# Research, Development, and Technology Transfer (T2) Program

**Annual Report**
2015

Oregon Department of Transportation

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# Introduction

## Who We Are

The goal of the Research Section is to foster innovation within the Oregon Department of Transportation (ODOT) by researching, developing, testing, and evaluating new and innovative transportation products, materials, methods, and processes.

Research and development has been an integral part of our business for nearly a century. The Federal Aid Highway Act of 1921 created the Research and Technology program within what is now the Federal Highway Administration (FHWA). The same bill earmarked resources to create what would become the Highway Research Board (now the Transportation Research Board - TRB) within the National Academy of Sciences.

Section 11 of the Hayden Cartwright Act of 1934 laid groundwork for the Highway Planning and Research (HP&R) program in all state departments of transportation by designating that "*1/2 per centum of the amount apportioned for any year to any State...may be used for surveys, plans, and engineering investigations....*"

Largely because of the HP&R (later SP&R) program, research has been an integral activity at ODOT and in most other states for nearly 50 years.

Historically, research efforts in ODOT have been primarily focused in areas relating to highway materials and construction. Only to varying degrees have these activities been distinct from other engineering and testing work done within ODOT's materials laboratory. In fact, until sometime in the 1980s, the titles of the State Materials Engineer and the State Research Engineer were held by the same person.

The agency's transition from a Highway Department to a Department of Transportation in 1969 and the Inter-modal Surface Transportation Efficiency Act of 1991 have brought about a gradual diversification of ODOT's research agenda. Research has changed from a focus on highways and construction materials to a much broader agenda that includes a greater diversity of highway topics as well as other modes of surface transportation. In 1996 the Research program was moved from the Highway Division to the Transportation Development Division, in part to consolidate administration of the SP&R program, but also to better serve a broader customer base within the agency.

Since that time, the Research Section has expanded, diversifying its research projects to include the following general categories:

- Maintenance and Operations;
- Hydraulics, Geotechnical, and Environmental;
- Active and Sustainable Transportation;

- Planning and Economic Analysis;
- Construction, Pavements, and Materials;
- Traffic, Safety, and Human Factors;
- Structures:
- Emerging Issues.

The ODOT Research Section oversees transportation research projects and, through the Technology Transfer (T2) Center, provides transportation-related information to local agencies throughout Oregon. The mission of the section is to contribute to improvement in the performance of the transportation system by studying ways to enhance processes, methods, or materials in use. The section also works with technical experts and agency personnel to support research implementation.

The staff includes the Research Manager, the T2 Center Director, the T2 Center Training Coordinator, eight research coordinators, an executive support assistant, three part-time trainers, and a limited duration, part-time Safety Circuit Rider.

## The Way We Do Business

ODOT research projects seek to address identifiable problems or issues with the goal of providing significant benefits to the department by: reducing costs, increasing efficiency, addressing environmental concerns, enhancing safety, improving productivity, improving the mobility of Oregonians, or providing better service.

Transportation problems or issues may be identified by anyone and are formally presented to the Research Section as *problem statements*. Each year these statements are reviewed by the section and other agency personnel to determine priorities for projects. Top projects receive research funding in order of priority.

The majority of direct funding for ODOT research projects is provided by the FHWA State Planning and Research (SPR) Program, Part 2. In recent years, a small portion of SPR planning funds have also been utilized. A few additional projects are financed entirely using state highway funds. Indirect costs, including facilities, office supplies and equipment, employee training, utilities, etc. are also paid for with state funds.

Project collaboration is an important element of the research program, and most research projects involve many levels of collaboration, not just funding. A small percentage of ODOT research projects are conducted in-house by Research Section staff. The section more often works with external principal investigators, most frequently those affiliated with universities. While the majority of research is performed by an outside organization, Research Section staff provide management and coordination services. Project coordination involves collaboration between the principal investigator, other researchers, and technical specialists within the agency. The project coordinator manages a technical advisory committee, composed of knowledgeable individuals from FHWA, ODOT, other state agencies, and the private sector.

## Organization of This Report

The main body of this report is organized as follows. The second chapter, “Completed and Ongoing Projects” summarizes important completed or continuing research projects. The following chapter, “Other Research Activities,” reports on other accomplishments, including

information about project selection, small projects, and various ongoing responsibilities. “Publications, Activity, and Spending” summarizes completed and continuing projects in tabular form, along with a budget and expenditures summary.

Appendix A details the Research Advisory Committee and Expert Task Groups, including each one’s research priorities and membership. A list of abbreviations is provided as Appendix B at the end of this document.

There are many names and organizations listed throughout the report. When these names or organizations are first mentioned, the full name will be used, and abbreviations appear mostly thereafter.

Length limitations preclude an in-depth description of every research project. Instead, the focus of this report is on projects of general interest, representative of a range of topics, and expected to be of the highest value to ODOT.

