


# RESULTS



# WSDOT

*MOVING WASHINGTON FORWARD*

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## RESEARCH PORTFOLIO

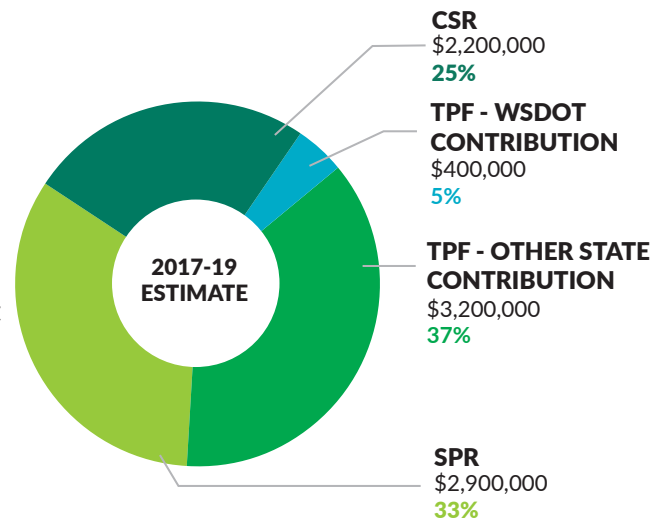
## 2017 - 2019

**R**esearch is an important tool supporting the delivery of a transportation program that uses the best & latest information, technologies and practices to serve Washington citizens and businesses. This portfolio presents ongoing research projects that are aligned with the Washington State Department of Transportation’s (WSDOT) Results WSDOT, the agency’s strategic plan or 2014-17.

These projects were inspired over the course of the last six years, and are in various stages of programming, scoping, data collection, analysis and development of final recommendations or products. These research projects, while organized by current strategic objectives, may also address other goals in the agency strategic plan.

## TRANSPORTATION RESEARCH FUNDING

State Planning and Research Program (SPR) funds are used to establish a cooperative, continuous, and comprehensive framework for making transportation investment decisions and carrying out research activities. Federal SPR funds are matched by 20% state funding through a formula based allocation. In addition, Transportation Pooled Funds (TPF) allow states to combine their funding to conduct research of a common interest. The WSDOT Research Office contributes about \$400K every biennium to various TPF projects and has current investments in 34 pooled fund projects. Other WSDOT programs may support research efforts – these are referred to as Client Sponsored Research (CSR) projects. WSDOT is also the recipient of research grants provided by the Accelerated Innovation Program (AID), the State Transportation Innovation Councils (STIC) Incentive Program, and the Strategic Highway Research Program (SHRP). Partnerships with University Transportation Centers such as PacTrans (UW & WSU) and the National Institute for Transportation and Communities (NITC at Portland State Univ.) and others allows research dollars to stretch even further.



# GOAL 1 - STRATEGIC INVESTMENTS

*Effectively manage system assets and multimodal investments on corridors to enhance economic vitality*

## CONSTRUCTION

### **Best Practices of Using Concrete for Wall Fascia and Slope Stabilization – Phase 1**

This study will review the state of academic and industry knowledge to ensure the proper use of shotcrete for wall fascia and slope stabilization. With the increasing emphasis on using shotcrete for accelerated construction and rapid renewal, there is an urgent need to document the use of shotcrete for wall fascia and slope stabilization by highway agencies, assess the condition of such existing inventory, and identify best practices during various stage of the life cycle of such structures.

**RESEARCH TEAM:** MARK GAINES | LU SAECHAO | PIZHONG QIAO, WSU

**SCHEDULED COMPLETION:** 2017

### **Best Practices of Using Shotcrete for Wall Fascia and Slope Stabilization – Phase 2**

This is a continuation of the Phase 1 study above. The goal of this project aims to address the impeding issues identified in Phase 1 to ensure the proper use of shotcrete for wall fascia and slope stabilization as well as other potential applications. The results will provide improved construction practices, field performance, long-term durability as well as test methods and acceptance guidelines for field use of shotcrete application.

**RESEARCH TEAM:** BRIAN ALDRICH | LU SAECHAO | PIZHONG QIAO, WSU

**SCHEDULED COMPLETION:** TO BE DETERMINED

## BRIDGE

### **Developing Connections for Longitudinal Joints between Deck Bulb Tees**

A decked bulb tee girder is a long span girder that incorporates the benefits of both an I girder and a precast slab deck used in bridge construction. This study will investigate ways of connecting the flanges of adjacent deck bulb tees by 1) developing a suitable Ultra High Performance Concrete (UHPC) mixture using locally sourced materials, and 2) investigate the connection details (for stiffness and strength in bending) for the deck bulb tee girders to minimize cracking at the joint. This will allow bridge decks to be created using precast deck members, and avoiding the need to form, reinforce, and cast the deck on site and will result in considerable time and cost savings.

**RESEARCH TEAM:** BIJAN KHALEGHI | LU SAECHAO | PIZHONG QIAO (WSU) & JOHN STANTON (UW)

**SCHEDULED COMPLETION:** 2017

### **Developing Girder Strands into the Cap Beam for a Positive Moment Connection**

This research will examine ways to develop a structurally efficient, easily constructible method for anchoring prestressed strands in the cap beam, and to verify by testing. Available anchoring systems used to make the connection at this region of a bridge typically create congestion and pose constructability issues, particularly in skewed bridges. Benefits of this study will include ensuring reliable resistance of prestressed concrete

girder bridges to earthquake forces, simplifying the contractor's task of installing girders (saving time and potentially costs) and minimizing construction delays caused by interference of reinforcement in the connection region.

**RESEARCH TEAM:** BIJAN KHALEGHI | LU SAECHAO | JOHN STANTON (UW)

**SCHEDULED COMPLETION:** 2017

### **Seismic Performance of SMA/ECC Columns of SR 99 Bridge Structure**

The research objective is to evaluate the use and performance of innovative materials such as Nickel-Titanium shape memory alloy (SMA) bars and engineered cementitious composites (ECC) specific to the SR-99 bridge piers at the south end of the Alaskan Way Viaduct project, the first in the world of its kind. These materials have been integrated into the columns to create a more seismic resilient structure, replacing conventional steel reinforcement and concrete. The spring-like behavior of these materials is expected to provide a serviceable structure after a substantial earthquake. Funding for this project is provided through a grant from the Federal Highway Administration (FHWA) program on Innovative Bridge Research and Deployment (IBRD).

**RESEARCH TEAM:** BIJAN KHALEGHI | LU SAECHAO | M. SAIIDI (UNIV. OF NEVADA, RENO)

**SCHEDULED COMPLETION:** 2018

### **Evaluation of Risk-Based Asset Management Systems for WSDOT Implementation**

This research evaluates various risk-based asset management systems to develop an agency asset management plan. This includes investigating the tools already developed by the Institute for Public Works Engineering Australia/Asia (IPWEA) to educate both department members and decision makers on the need for asset management and the stewardship responsibilities toward asset management. In addition to investigating the IPWEA system, the study will evaluate other available asset management tools.

**RESEARCH TEAM:** TOM BAKER | LU SAECHAO | DYE MANAGEMENT GROUP

**SCHEDULED START:** 2017

### **Develop Analytical Tool for Ranking Existing Bridges Built using Hollow Pile-Columns**

This research will result in an analytical tool for ranking WSDOT's existing bridges that were built using hollow precast, prestressed concrete pile-columns (approximately 25 total) in order of importance for retrofit, and a retrofit method, including design procedures and details. The hollow columns pose a seismic risk, especially because some of the bridges are on major highways such as I-5.

