPORTATION POOLED FUND PROJECTS SPOTLIGHT

Clear Roads Winter Highway Operations

The Clear Roads research program 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 program identifies the most effective techniques and technologies to save agencies money, improve safety and increase efficiency.

DOTs seeking to minimize costs to both the agency and the driving public are constantly seeking to optimize their winter maintenance strategies. Cost considerations for the agency include (but are not limited to) the costs of plowing and applying abrasives or chemicals, the economic impact of adjusting level of service relative to public mobility, and the cost of chemical corrosion and abrasive wear on application equipment, highway infrastructure, and the personal property of highway users. Safety is also a critical consideration.

Since getting under way in 2004, Clear Roads 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: PennDOT

LOCAL TECHNICAL ASSISTANCE PROGRAM (LTAP)

The PennDOT Local Technical Assistance Program (LTAP) is one of 58 LTAP centers across the nation, one in each state, Puerto Rico and regional centers serving American Indian tribal governments. These centers are dedicated to transferring transportation technology through training, technical assistance, and other customer services to municipal elected officials and their staff. PennDOT LTAP provides technical information and proven technologies dealing with roadway maintenance and safety methods to meet the growing demands on municipal governments, which in total, maintain over 77,000 miles of Pennsylvania roads. PennDOT LTAP has provided technology transfer services to Pennsylvania's more than 2,500 municipal governments since 1983.

LTAP by the numbers for F.Y. 2015-2016:

- In all, **3,141** individuals representing **591** municipalities attended LTAP classes.
- **221** classes for **31** course titles were held throughout the Commonwealth.
- Of classes held, **100** addressed maintenance topics and **121** addressed safety topics.
- **396** one-on-one technical assistance sessions were provided.



Source: PennDOT, 2015

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 2015 winner details are located on the following page.



Pennsylvania Build a Better Mousetrap 2015 Winner

PennDOT's LTAP awarded top honor to Swatara Township, Dauphin County in 2015 for the High-Pressure Sprayer. Swatara Township was also awarded 2nd Place on the National level.

Problem Statement:

The township had an ongoing problem with salt and salt residue on the underside of trucks and equipment corroding the metal, brake lines, fittings, and truck parts. Without a dedicated truck wash bay with undercarriage cleaning to completely wash off the salt and residue, the township spent thousands of dollars over the years to replace rusted parts. The rusted parts were also a problem because mechanics had a hard time removing the parts.



Source: Swatara Township, 2016

Solution:

Initially, the township tried removing the salt and residue with a garden hose and a landscape sprinkler. Without enough pressure to take off the salt and residue, this did not prove effective. An employee fabricated a high-pressure sprayer with four 45-degree sprayer nozzles to blast off the salt and residue. The township now uses the high-pressure washer and has had successful results. The township pre-rinses the undercarriages of trucks and equipment before treating them with a salt rinse product and rinsing them off again.

Labor, Equipment, Materials Used:

Total labor time, including gathering materials and fabricating: 4 hours

Equipment:

Cut-off saws, pliers, and pipe wrenches

Materials:

1/2" x 6' galvanized pipe, (4) 1/2" galvanized T-fittings, (6) 45-degree 1/2" fittings, (2) 1/2" 4-way cross fittings, (4) 1/2" end caps, and (4) 45-degree high-pressure sprayer nozzles

Cost:

Total cost - Labor: \$238.44, which includes total cost for employee including fringe benefits

Total cost - Materials: \$200

Savings/Benefit to the Community:

The invention of the high-pressure sprayer has resulted in fewer trucks and equipment with corroded undercarriages. The township has benefited from lower maintenance costs to replace rusted/corroded truck parts, fewer rusted/corroded parts in need of replacement, and a shorter amount of replacement time for mechanics to remove rusty parts. Another benefit is environmental. With fewer rusted/corroded parts, the trucks and equipment produce less oil and fluids that can leak onto roads and into storm drains and ultimately end up in creeks, streams, and rivers.



Source: Swatara Township, 2016



PENNDOT RESEARCH DIVISION F.Y. 2015-2016



Contact Information

Research Division	PennDOT Library
400 North Street, 6 th Floor East Harrisburg, PA 17120 (717) 787-5796 Ra-pennidotresearch@pa.gov	400 North Street, 6 th Floor East Harrisburg, PA 17120 (717) 787-5796 Ra-pennidotlibrary@pa.gov

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**

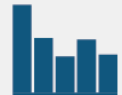

REAL TIME
INCIDENT
DETECTION

 **LTAP**  POOLED
FUND
PROGRAM  **IDEA**

 **OPERATIONS**  **APPROVED PRODUCTS**

 **PAVEMENT
EVALUATION** **CLEAR ROADS**
 **POLICY** 

DESIGN  **KEY**  **FOCUS**    

 **RESEARCH** **AREAS** **TRANSPORTATION**
IMPLEMENTATION  **PLANNING**