If you have questions about the contents of this report or about any aspect of research at ODOT, please feel free to contact the Research Section as follows:

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Figure 1 - Hess creek bridge construction

## MICHAEL BUFALINO
## ODOT RESEARCH SECTION

2015 was a busy year for the Research Section. Our accomplishments range from the ongoing work of conducting research to managing special requests and providing our expertise throughout the agency and state. We have supported a major ILT initiative to position Oregon to transition to a future of connected autonomous vehicles, managed projects for the highway division regarding work-zone safety, provided library reference services, and extended the tribal outreach of the technology transfer program.

This report does not sufficiently highlight the hard work and talents of the research staff. Each research project is the result of hours of contract negotiation, advisory committee meetings, field observations, data collection, paper reviews, and editing on the part of the ODOT Research Section staff. It is because of the hard work of this diverse group of professionals that the research program consistently produces high quality reports that serve as an example of what transportation research can be. This past year has seen an increase in staff efforts to support research implementation with follow-up work on the ORcycle software app and work-zone safety analysis. Ongoing and dedicated outreach by our research coordinators has brought in new partners and re-invigorated old relationships. We have just started our first research for ODOT facilities and initiated new work for the Rail division. It is the hard work of the people of ODOT that make the research program a success, and I want to thank our RAC, ETGs, TACs, and most of all the staff of our section for a job well done!

All this hard work takes place in the context of a rapidly advancing national transportation research endeavor. To make sure the work of the agency is integrated into the national arena we coordinate with our UTCs, Federal partners, other states, the Transportation Research Board, and the American Association of Highway and Transportation Officials. This coordination has included conducting a peer exchange with several other states focused on aligning research with the goals of the agency and specifically with the implementation of the Intermodal Oregon program. We participated in the TRB annual meetings to help coordinate the national research agenda, and Oregon hosted the 2015 AASHTO Research Advisory Committee and TRB State Representatives summer meetings in Portland, providing Oregon transportation professionals access to the research management of the other states. Oregon also coordinated with the FHWA on a review of the SPR part B program and then helped disseminate the findings of this review to the other states to help improve the administration of the SPR program.

The dual effort of strong staff work and national integration has resulted in high quality and effective research being delivered by the ODOT Research Section.

# Completed and Ongoing Projects

## Completed Projects

### SPR 756 – Improved Safety Performance Functions for Signalized Intersections in Oregon

Due to the high percentage of crashes occurring at signalized intersections, considerable attention is given to selecting improvements that result in the greatest reduction in crashes for dollars invested.

This research project developed more reliable ways to assess signalized intersection safety in Oregon, allowing ODOT and other agencies to allocate funding toward effective intersection safety configurations for both new and existing facilities. To do this, signalized intersection safety performance functions were developed that explicitly consider approach speed as a direct input in safety assessment of the location.

The HSM includes Safety Performance Functions (SPFs) to assess options for improving the safety of intersections. These are equations that use traffic volumes and other factors to predict crash reductions for various types of improvements. Since the SPFs do not allow for certain features, such as turn lanes and lane widths, Crash Modification Factors (CMFs) can then be used to adjust the results of the equations to allow for these factors. Prior to this project, these tools did not include consideration of approach speeds, which are known to affect the frequency and severity of crashes.

The initial predictive models upon which the HSM procedure was based focused on rural, two-lane highways, and the approach speed at those intersections was not deemed to be significant. This foundation work was then used to define the SPF format for future models for the first edition of the HSM, so speed was inadvertently excluded in subsequent studies.

The ability to reliably predict the expected signalized intersection safety performance enables transportation professionals to make informed decisions about anticipated safety tradeoffs at these intersections. Use of this information is expected to result in enhanced intersection safety and improved decision making tools for Oregon transportation professionals.

This research provides safety performance functions that can be used by various regional transportation agencies, including ODOT and local jurisdictions. These values are included in the final project report and a technical memorandum available for distribution. The final report also includes guidance for the use of the SPFs and recommended techniques for the effective estimation of minor road travel volume values that previously were often not readily available.

### SPR 771 – Risk Factors Associated with High Potential for Serious Crashes

Crashes are random events and, consequently, can occur at any location along the roadway. On roadways with higher traffic volumes, the more frequent occurrence of crashes allows for the identification of high crash locations using historical data. However, on local roads,

crash occurrence is less frequent, making it difficult to identify trends and treat hazardous sites using historical data.

Geometric, traffic, and other features may contribute to crashes in spot locations. Therefore, an approach to identifying these types of risk factors on low volume roads was necessary to reduce the number and severity of highway crashes and improve highway safety.

The primary benefit from this research is the identification of risk factors and features associated with increased crashes on low volume roads. Past studies have examined the various features that contribute to crashes; however, those efforts have focused on individual features rather than how the entire roadway environment—comprised of numerous features interacting with one another—can increase the risk of crashes. Consequently, by identifying risk factors and features for low volume roads, this research benefits practitioners by providing an approach to reviewing such roads for potential locations where low cost improvements might be made to proactively address safety issues.