**RESEARCH TEAM:** BIJAN KHALEGHI | LU SAECHAO | JOHN STANTON (UW)

**SCHEDULED START:** 2017

### **Asset Management: Bridge Elements Deterioration Rates and Curves for WSDOT Bridges**

The scope of this research is to develop deterioration rate curves for reinforced concrete bridge substructure elements such as reinforced concrete columns and piles specific to WSDOT bridges. These curves will allow the bridge office to assign costs to existing risk and assign monetary value to efficiently prioritize the WSDOT bridge inventory for timely repair, rehabilitation, and replacement. This research project will be limited to a literature review and analysis of WSDOT historical bridge condition data.

**RESEARCH TEAM:** DEWAYNE WILSON | LU SAECHAO | JILL WALSH (SAINT MARTIN'S UNIVERSITY)

**SCHEDULED START:** 2017

## **Full-Scale Shake Table Testing to Evaluate Seismic Performance of Reinforced Soil Walls Pooled Fund (TPF 5-276)**

This is a five state pooled fund research project led by WSDOT. The project will improve existing design procedures that relate to seismic demand and performance of earth retaining structures under strong ground motions. Earth retaining structures constitute a vital component of the civil infrastructure across the U.S. In high seismic risk zones, these structures are occasionally subjected to strong earthquakes that can threaten their integrity. Research is needed regarding seismic demand and performance of these structures under strong ground motion to improve existing design procedures. The objective of this project is to perform numerical studies and use UCSD's Large High Performance Outdoor Shake Table (LHPOST) to investigate the dynamic performance of mechanically stabilized earth (MSE) walls and abutments constructed using realistic materials and methods at larger half-scale models.

**RESEARCH TEAM: TONY ALLEN | LU SAECHAO | JOHN MCCARTNEY (UC SAN DIEGO)**

**SCHEDULED COMPLETION: 2018**

## **MATERIALS**

### **Performance Measures for Bituminous Surface Treatments (BST's)**

The goal of this research is to evaluate different performance indicators for Bituminous Surface Treatment (BST), also known as chip seal roadways and develop trigger values for these indicators that will indicate the end of service life and the appropriate index values for resurfacing. Currently the same performance indicators are being used for BST surfaces as for asphalt pavements (rutting, roughness, cracking). However, a BST structure does not behave the same as an asphalt pavement structure. It is more flexible and less susceptible to fractures, but more susceptible to surface raveling, asphalt flushing, and aggregate wear. Today, most BST routes in Washington are resurfaced on a regular 6-7 year schedule instead of resurfacing based on need. Increasing the service life of WSDOT pavements is one of the most effective ways available to reduce annual costs. It is expected that if the service life could be extended by just one year (from 6.5 to 7.5 years), this could potentially reduce WSDOT's annual BST costs by 15%.

**RESEARCH TEAM: DAVE LUHR | LU SAECHAO | WSDOT MATERIALS LAB**

**SCHEDULED COMPLETION: 2018**

### **Determining Expected Life and Best Practices for Pavement Maintenance Treatments**

The research will evaluate and develop best practices for pavement maintenance activities to develop guidelines on how each maintenance treatment affects pavement life. Typical preventive maintenance treatments include crack sealing, partial lane chip seals, patching and level-up, etc. The guidelines will be used by WSDOT to improve selection, planning, and completion of maintenance activities, which will result in longer pavement life and reduced life cycle costs.

**RESEARCH TEAM: JEFF UHLMAYER | LU SAECHAO | WSDOT MATERIALS LAB**

**SCHEDULED COMPLETION: 2018**

### **Development of a Strategic Pavement Study (SPS-2) Pooled Fund (TPF 5-291)**

This is a pooled fund effort led by WSDOT with six other states to develop a second tier experiment based upon the existing Long-Term Pavement Performance (LTPP) SPS-2 experiment. The original study represents the largest research effort undertaken since the American Association of State Highway and Transportation Officials Road Test and represents a national investment of about \$15 to \$20 million dollars for the

construction, sampling and testing, monitoring, and analysis of concrete pavements. Thirteen of these sites still exist and are continuing to be monitored and evaluated. The objective of this second tier experiment is to look at how to preserve these pavements and to develop tools for determining strategy selection and pavement life extension for incorporation into pavement and maintenance management systems.

**RESEARCH TEAM: JEFF UHLMAYER | LU SAECHAO | NICHOLS CONSULTING ENGINEERS**

**SCHEDULED COMPLETION: ONGOING**

### **Performing Forensic Evaluations of Long-Term Pavement Performance (LTTP) Remaining Sections Before They Leave Service Pooled Fund (TPF 5-332)**

This is a pooled fund led by WSDOT with three other states and FHWA. The research is investigating LTPP test sections as they prepare to go out of service, capturing data on exactly why the section failed and had to be removed from service. This may entail trenching and coring, measuring lift deflection, and potential lab testing of field samples for materials characteristics. The study will perform the forensic evaluation in the field and limited lab testing from field samples. Additional work will include building tracking lists of remaining sites, contacting states for updates on site status and planning action for sites about to go out of service.

**RESEARCH TEAM: TOM BAKER | LU SAECHAO | TO BE DETERMINED**

**SCHEDULED START: 2017**

### **Recycled Asphalt Pavement (RAP) Reset**

This project evaluates how recent materials technologies could be integrated into WSDOT policy, specifications and procedures to maximize the use of recycled materials without compromising pavement performance. The objective of the study is to enhance WSDOT Hot Mix Asphalt (HMA) materials selection, mix design process, and standard specifications to responsibly optimize the use of recycled materials based on recent readily implementable technology in collaboration with stakeholders for improved pavement performance. The benefits will include improved mix design, improved pavement life, improved environmental conditions (reduction in greenhouse gases and carbon footprint) and cost savings.

**RESEARCH TEAM: JOE DEVOL & JEFF UHLMAYER | LU SAECHAO | ADAM HANDS (UNIV. OF NEVADA, RENO), STEVE MUENCH & JOE MAHONEY (UW)**

**SCHEDULED START: 2017**

### **Probabilistic Liquefaction Hazard Analysis: WSLIQ Expansion & Update**

The WSDOT Liquefaction Hazard Evaluation System (WSLIQ) is a joint effort of the WSDOT Materials Lab and the University of Washington. WSLIQ allows the evaluation of the susceptibility, initiation potential, and effects of earthquake-induced soil liquefaction in Washington State. The objective of the research is to develop, implement, and test new Probabilistic Liquefaction Hazard Analysis (PLHA) procedures and to update the WSLIQ program to incorporate the resulting improvements. This will provide better designs of bridges, fish passage structures, walls, etc. especially in Western WA where earthquake ground motions are larger. The research will improve WSDOT's designs for liquefaction effects on structures and reduce conservatism for routine liquefaction design thus reducing project costs.