An additional benefit of the research is that it provides guidance on how to address risk factors and features in a proactive manner to reduce crashes on low volume roads. This allows for a methodology to be used in the field by local staff throughout the state to identify potential locations where specific features and factors may contribute to crashes. They can then begin to identify low cost improvements that can be programmed into annual budgets and work plans.

## SPR 742 – Understanding and Mitigating Effects of Chloride Deicer Exposure on Concrete

ODOT's primary deicing chemical is magnesium chloride. It is widely known that chloride ions from deicing chemicals can cause corrosion damage to the steel in reinforced concrete bridge elements. However, there has been evidence that magnesium chloride may also damage concrete.

This project investigated the exposure of Oregon's bridges to magnesium chloride deicer, whether the deicer is causing concrete damage, and surface treatments to mitigate bridge deck damage. The project developed a method to map deicer exposure and provided the initial approach to using sacrificial coupons for measuring deicer exposure.

The project results showed that magnesium chloride is likely damaging to bridge deck concrete, especially where the bridge decks undergo freezing and thawing. Test results showed the benefit of surface treatments to mitigate chloride ingress and concrete damage, and the project investigators recommended specific treatments for best protection. Methods for categorizing bridge deck concrete damage condition based on environmental exposure were presented. The outcomes of the research will be used by ODOT to guide future bridge deck damage mitigation efforts.

## SRS500-620 – Use of Blended Synthetic Fibers to Reduce Cracking Risk in High Performance Concrete

Early-age bridge deck cracking is a major concern for many DOTs throughout the United States. Cracking within the first months of a bridge deck's lifespan compromises its long-term performance and durability, ultimately reducing the sustainability of this crucial piece of transportation infrastructure. This project investigated incorporating synthetic fibers into concrete to mitigate cracking.

The results of the research showed that incorporating fibers into high performance concrete can reduce the risk of cracking and limit the width of cracks that do form. The research verified ODOT's practice of allowing 5 lb./yd$^3$ fiber dosage for bridge decks.

## SPR734 – Premature Asphalt Concrete Pavement Cracking

Recently, ODOT identified hot mix asphalt concrete (HMAC) pavements that displayed top-down cracking within three years of construction. The objective of the study was to evaluate the top-down cracked pavement sections and compare the results with the non-cracked pavement sections.

Research involved evaluating six surface cracked pavements and four non-cracked pavement sections. The research included extensive field and laboratory investigations of the ten pavement sections by conducting distress surveys, falling weight deflectometer (FWD) testing, dynamic cone penetrometer (DCP) testing, and coring from the cracked and non-cracked pavement sections. Cores were then subjected to a full laboratory testing program to evaluate the HMAC mixtures and binder rheology. The laboratory investigation included dynamic modulus, indirect tensile (IDT) strength, and specific gravity testing on the HMAC cores, binder rheological tests on asphalt binder and aggregate gradation analysis.

The FWD and DCP tests indicated that top-down cracked pavement sections were structurally sound, even some of the sections with top-down cracking showed better structural capacity compared to non-cracked sections. The study also found that top-down cracking initiation and propagation were independent of pavement cross-section or the HMAC thickness. The dynamic modulus testing indicated that cores from all the top-down cracked pavement sections except one (OR 140) possessed stiffer mixtures than the non-cracked sections. All four non-cracked pavement areas were found to be exhibiting fairly high IDT strength, and low variability in IDT strength and HMAC density when compared to top-down cracked sections as indicated by the IDT strength tests and air void analysis. Asphalt binder rheological test results indicated that asphalt binders from all the top-down cracked sections except OR140 showed higher complex shear modulus (stiffer binder) compared to non-cracked pavement sections.

The study concluded that top-down cracking could be caused by a number of contributors such as stiffer HMAC mixtures, mixture segregation, binder aging, low HMAC

tensile strength, and high variability in tensile strength or by combination of any.

### SPR750 – Methods for Strengthening Reinforced Concrete Bridge Girders Containing Poorly Detailed Flexural Steel Using Near-Surface Mounted Metallics

Many older reinforced concrete deck girder (RCDG) bridges contain straight-bar terminations of flexural reinforcement in flexural tension zones without special detailing. Common bridge design practice of the 1950s did not consider the additional demands on the terminated bars from shear and flexure. Moreover, application of modern design code provisions and use of heavier trucks contribute to insufficient bridge load ratings when evaluating flexural anchorages in existing RCDG bridges. Replacement of bridges with poor ratings due to localized deficiencies is not economically feasible and thus strengthening methods are necessary.

The goal of this research was to investigate methods for strengthening deficient flexural steel anchorages using supplemental surface bonded metallic reinforcing bars. Full-scale reinforced concrete girder specimens with typical vintage details and materials were used as test specimens. The specimens were constructed with flexural anchorage deficiencies by terminating some of the embedded flexural bars past a 45° preformed diagonal crack. The terminated bars had only one-third of the code-prescribed development length past the diagonal crack.