**RESEARCH TEAM: TONY ALLEN | LU SAECHAO | STEVE KRAMER (UW)**

**SCHEDULED START: 2017**

### **Hot Mix Asphalt (HMA) Reset**

This research updates the WSDOT asphalt pavement policy, mix design, and specifications to reflect what has been learned in-state and nationwide over approximately the last 15 years. This effort is termed an “HMA reset”. This would lead to improved pavement performance by reducing the risk of early pavement failure from mix design or construction issues and an associated reduction in cost.

**RESEARCH TEAM:** JOE DEVOL & JEFF UHLMAYER | LU SAECHAO | STEVE MUENCH & JOE MAHONEY (UW), ADAM HANDS (UNIVERSITY OF NEVADA-RENO)

**SCHEDULED START:** 2018

### **Concrete Pavement Replacement Using Precast Concrete Panels (PCP)**

This demonstration project would give WSDOT the opportunity to implement PCP technology on a section of I-90 east of Seattle in conjunction with a WSDOT Preservation (P1) project to expedite construction time and improve user cost benefits. The project would allow WSDOT to assess materials and construction specifications, design procedures, and to evaluate construction methods first hand before this technology is attempted on the more congested (higher risk) I-5 corridor. Financial assistance (pending approval) for this research will come from Federal Highway Administration’s (FHWA) Accelerated Innovation Deployment (AID) Demonstration program to accelerate implementation and adoption of proven innovation in highway transportation.

**RESEARCH TEAM:** JEFF UHLMAYER | LU SAECHAO | TO BE DETERMINED

**SCHEDULED START:** 2018 (PENDING FHWA AID PROGRAM APPROVAL)

### **Ground Penetrating Radar (GPR) to Determine Asphalt Mixture In-Place Density**

This research will acquire a ground penetrating radar (GPR) unit and compare it to the nuclear density gauge measurements on asphalt paving projects during the 2017 and 2018 construction season to determine the feasibility of replacing nuclear gauges with the GPR. Technology advancements in the area of GPR has shown the ability to measure the density of new asphalt pavements quickly and with better coverage than the nuclear density gauge (point test evaluation) currently used. The intent of this study is to determine if GPR can be used for quality assurance of freshly placed HMA pavement density. A shadow WSDOT specification would be developed to evaluate whether the results of the GPR are comparable to the densities from the nuclear gauge. If the trial projects are successful, the goal would be to integrate the GPR into the acceptance program for asphalt pavements in 2020. Funding assistance is provided from FHWA’s State Transportation Innovation Council Incentive (STIC) Incentive program to support or offset some of the costs of standardizing innovative practices in a state transportation agency.

**RESEARCH TEAM:** JEFF UHLMAYER | LU SAECHAO | WSDOT MATERIALS LAB

**SCHEDULED START:** 2017

### **Technology Transfer Concrete Consortium (TPF 5-313)**

This is a thirty-one state pooled fund led by the Iowa DOT. The purpose of this pooled fund project is to identify, support, facilitate and fund concrete research and technology transfer initiatives.

**RESEARCH TEAM:** JEFF UHLMAYER | LU SAECHAO | IOWA STATE UNIVERISTY

**SCHEDULED COMPLETION:** ONGOING

### **Recycled Materials Resource Center (RMRC) – 4th Generation (TPF -352)**

This is a six state pooled fund led by the Wisconsin DOT. The RMRC-4G pooled fund will focus on recycled bound materials (e.g., asphalt and Portland cement concrete), unbound materials (e.g., base, sub-base, structural fill), the highest and best use of these materials in transportation infrastructure, stabilization of materials using industrial byproducts (e.g. fly ash, lime, other binders) and other related research projects. Factors that affect long-term physical and environmental performance of recycled materials will be evaluated using scientific principles and applied research.

RESEARCH TEAM: DAVID JONES | LU SAECHAO | TO BE DETERMINED

SCHEDULED START: TO BE DETERMINED

## **SAFETY**

### **Advancing Multimodal Safety through Pedestrian Risk Reduction**

The project will develop pedestrian risk models for identifying pedestrian risk locations at urban & suburban locations throughout the WSDOT roadway network. The locations identified will be analyzed & potential contributing factors selected so lower cost pedestrian counter measures can be applied.

RESEARCH TEAM: JOHN MILTON & MIKE DORNFELD | JON PETERSON | TO BE DETERMINED

SCHEDULED COMPLETION: TO BE DETERMINED

### **Safe from Crime at Location-Specific Transit Facilities**

The overall goal of this project is to provide transit agency planners new data and tools for crime surveillance and prevention and to help them better protect transit riders on their way to and from the transit systems and while waiting for transit.

RESEARCH TEAM: ALAN SOICHER | JON PETERSON | ANNE VERNEZ-MOUDON & MARK HALLENBECK (UW)

SCHEDULED COMPLETION: 2018

### **Evaluation of Low Cost Safety Improvements Pooled Fund (TPF 5-317)**

Forty-Two states are involved in this pooled fund research effort that is being led by FHWA. The goal of this research is to develop reliable estimates of the effectiveness of the safety improvements that are identified as strategies in the National Cooperative Highway Research Program (NCHRP) Report 500 Guidelines. These estimates are determined by conducting scientifically rigorous before-after evaluations at sites in the U.S. where these strategies are being implemented.

RESEARCH TEAM: MIKE DORNFELD | DOUG BRODIN

SCHEDULED COMPLETION: ON GOING

### **Partnership for the Transformation of Traffic Safety Culture Pooled Fund (TPF 5-309)**

This eleven state partnership will support an integrated and multiyear program of research in a long-term effort to support the transformation of state and national traffic safety culture. This project will direct action research to measure, analyze, and help transform the cultural factors that influence the most common behavioral risk factors. The Montana Department of Transportation (lead state) is partnering with the Center for Health and Safety Culture (CHSC) within the Western Transportation Institute (WTI) at Montana State University to: (1) conduct research to solve specific culture-based traffic safety problems, (2) create training and education materials to enhance workforce understanding and application of traffic safety culture methods, and (3) provide technology transfer of best practices in traffic safety culture methods to



all stakeholders. Together, these efforts will support the transformation of traffic safety culture within the families, communities, and organizations of the participating states.

RESEARCH TEAM: MIKE DORNFELD | DOUG BRODIN

SCHEDULED COMPLETION: 2019

### **A Data Driven Safety Assessment of Various Left Turn Phasing Strategies**

The goal of this project is to assess the safety of different left turn movement treatments at signalized intersections using crash, video, and survey data. This project is jointly funded by PacTrans.

RESEARCH TEAM: TED BAILEY | DOUG BRODIN | ALI HAJBABAIE (WSU)

SCHEDULED COMPLETION: 2018

### **Roadside Safety Research for the Manual for Assessing Safety Hardware (MASH) Implementation (TPF 5-343)**

This is an eighteen state pooled fund research effort led by WSDOT. This research program will identify, analyze, and develop solutions for roadside safety problems with the goal of reducing the tremendous loss of life that occurs on our highways each year because of roadway departure crashes. Specific research activities addressed within the program will include the design, analysis, testing, and evaluation of roadside safety hardware, and the development of guidelines for the use, selection, and placement of these features.