A strengthening technique called near-surface mounting (NSM) was applied to the specimens. Two metallic materials were selected for the NSM reinforcement: titanium and stainless steel. These materials were chosen because of their high strength, ductility, environmental durability, and ability to form mechanical hooks at the ends of the bars. This study found that the NSM strengthening technique with metallic materials increased the deformation and load capacity of all specimens. In addition, a case study was performed to demonstrate the flexural strengthening for the Mosier Bridge overcrossing of I-84 in Oregon. The case study demonstrated that the techniques and materials applied to the girder were able to achieve the required strength and provided good deformation capacity.

### SPR 741 – Bridge Seismic Retrofit Measures Considering Subduction Zone Earthquakes

Over the years, earthquakes have exposed the vulnerability of reinforced concrete (RC) structures under seismic loads. In the Pacific Northwest, a mega subduction zone earthquake is impending.

Typical RC bridge bents constructed in the 1950 to mid-1970 in the State of Oregon were designed and built with minimum seismic considerations. This left numerous RC bents highly susceptible to damage following an earthquake. In this study, the cyclic performance of an as built RC square column and a RC bridge bent retrofitted using buckling restrained braces (BRBs) was experimentally evaluated using quasi-static cyclic loading protocols aiming to reflect subduction zone earthquake demands up to displacement ductility. The results of

these large-scale experiments successfully demonstrated the effectiveness of utilizing buckling restrained braces for achieving high displacement ductility of the retrofitted structure, while also controlling the damage of the existing vulnerable reinforced concrete bent up to the design performance levels. The potential of improving the overall seismic behavior and the design performance levels with BRBs offers structural design professionals a viable method for performance driven retrofit of reinforced concrete bents.

### SPR 757 – Bluetooth Data Collection System for Planning and Arterial Management

This project developed an inexpensive portable wireless roadside data collection system. The system is comprised of the roadside data collection units (DCUs) and a web-based software application that is used to process the collected data.

The system utilizes Bluetooth technology due to the widespread use of Bluetooth-enabled devices in vehicles. The data collection units are used for short term data collection (normally a week or less). They are portable and can be deployed on the roadside. The system has been used for origin-destination data collection for two ODOT model development projects in the Transportation Planning Analysis Unit. The system was also used to estimate traffic control delay at an intersection in Corvallis. In addition, the system was tested to estimate time-distance diagrams for individual vehicles. To assure data privacy, the system has been designed to remove the first four characters (out of 12) of every MAC address that is recorded by the device.

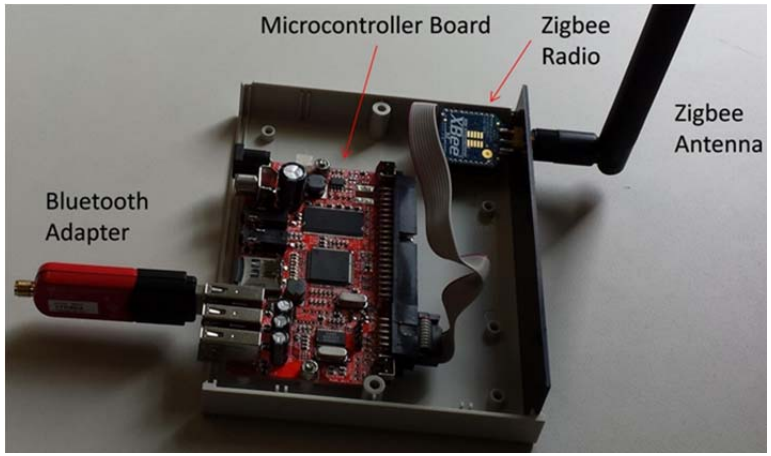

Figure 2 - Bluetooth data collection unit

## Ongoing Projects

### SPR 773 – Smart Red Clearance Extensions to Reduce Red Light Running Crashes

Red Light Running (RLR) describes the act of entering, and proceeding through, a signalized intersection after the traffic signal has turned red. RLR is one of the most significant causes of fatalities and injuries at signalized intersections in North America (NHTSA, 2008). A wide variety of strategies have been used in an attempt to address the issue of RLR, including timing modifications (red and yellow clearance), improved detection, and enforcement strategies such as automated cameras and enforcement or "tattle-tale" lights at a traffic signal. The first edition of the Traffic Signal Timing Manual (FHWA, 2008), the most comprehensive traffic signal guidance document endorsed by FHWA, does not provide any

design or timing guidance on red clearance extensions, nor will the second edition due later this year.