RESEARCH TEAM: JEFF PETERSON | RHONDA BROOKS | TEXAS TRANSPORTATION INSTITUTE

SCHEDULED COMPLETION: ONGOING

### **Strategic Highway Research Program (SHRP) Naturalistic Driving Study Pooled Fund: Advancing Implementable Solutions (TPF 5-361)**

This is a new study led by FHWA that will support groundbreaking research using data from the second Strategic Highway Research Program (SHRP 2) Naturalistic Driving Study (NDS). The goal is to advance the development of implementable solutions for State and Local transportation agencies with an emphasis on the broad areas of Safety, Operations, and Planning. This will be a Federal Highway Administration (FHWA) led pooled fund with very active participation from member State and Local agencies to determine the research that is undertaken.

RESEARCH TEAM: JOHN MILTON | JON PETERSON | TO BE DETERMINED

SCHEDULED COMPLETION: ONGOING

### **Fostering Innovation in Pedestrian and Bicycle Transportation Pooled Fund Study (1441)**

This TPF study led by FHWA will supplement existing research and fill an important missing gap by emphasizing short turnaround practical research on issues immediately relevant to practitioners. It will address national goals and priorities identified through input from local, State, and national partners in FHWA's Strategic Agenda for Pedestrian and Bicycle Transportation.

RESEARCH TEAM: CHARLOTTE CLAYBROOK | JON PETERSON

SCHEDULED COMPLETION: ONGOING

## PRESERVATION

### Improved Methodology for Benefit Estimation of Preservation Projects

The objective of this research is to evaluate and analyze the current process for calculating preservation project benefits and to develop improved methods for this calculation.

RESEARCH TEAM: WENJUAN ZHAO | DOUG BRODIN | ERIC JESSUP (WSU)

SCHEDULED COMPLETION: 2017

## MAINTENANCE

### Clear Roads Phase II Pooled Fund (TPF 5-353)

This is a thirty-four state pooled fund research project led by Minnesota DOT. This new Clear Roads project will focus on advancing winter highway operations nationally through practical, practice-ready research related to materials, equipment and methods. State departments of transportation are aggressively pursuing new technologies, practices, tools, and programs to improve winter highway operations and safety while maintaining fiscal responsibility.

RESEARCH TEAM: JAMES MORIN | DOUG BRODIN | TO BE DETERMINED

SCHEDULED COMPLETION: ON GOING

### No Boundaries Roadway Maintenance Practices Pooled Fund (TPF 5-330)

This is a sixteen state pooled fund research effort led by Ohio DOT and provides a forum for State DOTs to share their maintenance innovations with each other, support technology transfer activities and develop marketing and deployment plans for the implementation of selected innovations. Resources will be provided for implementing the innovations that includes travel, training and other technology transfer activities.

RESEARCH TEAM: JAMES MORIN | DOUG BRODIN | CTC & ASSOCIATES AFTER DOUG BRODIN

SCHEDULED COMPLETION: ON GOING

### Avalanche Research Pooled Fund (TPF 5-337)

This is a five state pooled fund research project led by Colorado DOT. The study's mission is to support collaborative research efforts in the field of avalanche hazard assessment and mitigation, with the goal of improving the safety, efficiency, and quality of control efforts, along with providing better information gathering and analysis techniques and seamless integration of new technologies to further these goals.

RESEARCH TEAM: JAMES MORIN | DOUG BRODIN

SCHEDULED COMPLETION: 2019

### Implementing ShakeCast Across Multiple State Departments of Transportation for Rapid Post-Earthquake Response Pooled Fund (TPF 5-357)

This is a ten state pooled fund research effort led by California DOT (Caltrans). ShakeCast, short for ShakeMap Broadcast, is a fully automated system for delivering specific ShakeMap products to critical users and for triggering established post-earthquake response protocols. This collaborative effort will bring participating DOTs into full ShakeCast operation for post-earthquake assessment of state and local bridge inventories. The project will provide a mechanism to actively engage representatives from state DOTs with the common interests in implementing and expanding the application of ShakeCast technologies to improve emergency response capabilities.

RESEARCH TEAM: JOHN HIMMEL | DOUG BRODIN | U.S. GEOLOGICAL SURVEY

SCHEDULED COMPLETION: ON GOING

## Locally Sourced Renewable Additives for Infrastructure-Friendly Snow and Ice Control Operations

The objective of this research is to develop innovative anti-icing and pre-wetting formulations for snow and ice control on roadways, using locally-sourced agricultural wastes, fruit by-products and other bio-based additives for freezing-point suppression, performance enhancement, and infrastructure preservation.

RESEARCH TEAM: JAMES MORIN | DOUG BRODIN | XIANMING SHI (WSU)

SCHEDULED COMPLETION: 2017

## Statewide Road & Weather Information System (RWIS) Plan

This research will provide direction on future RWIS deployment, implementation and overall sustainment activities; determine a set of data and criteria for winter snow and ice fighting performance measurement; and provide accurate and timely roadway weather data to users and stakeholders. The cost of a typical RWIS station is \$60,000 and this project will ensure future deployment will be done in a strategic manner and RWIS assets are managed within the agency asset management plan.

RESEARCH TEAM: JAMES MORIN | DOUG BRODIN | NORTHWEST WEATHERNET INC.

SCHEDULED START: 2017

## Long Term Pavement Performance (LTPP) Forensics (Flexible Pavement) (TPF 5-332)

This is a four state project led by WSDOT. The intent is to investigate LTPP test sections as they prepare to go out of service, capturing data on exactly why the section failed and had to be removed from service. This may entail trenching and coring, measuring lift deflection, and potential lab testing of field samples for materials characteristics. The pooled fund will pay the costs to perform the forensic evaluation in the field and limited lab testing from field samples. Additional work will include building tracking lists of remaining sites, contacting states for updates on site status and planning action for sites about to go out of service.

RESEARCH TEAM: TOM BAKER | LU SAECHAO

SCHEDULED COMPLETION: TO BE DETERMINED

# TRAFFIC

## Maintenance of WSDOT/UW Travel Weather Information System

This research project provides the system software and hardware for the University of Washington to provide travel weather information for over 60,000 computer hits per day.

RESEARCH TEAM: JAMES MORIN | DOUG BRODIN | CLIFF MASS (UW)

SCHEDULED COMPLETION: 2017

## Light-Emitting Diode (LED) Adaptive Roadway Lighting on Interstate 5

This project, funded by a federal AID grant, examines the use of adaptive lighting as a means of reducing operating costs in a field test on I-5.

RESEARCH TEAM: TED BAILEY | DOUG BRODIN | WSDOT IN HOUSE

SCHEDULED COMPLETION: 2017

## Adaptive Roadway Lighting and Control

The objective of this project is to develop a WSDOT adaptive roadway lighting methodology. Specifically, this project will conduct research to evaluate the feasibility and value of controlling the roadway lighting system based on site and time specific characteristics (i.e. weather, traffic, and pavement marking conditions).

RESEARCH TEAM: TED BAILEY | DOUG BRODIN | YINHAI WANG (UW)

SCHEDULED COMPLETION: 2018

## DESIGN

### **Field Analysis of Wood Guardrail Post Decay**

This project builds upon the Phase 1 study and will utilize the stress wave device developed in Phase 1 to collect non-destructive, real time data about wood decay condition on wood guardrail posts. The information will be used to help improve wood guardrail design guidance.

RESEARCH TEAM: BRAD MANCHAS | DOUG BRODIN | ADAM PHILLIPS (WSU)

SCHEDULED START: 2017

## AVIATION

### **Aviation Emergency Response Airport Infrastructure Resource Manual**

This research will compile information related to the physical layout and infrastructure attributes of selected airports in Western Washington. This information is critical in case of a large earthquake so responders can get the airports up and running quickly to bring in needed supplies and emergency personnel in the event of a statewide emergency.

RESEARCH TEAM: JOHN MACARTHUR | JON PETERSON | TO BE DETERMINED

SCHEDULED START: 2017



## GOAL 2 - MODAL INTEGRATION

*Optimize existing system capacity through better interconnectivity  
of all transportation modes*

### CONNECTIVITY

#### **Use of Electronic Fare Transaction Data for Transportation Planning & Travel Demand Management**

This research project will utilize modern data analytics on electronic transit fare data in the Puget Sound Region to guide strategies for demand management and congestion reduction programs.

RESEARCH TEAM: ALAN SOICHER | JON PETERSON | MARK HALLENBECK (UW)

SCHEDULED COMPLETION: 2017

#### **Optimizing Bicycle and Pedestrian Counting in Washington State: A Guidebook**

This research develops a protocol and recommendations for WSDOT's community partners to help determine where automated bicycle/pedestrian counters should be located. The guidebook will also recommend how to conduct short-duration manual counts to maximize the accuracy in estimating annual average daily bicycle and pedestrian traffic.

RESEARCH TEAM: JON PETERSON | KRISTA NORDBACK (UNC) | MIKE LOWRY (IDAHO)

SCHEDULED COMPLETION: 2017

#### **Use of Electronic Transit Data for Multi-Modal Corridor Planning**

This project will focus on the use of multiple new data sources and tools in order to identify effective non-motorized improvements that can significantly increase transit use in the Interstate 5 (I-5) corridor. The data will then be used to revise the available multi-modal forecasting models in order to more accurately predict changing travel behavior in the region. These revised models will help guide the development of more effective multi-modal transportation plans.

RESEARCH TEAM: ALAN SOICHER | JON PETERSON | M. HALLENBECK & A. CASPI (UW)

SCHEDULED COMPLETION: 2017

### FREIGHT

#### **Implementing the Routine Computation and Use of Roadway Performance Measures with WSDOT**

This project will provide WSDOT with overall roadway performance measures that are specifically oriented toward truck freight movement.

RESEARCH TEAM: MONICA HARWOOD | DOUG BRODIN | MARK HALLENBECK (UW)

SCHEDULED COMPLETION: 2017

## TRAFFIC

### **HOV (High Occupancy Vehicle)/Managed Use Lane Systems Pooled Fund (TPF 5-322)**

This project is an eleven state pooled fund research effort lead by FHWA that is a continuation of a previous project. The goal of this study is to assemble regional, state, and local agencies, service providers, and FHWA to: (1) identify issues that are common among agencies that manage roadway lanes as a tool to reduce congestion and optimize facility usage; (2) suggest projects and initiatives to advance practice; (3) select and initiate projects intended to address identified issues; (4) identify recommendations and potential solutions, and (5) disseminate results.

RESEARCH TEAM: MARK LETH | DOUG BRODIN | TO BE DETERMINED

SCHEDULED COMPLETION: ONGOING

### **Transportation Management Center (TMC) Pooled Fund (TPF 5-319)**

This is a 20 state pooled fund research effort lead by FHWA. The goal of the TMC Pooled Fund is to assemble regional, state, and local transportation management agencies and the FHWA to (1) identify human-centered and operational issues; (2) suggest approaches to addressing identified issues; (3) initiate and monitor projects intended to address identified issues; (4) provide guidance and recommendations and disseminate results; (5) provide leadership and coordinate with others with TMC interests; and (6) promote and facilitate technology transfer related to TMC issues nationally.

RESEARCH TEAM: VINH DANG | DOUG BRODIN

SCHEDULED COMPLETION: 2020

### **Support and Align Operational and Demand Strategies and Business Process with Planning & Programming with WSDOT**

This research project will help to change the WSDOT culture into one that more effectively integrates Transportation System Management and Operations strategies into the planning and programming process in a multidisciplinary way.

RESEARCH TEAM: MONICA HARWOOD | DOUG BRODIN | MARK HALLENBECK (UW)

SCHEDULED COMPLETION: 2017

### **Urban Mobility Pooled Fund (TPF 5-198)**

This is a 14 state pooled fund research project led by Texas DOT. The objectives of the pooled fund are: 1) Form a steering committee, which will decide on the congestion reduction methods to include in the new methodology and which cities will be included in study; 2) Continuously refine the Congestion Index to include multimodal operations or regional operational improvement programs (i.e., ITS service, incident detection and response, travel demand management, transportation systems management, and computerized signal control coordination); 3) Maintain existing congestion measures; 4) Add additional urban areas; and, 5) Respond to requests for mobility data.

RESEARCH TEAM: DANIELA BREMMER | DOUG BRODIN | TEXAS TRANSPORTATION INSTITUTE

SCHEDULED COMPLETION: ONGOING



## GOAL 3 - ENVIRONMENTAL STEWARDSHIP

*Promote sustainable practices to reduce greenhouse gas emissions and protect natural habitat and water quality*

### SUSTAINABILITY

#### **Stormwater Testing and Maintainability Center (STTC) Pooled Fund (TPF 5-355)**

This is a three state pooled fund led by the Oregon Department of Transportation. The STTC will verify the maintainability performance characteristics and costs of innovative commercial-ready stormwater treatment technologies that have the potential to improve protection of water quality and the environment. STTC will provide designers, owners, and permittees of stormwater treatment technologies with an independent and credible assessment of the technology they are purchasing or permitting. The STTC will also have the capability to test three technologies simultaneously for compliance with the Washington Department of Ecology's Technology Assessment Protocol – Ecology (TAPE) guidelines.

RESEARCH TEAM: FRED BERGDOLT | JON PETERSON | OREGON DOT

SCHEDULED COMPLETION: 2018

#### **Near Road Air Quality Research Pooled Fund (TPF 5-284)**

This research project is a \$1.5 million pooled fund involving seven states and FHWA with WSDOT as the lead. The project is looking at new federal regulations that require state and local agencies to monitor near-roadway emissions and quantitatively assess potential for air quality impacts ("hot-spots"). This project is a unique venue for collaboration between state DOTs and FHWA to clarify near-road emissions challenges, prioritize research needs, discourage redundant individual state efforts, and to quickly initiate research that develops solutions that meet the needs of multiple states.

RESEARCH TEAM: KARIN LANDSBERG | JON PETERSON | SONOMA TECHNOLOGY

SCHEDULED COMPLETION: 2018

#### **Underwater Noise Attenuation Experimental Methods Pooled Fund (TPF 5-323)**

This is a four state research effort led by WSDOT. For several years concern over the impact of underwater noise from construction pile driving has created regulatory challenges, as well as influenced construction practices and schedules. New methods to attenuate the underwater sound are needed to protect species in marine and estuarine waters and to provide new methods and processes to efficiently drive piles for overwater structures.