The Oregon Department of Transportation (ODOT) maintains a statewide license to traffic signal controller software (*Northwest Signal Voyage*), which has a red clearance (all-red) extension feature to dynamically extend the red clearance if a vehicle that has or will likely run the red signal indication is detected. This smart, adaptive red clearance treatment provides additional safety protection when risks of a RLR event is high, but is passive in other cases, thus having almost no impact on intersection capacity and delay. The cost is very low to implement this smart intelligent transportation system (ITS) treatment and over 500 intersections currently have controllers with this software feature available to them (and that number is growing). While widely available in Oregon, little is known about the impacts of this feature on intersection safety or best practices for detector placement and settings to maximize the safety and crash reduction benefits of the red clearance extension feature.

Preliminary research suggests that detector placement is critical to achieving optimal benefits. This research would develop quantitative information about the safety effects of red clearance extensions from simulated data and available empirical data. The there is a clear opportunity to leverage the controller and software investments to larger safety gains and provide ODOT the opportunity to provide leadership on an issue of national importance. The value of this research is potentially high.

The overall goal of the proposed research is to quantify the safety performance of alternative red clearance extension detection and controller settings to mitigate RLR crashes at intersections in Oregon. More specifically, the objective is to determine where detection zones should be placed so as to maximize RLR crash avoidance potential (detection further away from the stop bar), while minimizing the likelihood of false red light extensions (extension is triggered for a stopping vehicle), and to establish optimal timing parameters for various objectives.

### SPR 779 – Risk Factors for Pedestrian and Bicycle Crashes

In Oregon, pedestrian and bicyclist fatalities comprise more than 15% of all traffic deaths and are of primary concern for many communities in Oregon. (There were 56 bicycle and 247 pedestrian fatalities in the last five years.) Oregon has identified pedestrian and bicycle crashes as a primary focus area for investing infrastructure funding and has marked approximately $4 million in the All Roads Safety Program to help address this key need. However, developing a plan for targeted investments is challenging, because pedestrian and bicycle crashes are uncommon enough to make it difficult to predict where they will occur next. This random nature also makes it difficult to identify high crash locations and corridors.

As preliminary work towards this problem, ODOT TRS hired a consultant in Spring 2013 to prepare a plan to reduce bicycle and pedestrian crashes by focusing limited resources on locations that have the greatest potential for crash reductions. The objectives of the plan were to

match key effective safety systemic infrastructure countermeasures with potential locations for improvements by identifying a few key patterns of behavior and roadway conditions that create the high risk locations. The results of the plan were presented and discussed with stakeholders from around Oregon. The identification of risk factors and the magnitude of their influence on the likelihood of future crashes were significantly constrained by limited roadway information used in the analysis, such as bicyclist and pedestrian volumes, the presence of a crossing treatment, presence of a turn lane, driveway activity, and sight distances. To improve ODOT's ability to target limited resources, more certainty is needed about the most important risk factors.

The objective of this work is to develop a tool for identifying and prioritizing locations with increased risk. Using this tool, rather than a simple crash history, the locations can be proactively treated.

With the consultant's work as a starting point, this research will continue to investigate the factors related to the common causes of pedestrian and bicycle crashes. This research will seek to identify key risk factors that contribute to higher than average numbers of serious or fatal pedestrian and bicycle crashes to generate best practices in pedestrian and bicycle problem identification and prioritization, and identify data elements that support decision making and prioritization.

### SPR 764 – Creating a Possible Oregon Road Map for Connected Vehicles

Connected vehicles have the potential to dramatically reduce the number of fatalities and injuries that happen on our roads each day. National Highway Traffic Safety Administration (NHTSA) demonstrated that 80% of unimpaired driver crash types could be addressed by connected vehicle technology.

The U.S. DOT plans to fund future pilot deployments of mobility and environmental related applications in the coming years – likely including a set of regional pilots as well as smaller, more self-contained projects focused on priority applications.

As connected vehicle research moves into deployment, state, local and transit agencies, Metropolitan Planning Organizations (MPOs), and the private sector will start feeling the effects of vehicles, after-market devices, mobile devices, and infrastructure with Dedicated Short-Range Communication (DSRC) and other wireless connectivity at their cores. Along with other states and regions, ODOT can benefit from preliminary scoping, evaluation, and assessment of the impact of connected vehicles and infrastructure and a wide range of potential cooperative system applications.

The project has so far conducted an internal survey to determine the level of knowledge about connected and autonomous vehicles as well as how technically and culturally ready ODOT is for the upcoming technological changes. Also, the researchers looked at all the connected vehicle applications currently available and based on maturity, benefits, implementation requirements, and

relevance to ODOT, filtered the 65+ applications down to 25 for ODOT to review. An ODOT workshop chose seven applications for the agency to further consider due their ease of implementation and benefit to ODOT.

Further work includes completing a detailed data dictionary of applications, investigating potential pilot projects using connected vehicle technology, and a final "road map" for ODOT to consult in the coming years of technological change.

### SPR 774 – Road User Fee Economic Analysis

Decreasing fuels tax revenues combined with increasing infrastructure costs has led to the exploration of alternative strategies for financing the transportation system. As Oregon continues to lead the nation in exploring a Vehicle Miles Traveled (VMT) based Road User Fee (RUF), it is important to know how various rate structures and implementation strategies may impact different socio-economic groups and regions of the state.

ODOT relies on the fuels tax to fund road infrastructure, maintenance, operations, and improvements. The fuel tax has been a reliable source of transportation revenue for decades, but increasing vehicle fuel efficiency and other factors are expected to result in permanent funding shortfalls.

Oregon began thinking about this in 2001, when the state legislature formed the Road User Fee Task Force (RUFTUF) to explore new ways of funding the state's transportation system. In response to RUFTUF's recommendations, Oregon has completed two road usage fee pilot programs and began a third one in July of 2015.

This project will provide ODOT with up to date information on the economic impact of various RUF alternatives on the stakeholders in the state of Oregon. This information can then be used to make informed decisions on which VMT fee structure to adopt in the transition between the current finance structure and a sustainable finance structure for the future.

The three fee structures the project will look at are (1) A simple flat rate structure that applies to all vehicles, (2) a fee applied only to vehicles with MPG greater than 20, 30, 40 or 50 (four different scenarios) while retaining the fuel tax for all others, (3) A fee applied only to vehicles in the Oregon House-hold Activity Survey (OHAS) that are considered new (2010, 2011, or 2012 model year).

To date, the data has been cleaned and static economic models have been done on the three fee structures for various income levels and custom-created Oregon regions.

### SPR 768 – Developing a Smartphone Application to Crowdsource Bicycle Safety and Crash Data

Although there is a great body of knowledge and practice to measure motorized vehicle highway infrastructure performance levels and activity, the same cannot be said for bicycles. Although ODOT does collect some bicycle/pedestrian data, the data and quality is not as abundant as is collected for automobiles. In particular, there is scant information regarding bicycle routes (origin-destination) and adequacy of existing bicycle facilities.

The project used recent advances in smartphone technology and crowdsourcing to gather bicycle data and identify deficient segments/facilities. The key objective is to feed ODOT's growing active transportation performance measures and investment prioritization needs.

The project has delivered an application called ORcycle that works on both Android and iOS operating systems. The application collects user demographic data and purpose of the bicycle trip. When actively logging, the route of the bicyclist is recorded using GPS. If the user encounters an unsafe or inadequate infrastructure on their route, they can upload a report detailing the issue. The report contains the location, description, severity and can also include a picture. A similar feature allows the bicyclist to upload a report if they were involved in a crash or near miss.

The project was completed in July of 2015. ODOT is starting a pilot project to have the ORcycle safety incidents sent to AskODOT, which currently collects the public's concerns and responds appropriately. This is the first use of crowdsourced data being sent directly to the agency.

### SRS500-610 – Seismic Performance of Circular Reinforced Concrete Bridge Columns Constructed with Grade 80 Reinforcement

This project assessed the performance of reinforced concrete columns constructed with ASTM A706 Grade 80 reinforcing bars in place of Grade 60 bars. The higher strength of Grade 80 steel compared to the normally-used Grade 60 steel means less steel is required to achieve the same load capacity. Unfortunately, Grade 80 is not currently allowed in reinforced concrete columns in seismic zones due to a lack of information on the material characteristics and column performance during an earthquake.

This project evaluated the performance of columns constructed with Grade 80 steel. Results from tests on half-scale, circular columns showed that columns constructed with Grade 80 reinforcement performed similar to columns constructed with Grade 60 reinforcement. The performance information provided another level of confidence for designers to consider using Grade 80 steel in certain circumstances. The column performance information combined with the results of project SPR 762, which is in progress and will provide data on the key properties of Grade 80 steel bars, will give ODOT the basis for allowing the new steel in columns in seismic zones.

### SPR 755 – Performance Based Selection of RAP-RAS in Asphalt Mixtures

The use of Recycled Asphalt Pavement (RAP) and Recycled Asphalt Shingles (RAS) is restricted based upon local and national experience. ODOT typically limits the combined amount of RAP/ RAS to 20 percent of the total mixture. However, ODOT was interested in allowing for more innovation and optimization of mixtures, including recycled materials. The intent of this study was to use performance based tests to evaluate mixtures with increased RAP/ RAS content (up to 40 percent, or possibly higher), resulting in minimizing the potential

cost and providing environmental and performance benefits.

ODOT currently allows the use of RAP/ RAS in its HMAC without any adjustments to the virgin binder grade. The effect of the recycled asphalts on the final binder grading was unknown. It was thought that this may lead to a stiffer HMAC product that is more susceptible to early fatigue or thermal cracking.

This study compared the performance of one mix design with five different quantities and combinations of recycled asphalt pavement (RAP) and recycled asphalt shingles (RAS) using an Asphalt Mixture Performance Tester (AMPT). Three different performance graded binders were utilized.