RESEARCH TEAM: MARION CAREY | JON PETERSON | TO BE DETERMINED

SCHEDULED COMPLETION: 2018

#### **Highway Stormwater Runoff – Steep Slopes Phase 2**

This study will measure infiltration of highway runoff into embankment side slopes to develop a more accurate method for estimating saturated hydraulic conductivity (Ksat). Currently, water loss by infiltration between the highway pavement edge and toe of slope is not accounted for. An accurate and cost effective method for estimating Ksat rates and water losses on highway embankments will minimize over designing (oversizing) stormwater best management practices (BMPs), reducing project cost and minimizing environmental impacts. Geotechnical and surface flow data collected from project sites will be used to

model the water losses due to infiltration and ultimately development of a stormwater module in MGSFlood for designers to use in sizing stormwater BMPs.

RESEARCH TEAM: ALEX NGUYEN & FRED BERGDOLT | LU SAECHAO | WSDOT IN-HOUSE

SCHEDULED COMPLETION: ONGOING

### **Design Guidance and Long-Term Monitoring of Flow Deflection Structures**

This research investigates the characteristics of the SR 20 Skagit River flow-deflection structures, known as engineered logjams (ELJ), in order to develop hydraulic design guidelines for in water deflection structures. The ultimate goal of this research is to develop scour (removal of sediment) equations for gravel bed rivers to be utilized in predicting scour that adversely impacts bridges, culverts and adjacent highways in or near Washington Rivers.

RESEARCH TEAM: GARRET JACKSON / LU SAECHAO / THANOS PAPANICOLAOU (UNIVERSITY OF TENNESSEE)

SCHEDULED COMPLETION: 2018

### **Sustainable Design Guidelines to Support the Washington State Ferries (WSF) Terminal Design Manual: Mechanisms involved in the Removal of Heavy Metals from Stormwater via Lignocellulose Filtration Media**

This research aims at providing sustainable design guidelines for Washington State Ferry terminals, specifically the use of Lignocellulosic (plant dry matter such as wood crumbles) materials as an effective filtration media to remove stormwater pollutants. Laboratory and field scale continuous flow column studies were performed on raw and torrefied Douglas-fir Crumbles, charcoal (biochar), and pea gravel to evaluate their effectiveness for adsorbing soluble forms of copper and zinc. Media filtration BMPs provide the flexibility and small treatment footprint needed for retrofit applications that are space limited, such as ferry terminal staging areas. The overall goal of this proposed project is to provide a mechanistic understanding on the interactions of copper and zinc with raw wood crumbles and to help in predicting the longevity of the filter media at the ferry terminal test sites.

RESEARCH TEAM: TOM BERTUCCI | LU SAECHAO | I. CHOWDHURY & M. WOLCOTT (WSU)

SCHEDULED COMPLETION: 2017

### **Toolkit for Deployment of Alternative Vehicle and Fuel Technologies Pooled Fund (TPF 5-331)**

This is an eight state pooled fund research effort led by Oregon DOT. The objectives of this project are twofold: (1) implementation of 8-10 regional/topic-based workshops for state and local transportation agencies, their state counterparts and stakeholders to discuss the current status of alternative vehicle and fuels technologies in their specific region; and, (2) development of a “toolkit” for state and local transportation agencies who are interested in advancing the deployment of alternative vehicle and fuels technologies. The toolkit will be tailored to the specific needs of each region.

RESEARCH TEAM: TONIA BUELL | DOUG BRODIN

SCHEDULED COMPLETION: 2018

### **Design of Coarse Bands and Channel Shape for Stream Simulation Culverts**

This study will evaluate the hydraulic performance and sediment transport characteristic of stream beds containing coarse bands of different layouts, cross section geometries, and grain size distributions. The study will consist of a survey of design practices for stream simulation culverts and mobile bed laboratory flume



experiments. WSDOT is required by a Federal Court injunction to fix a significant number of fish blocking culverts in Western WA and this research will provide a science based design criteria for stream channel bed designs that require installation of coarse bands.

RESEARCH TEAM: JULIE HEILMAN | LU SAECHAO | TO BE DETERMINED

SCHEDULED START: 2017

### **Performance Effectiveness of a Modified Vegetated Filter Strips (VFS) BMP using a Compost-blanket Application**

This project will evaluate the stormwater treatment performance of a modified-VFS (3-inch compost-blanket application) compared to a standard compost-amended VFS (CAVFS) installation. This research may show the potential advantages in terms of safety and performance of the modified-VFS. If successful, a new Low Impact Development (LID) tool will be available in the WSDOT Highway Runoff Manual for state and local transportation agencies to use for mitigating stormwater water runoff.

RESEARCH TEAM: FRED BERGDOLT | LU SAECHAO | WSDOT IN-HOUSE

SCHEDULED START: 2018

### **Ferry Vessel Propeller Wash Effects on Scour at Terminal Structures**

Recent studies have shown an alarming trend of scour at various ferry terminals due to vessel propeller wash. This research will measure vessel propeller wash and its dissemination through the water towards the soil around structures. The research will produce guidelines & modeling techniques for estimating the effects of prop wash onto the surrounding soils & how to account for scour over the design life of the terminal structure.

RESEARCH TEAM: CHRIS STEARNS | JON PETERSON | PETER MACKENZIE-HELNWEIN (UW)

SCHEDULED COMPLETION: TO BE DETERMINED

### **Development of Case Pile Wave Analysis Program (CAPWAP) and Wave Equation Analysis of Pile Driving (WEAP) for Double Piles**

A double-walled pile was developed by the University of Washington with funding from WSDOT to decrease the total noise transmitted into the water and substrate during construction. Two field tests were performed using this technology at Commencement Bay and Vashon Island. Pile Driving Analyzer (PDA) data collected from both the inner and outer tubes of the mandrel and double piles during the two field tests will be used to modify existing commercial software for predicting drivability and stresses in the piles (WEAP analysis) and for estimating load capacity after driving (CAPWAP analysis).

RESEARCH TEAM: TOM BERTUCCI | JON PETERSON | PER REINHALL (UW)

SCHEDULED COMPLETION: 2017

### **Optimizing Public Investments in the Electric Vehicle (EV) Charging Infrastructure**

Washington is planning to invest public funds in Direct Current Fast Charging (DCFC) infrastructure over the next 5 years, through the EV Infrastructure Pilot Program. However, this funding is limited and DCFC stations are expensive, so public investments must be made where they can generate the biggest impact on EV adoption and travel. This research will help WSDOT to prioritize investments of funds from the EV Infrastructure Pilot Program.

RESEARCH TEAM: TONIA BUELL | DOUG BRODIN | DON MACKENZIE (UW)

SCHEDULED COMPLETION: TO BE DETERMINED

### **National Hydraulic Engineering Conference (TPF 5-365)**

The purpose of this pooled fund led by FHWA is to hold three hydraulic engineering conferences (2018, 2020, & 2022) for collaboration, technology deployment, and best practice information sharing among transportation hydraulic engineers and practitioners to improve the state of the practice of transportation hydraulic engineers and practitioners.

RESEARCH TEAM: JULIE HEILMAN | LU SAECHAO | FHWA

SCHEDULED COMPLETION: 2022

## **WILDLIFE AND SPECIES PROTECTION**

### **I-90/Snoqualmie Pass Wildlife Monitoring**

This research effort is led by Central Washington University and is monitoring new bridges and culverts recently built for the I-90 Snoqualmie Pass project to identify fish, amphibian and wildlife populations and use of the new structures by these populations.