Based on the measurements of dynamic modulus and phase angles from the AMPT, it was concluded that a high RAP mixture with a soft binder grade could perform similarly to a low RAP mixture with a harder binder grade. Mixtures using RAS have different performance characteristics than those using RAP only. These mixtures were less susceptible to changes in loading frequency and temperature.

### SPR 775 – Titanium for Strengthening Existing Reinforced Concrete Bridges

Oregon has many reinforced concrete bridges that were built in the 1950s. The bridges from this era commonly have poor reinforcing details, such as longitudinal reinforcing bars terminating in areas under stress, inadequate bar splices, and insufficient vertical reinforcement. Consequently, these older ODOT bridges are often evaluated as deficient and require remediation. It is anticipated that on-going load rating and evolving loading requirements will uncover many deficient bridges for years to come.

Current practice and previous ODOT research provide design options for strengthening. A common option is to bond carbon fiber reinforced polymer (CFRP) strips either on the surface or just below the surface. The method relies solely on the adhesive bond to transfer stresses to the CFRP. Consequently, the full strength of the CFRP is never utilized because the concrete near the bond fails first. To compensate for the relatively weak bond, more strips are installed to distribute stresses across more bond surfaces. If space is not available for more strips, a more elaborate strengthening scheme may be deployed.

This research project is developing a titanium alloy bar that is lightweight and has high-strength and high ductility and is impervious to environmental degradation. The bar can be produced over a wide range of sizes. Unlike CFRP, a key feature of this material is that it can be bent. Consequently, the ends of the titanium bar can be bent to ninety degrees and embedded deep into a beam that needs strengthening. This mechanical anchorage overcomes the problem of the weak bond and allows the titanium reinforcing material to utilize its high strength. These characteristics make it both a structurally and economically effective choice over CFRP and other alternatives.

The research is progressing to meet the three objectives to expand the use of titanium reinforcement. The first is

to develop a splicing method that allows supplemental reinforcing bars to be deployed along the full length of girders, including through the intermediate diaphragms that protrude from most beams. The second objective being addressed is development of an un-bonded strengthening detail that eliminates the need to cut grooves into the concrete surface, thereby reducing labor costs, epoxy material costs, and construction time. The third and final objective is to develop methods to apply exterior titanium bars to strengthen girders with inadequate transverse reinforcement.

### SPR 782 – HMAC Layer Adhesion through Tack Coat

Tack coats are the asphaltic emulsions applied between pavement lifts to provide adequate bond between the two surfaces. Tracking, the pick-up of bituminous material by construction vehicle tires, reduces the amount of tack coat in certain areas and creates a non-uniform tack coat distribution between the two construction lifts. This non-uniform tack coat distribution creates localized failures around the low tack coat locations and reduces the overall structural integrity of the pavement structure.

The major objective of this study is to develop a low cost test method to predict the after-construction bond performance from the tests conducted on the tack coat. In addition, the factors that influence the bond strength, such as existing surface condition, residual application rates, tack coat type, moisture, and temperature will also be investigated to recommend revisions to current methods and practices. Using lab measurements, regression equations will be developed for different tack coat types to predict tack coat set times that can be used during construction to minimize tracking.

The output of this research study will be a low cost in-situ tack coat testing apparatus, a quantitative process for tack coat performance evaluation, a model to determine tack coat set times (to avoid tracking), and a test apparatus to evaluate the long term tack coat performance of ODOT pavement sections. The process will include step-by-step procedures that can be implemented by ODOT when deciding tack coat type and residual application rates for pavements with different textures. The process is expected to be implemented by ODOT Maintenance and outside contractors hired by ODOT.

### 304-581 Imaging tools for evaluation of gusset plate connections in steel truss bridges

This project is supported by Federal Highway Administration and state DOTs, including California, Idaho, New York, North Carolina, Oregon, Texas, and Wisconsin through the Transportation Pooled Fund Program.

Gusset plate connection performance is very important, because failure of a connection may cause collapse of the steel truss bridge. As an outcome of the investigation into the collapse of the I-35W Bridge in Minnesota, steel truss bridge connections are required to undergo review. There are large numbers of steel bridge connections in the inventory, and tools are needed to evaluate the connections.

Geometry and information on deformations of gusset plate connections is needed to assess the safety, but field data collection is time consuming and expensive. Capturing images in the field with digital cameras is a new, rapid way to collect the data. For this project, the researchers from Oregon State University have been developing a method to produce three-dimensional representations of gusset plate connections from multiple two-dimensional images.

The researchers have been developing computer software that can directly use the geometric information collected from the images to evaluate the gusset plate connections. Implementation examples have been developed. A user's manual and training have been provided. Further helping the inspector, the team developed computer database protocols to enable image comparisons between inspection intervals. The images in the database are linked to available drawings and inspection notes. This helps with long-term bridge management. The state DOTs have been testing the software developed for this project.