RESEARCH TEAM: MARK NORMAN | JON PETERSON | STEVE WAGNER, KRIS ERNEST, PAUL JAMES (CWU)

SCHEDULED COMPLETION: ONGOING

### **Preventing Animals from Accessing the Highway at Intersecting Roadways**

This research project will inform WSDOT whether electrified concrete is effective, and, represents a new tool for reducing wildlife-vehicle collisions and increasing the ecological sustainability of the highway system. This new tool would possibly replace the old cattle guard type of animal exclusion system that is not effective for all animals.

RESEARCH TEAM: MARION CAREY & KELLY MCALLISTER | JON PETERSON | TO BE DETERMINED

SCHEDULED COMPLETION: TO BE DETERMINED

### **Modeling Environmental Factors Affecting the Frequency of Wildlife-Vehicle Collisions in the Methow Valley to Inform Engineering Solutions**

This research is looking at deer vehicle collisions on a stretch of State Route 20 that runs through the Methow Valley. The objectives are: 1) to determine the environmental factors associated with the frequency of deer-vehicle collisions; 2) expand our understanding about why these collisions are occurring; and 3) provide management recommendations to reduce the frequency of deer-vehicle collisions.

RESEARCH TEAM: PIPER PETIT | JON PETERSON | JEFFREY MANNING (WSU)

SCHEDULED COMPLETION: 2018

### **TPF-5(358) Wildlife Vehicle Collision Reduction & Habitat Connectivity (TPF 5-358)**

This is an eight state project led by the Nevada DOT. The scope of the project is proposed to include the following items: 1) Develop, select and provide support for priority research of new wildlife mitigation solutions, 2) Explore and encourage collaboration for research and implementation of wildlife mitigation measures by state DOTs, land management agencies, wildlife agencies and their partners, and 3) Convene an annual meeting of the Pooled Fund's Technical Advisory Committee and invited guests.

RESEARCH TEAM: MARION CAREY | JON PETERSON | TO BE DETERMINED

SCHEDULED COMPLETION: ONGOING



## GOAL 4 - ORGANIZATIONAL STRENGTH

*Support a culture of multi-disciplinary teams, innovation and people development through training, continuous improvement and Lean efforts*

### BEST PRACTICES

#### Library Digitization Project

Older and historically significant publications from WSDOT and its predecessor agencies have been identified for digitization to improve access and preserve the original documents. Digital versions of these documents will be widely available and searchable. Also, with the availability of digital versions, the original reports will be handled less frequently so they will deteriorate at a slower rate.

RESEARCH TEAM: JEFFREY WINTERS | MICHEL WENDT

SCHEDULED COMPLETION: 2019

#### Transportation Research Program Management Database (TPF 5-181)

This is a seven state pooled fund lead by WSDOT to examine the best practices to manage research projects and associated databases.

RESEARCH TEAM: LENI OMAN | JON PETERSON | SPY POND PARTNERS

SCHEDULED COMPLETION: 2017

#### Practical Solutions

This federal grant provides WSDOT resources to utilize LEAN methodology to streamline processes and knowledge management practices for selected transportation project development and management.

RESEARCH TEAM: LENI OMAN & MUSTAFA MOHAMEDALI | JON PETERSON

SCHEDULED COMPLETION: 2017

### CONTINUOUS IMPROVEMENT

#### Commute Trip Reduction (CTR) Survey Processing Data Capturing and Reporting

The CTR law requires participating worksites to measure employee commute behavior every 2 years to determine their progress toward CTR goals. The University of Washington processes the survey responses so that the data may be analyzed on various mobility options.

RESEARCH TEAM: MICHAEL WANDLER | JON PETERSON | DEBORAH SMITH (UW)

SCHEDULED COMPLETION: ON GOING

#### Western Alliance for Quality Transportation Construction (WAQTC) Pooled Fund (TPF 5-349)

This is a six state pooled fund research effort lead by the Utah DOT. The Western Alliance for Quality Transportation Construction (WAQTC) is a partnership of western state and federal highway agencies in cooperation with industry associations. This organization was formed to assure qualified personnel for the

transportation construction workforce as well as act as a unified body to meet today's challenge of improving the transportation products and services that we provide to the public. WAQTC is focused in three main areas: Standardizing test methods (WAQTC, AASHTO, and ASTM), accreditation of the Transportation Technician Qualification Program (TTQP), and working together on national programs of significance including research, training, and technology deployment. This pooled fund will continue the development and refinement of the TTQP, including maintaining and revising the six existing WAQTC TTQP training and certification courses in coordination with member state agencies, distributing training materials, including training manuals, PowerPoint presentations, and written and practical exams, to member states; maintaining the WAQTC website; and developing and presenting proposed revisions and new standards to the AASHTO Subcommittee on Materials. <http://www.waqtc.org/>

**RESEARCH TEAM:** KURT WILLIAMS | LU SAECHAO | TO BE DETERMINED

**SCHEDULED COMPLETION:** ON GOING

### **Highway Safety Manual (HSM) Implementation Pooled Fund (TPF 5-255)**

This is a twenty state pooled fund research project led by FHWA. The objectives of the study are (1) to advance ongoing efforts by lead states to implement the HSM, and (2) to expand implementation to all states. This study would be coordinated with other ongoing and planned implementation activities sponsored by the American Association of State Highway & Transportation Officials (AASHTO), FHWA, and Transportation Research Board (TRB), including National Cooperative Highway Research Program (NCHRP) Project 17-50 "Lead States Initiative for Implementing the Highway Safety Manual"

**RESEARCH TEAM:** JOHN MILTON | JON PETERSON

**SCHEDULED COMPLETION:** 2019

### **National Accessibility Evaluation Pooled Fund (TPF 5-315)**

This is a ten state pooled fund led by the Minnesota Department of Transportation. This project has two main objectives. First, it will create a new, national Census block-level accessibility dataset that can be used by partners in local transportation system evaluation, performance management, planning, and research efforts. Second, it will produce and publish a series of annual reports describing accessibility to jobs by driving and by transit in metropolitan areas across America.

**RESEARCH TEAM:** ELIZABETH ROBBINS | JON PETERSON

**SCHEDULED COMPLETION:** 2019

## COLLABORATION

### **Western States Rural Transportation Consortium (WSRTC) Pooled Fund (TPF 5-241)**

This is a four state pooled fund project led by WSDOT. The purpose of the WSRTC is to promote innovative partnerships, technologies and educational opportunities to facilitate and enhance safe, seamless rural travel throughout the western United States. The WSRTC also provides a collaborative mechanism to leverage research activities in a coordinated manner to respond to rural transportation issues among western states related to technology, operations and safety.

**RESEARCH TEAM:** RON VESSEY | DOUG BRODIN | DOUG GALARUS (WESTERN TRANSPORTATION INSTITUTE AT MONTANA STATE UNIVERSITY)

**SCHEDULED COMPLETION:** 2020

## Western Maintenance Partnership Pooled Fund (TPF 5-312)

This is an eight state pooled fund project led by Utah DOT. The participating agencies provide a focused look at maintenance, and will partner with the Western Association of State Highway Transportation Officials (WASHTO) states to share experiences, innovations, expertise and solutions to the complex management of highway assets. Maintenance issues include policies, practices, specifications, field investigations, applied research, materials, and training. It is expected that a roundtable and sharing of field experience via hands on demonstration of features will be key elements of the annual meetings.

RESEARCH TEAM: JAMES MORIN | DOUG BRODIN

SCHEDULED COMPLETION: ONGOING

## INTERNSHIPS

### Northwest Region Traffic Management Center Intern Program

This project supports internships for University of Washington students at the NW Region Traffic Management Center (TMC) who, under the supervision of WSDOT engineers, operate the freeway systems in central Puget Sound controlling ramp meters, assisting in incident identification with closed circuit television cameras, and informing the traveling public with variable message signs, highway advisory radio and traffic condition update reports.

RESEARCH TEAM: CHRIS THOMAS | DOUG BRODIN | SCOTT RUTHERFORD (UW)

SCHEDULED COMPLETION: ONGOING

### Toll Division Intern Program

This effort supports internships for UW students, who under the supervision of WSDOT engineers, assist in collecting, storing and process data related to the operation of the WSDOT Toll facilities.

RESEARCH TEAM: TYLER PATTERSON | DOUG BRODIN | SCOTT RUTHERFORD (UW)

SCHEDULED COMPLETION: ONGOING

### Research Intern Program

College students and/or recent graduates are employed to conduct short-term research projects for various programs throughout WSDOT. The program provides professional work experience for students interested in transportation. It also provides WSDOT managers with research results from the collecting and analyzing of information by the interns to assist in decision making on transportation related issues.

RESEARCH TEAM: RHONDA BROOKS | DOUG BRODIN | LU SAECHAO | JON PETERSON

SCHEDULED COMPLETION: ONGOING



## GOAL 6 - SMART TECHNOLOGY

*Improve information system efficiency to users and enhance service delivery by expanding the use of technology*

### TRAFFIC

#### **Research Program to Support the Research, Development, and Deployment of System Operations Applications of Vehicle Infrastructure Integration (VII) Pooled Fund (TPF 5-206)**

This is an eighteen state and FHWA pooled fund project led by Virginia DOT. This pooled fund study will focus on the following:

- Development and evaluation of Connected Transportation Systems large-scale system level operations applications
- Independently research and address issues that will affect the deployment of Connected Vehicle systems by state and local transportation agencies
- Support AASHTO's Strategic and Deployment Plans
- Support USDOT's Connected Vehicles Programs and initiatives

**RESEARCH TEAM:** TED BAILEY | DOUG BRODIN | MULTIPLE CONTRACTORS

**SCHEDULED COMPLETION:** 2020

#### **Connected Vehicles and Smart Cities**

This research project will serve as a pilot study in the application of Connected Vehicles technology and will support WSDOT's efforts to transition to the future of data infrastructure.

**Research Team:** Ted Bailey | Doug Brodin | Yin Hai Wang (UW)

**SCHEDULED COMPLETION:** TO BE DETERMINED

#### **Northwest Passage Pooled Fund (TPF 5-190)**

This is an eight state pooled fund lead by Minnesota DOT. The research project coordinates, develops and deploys Intelligent Transportation Systems (ITS) along the I-90 and I-94 corridor. The long-term goal of the study is to utilize effective methods for sharing, coordinating, and integrating traveler information across state borders and to influence ongoing standards developments.

**RESEARCH TEAM:** RON VESSEY | DOUG BRODIN | MULTIPLE CONTRACTORS

**SCHEDULED COMPLETION:** 2018

#### **Traffic Office Support**

This research effort will provide analytical assistance and data resources to the various WSDOT groups at the requests of the Headquarters Traffic Office. The assistance will take the form of analytical results (data, graphs, presentation materials, and reports) produced the UW TRAC office.

**RESEARCH TEAM:** TED BAILEY | DOUG BRODIN | MARK HALLENBECK (UW)

**SCHEDULED COMPLETION:** 2017

## **Enhancing Roadway Safety Using Real-Time Dedicated Short Range Communications (DSRC) Messaging in the Connected & Autonomous Vehicles Context**

This is a pilot research project to realize and assess the opportunities and potential benefits associated with DSRC-enabled warning systems. Advances in DSRC technology provide WSDOT with an incredible opportunity to reconsider how we can make intersections safer and warn drivers of potential hazards. Implementation of DSRC in applications to improve safety will allow WSDOT to maintain a competitive edge as the era of connected and autonomous vehicles is increasingly realized.

RESEARCH TEAM: TED BAILEY | DOUG BRODIN | YINHAI WANG (UW)

SCHEDULED COMPLETION: 2019

## **Preparing for Traffic Signal Operations in a Multi-modal Connected and Autonomous Vehicle Environment**

Connected and Autonomous Vehicle (CAV) technology and information may greatly help reduce congestion, especially in urban settings. However, there is no real-time, reliable, and multimodal approach to control the timing of signalized intersections in a connected or semi-connected arterial street or urban street network to date. It is important to plan for this emerging and revolutionary technology and develop methodologies that can use the additional information CAVs provide to improve traffic operations.

RESEARCH TEAM: TED BAILEY | DOUG BRODIN | ALI HAJBABAIE (WSU)

SCHEDULED COMPLETION: 2019

## **Open Sidewalks: Standardizing and Maintaining Sidewalk Connectivity Data for Accessible Trip Planning**

This research will produce high quality, high granularity sidewalk map data & automate the process of identifying the connectedness of a sidewalk segments, with an initial goal of improving automatic routing services for pedestrians. This project will fill a longstanding gap about key roadway attributes associated with sidewalks.

RESEARCH TEAM: ALLEN SOICHER | JON PETERSON | ANAT CASPI (UW)

SCHEDULED COMPLETION: TO BE DETERMINED

## **Enhancing Traffic Incident Management**

In collaboration with the Mobility Innovation Center (MIC), the Center for Collaborative Systems for Security, Safety, and Regional Resilience (CoSSaR) at the University of Washington (UW) is conducting research that will take a foundational step towards the design and delivery of an enhanced traffic incident management (TIM) system and related services for the Washington State Department of Transportation (WSDOT) and the city of Seattle. In the larger scheme, these services will enhance the capabilities of traffic managers, first responders and others involved in traffic incident management to take actions to prepare for, cope with and recover from traffic congestion and associated delays.

RESEARCH TEAM: RON VESSEY | DOUG BRODIN | MARK HASELKORN (UW)

SCHEDULED COMPLETION: 2017

## USER FEES

### Western Road Usage Charging Consortium (WRUCC) Pooled Fund (TPF 5-288)

This is a fourteen state pooled fund project led by Oregon DOT. This project conducts collaborative research and explores the development of a potential new transportation funding method that would collect a road usage charge (RUC) from drives based on actual road usage. The goals of the WRUCC are to foster competition providing RUC services allowing for motorist choice; compatibility with readily available and affordable consumer products and technologies; and achieve the primary purpose of collecting taxes to fund roadway maintenance and improvement, and allow for each state's needs.

RESEARCH TEAM: ANTHONY BUCKLEY | DOUG BRODIN

SCHEDULED COMPLETION: ONGOING

### Miles Based User Fee (MBUF) Pooled Fund (TPF 5-289)

This is a three state pooled fund project led by Minnesota DOT. The objective this project is to learn and begin coordinating efforts with respect to the MBUF concept. Up to now, coordination between states has been difficult. Several states have conducted their own research and demonstration projects and some states have expressed interest in just learning more about the topic.

RESEARCH TEAM: ANTHONY BUCKLEY | DOUG BRODIN

SCHEDULED COMPLETION: ONGOING

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