## Five Year Review

This section looks back at research projects completed five years ago and discusses their implementation and uses since that time. Not all completed research products will be discussed. Only those which have shown real value over time are listed.

### Fleet Replacement Modeling

This research focused on fleet replacement decisions and the dynamics (and usage) within a large fleet at ODOT. The research was able to use years of ODOT Fleet data to review types of vehicles, usage, mileage, repairs, life-span, etc. It confirmed a theory that when assets are not equally utilized, overall operational costs increase. Also, the research provided an equation involving asset age and usage to assist ODOT staff when considering replacement. The new equation proved better in modeling than other metrics to reduce overall Fleet program costs.

The result of the research started several internal discussions on how to best optimize the ODOT Fleet replacement process. The newly calculated list of assets for replacement was compared to the older list and process of selection. Comparing both lists identified deferred equipment replacement practices. This prompted senior management to invest in a software system that incorporates the new calculations for both reports and continues to monitor replacement and repair practices.

During the review and selection process for the new software, ODOT Fleet discovered a commercial off-the-shelf product which had the ability to customize additional functionality. ODOT purchased the product and named their new software Fleet Information Management System (FIMS). FIMS provided easier reporting, detailed data tracking, and allowed for custom equations to be inserted for asset repair or replacement tracking. FIMS was installed and started operating in April 2013.

### Work Zone Design and Operation Enhancements

This report focused on Traffic Control Plans (TCPs) and enhancements to modify existing plans for better safety,

traffic throughput, and easier implementation. From the results of the research project, Standard Drawing TM880 was developed along with the accompanying "unique" special provision, which ODOT TCP designers are now using within the design of the TCP for freeway paving operations.

The research project and follow-up work raised the level of awareness in considering speed when designing traffic control measures and providing safety countermeasures in work zones. Additionally, other research questions were identified for follow-up study. The development of the "Radar Speed Trailer" item specification and design guidance (within the TCP Design Manual) was another result of "further research questions," which was implemented in 2015.

Overall, this research developed several changes to standard drawings, resulted in questions for further research work, and helped evolve a safety culture to look closer at means to control or reduce public traffic speeds or enhance the presence and visibility of highway workers.

# Other Research Activities

In addition to major research projects, the ODOT Research Section is responsible for a number of ongoing programs and activities, smaller projects, and the annual selection of new research projects.

These include:

- the Oregon Technology Transfer (T2) Center, Oregon's Local Technical Assistance Program (LTAP);
- research project selection;
- small, discretionary projects;
- specific activities to support research implementation;
- selection of and participation in pooled fund projects with other states; and
- serving as ODOT's point of contact for regional and national transportation research activities.

The next few pages present activities and accomplishments in some of these areas.

## Oregon Technology Transfer Center (T2)

The T2 Center provides transportation-related information to local agencies throughout Oregon. The Center is jointly funded by FHWA, local agencies, and ODOT. Oregon's T2 Center is one of 58 centers in the nation that make up FHWA's Local Technical Assistance Program (LTAP) and Tribal Technical Assistance Program (TTAP).

The T2 Center provides the following services:

- a lending library of audio/visual materials;
- a program of free and low cost seminars, training classes, and workshops;
- a "Circuit Rider" service that includes annual technical assistance and informational visits to local road agency customers;
- responses to customer inquiries relating to transportation technology;
- a newsletter on transportation-related topics of general interest.

The T2 Center strives to make local road agencies aware of the latest and most effective transportation technologies. T2 does this by acting as an information and training resource to encourage and strengthen communication between government agencies at all levels and through the delivery of "low cost seminars, training classes and workshops" to local road agency employees.

The center's training program is its most visible service. It consists of three elements: 1) short courses, which are delivered by Circuit Riders and focus on roadway and workplace safety; 2) a training program, which delivers six or more events per year in partnership with organizations such as the Oregon Chapter of the American Public Works Association (APWA); and 3) a two-level

*Roads Scholar* certification program with 18 core classes taught by in-house and contract trainers.

The *Roads Scholar* program is the most formalized aspect of the center's training services and continues to be very successful. There are currently over 1,000 active participants in the program, and by the end of FY 2015 387 students had completed their Level 1 certification. In addition, at least four local road agencies have adopted the *Roads Scholar* curriculum and/or attainment of the Level 1 certification as a career ladder or promotion requirement. Other agencies are now offering bonuses for achieving the Level 1 certification.

The development of the Roads Scholar Level 2 program is now complete, with eight, six-hour courses. We saw our first graduates of the Level 2 program at the end of 2015.

The T2 Center's newest addition is the Safety Circuit Rider Program. The Safety Circuit Rider is available to city, county and tribal employees responsible for transportation safety and is available to assist with:

- identifying areas of improvement on the agency's road network;
- identifying crash sites by severity, number of crashes or types of crashes;
- identifying potential benefits for a variety of safety improvements for both spot and system wide crash reduction;
- calculating benefit-cost ratios;
- confirming the identification of both spot and systemic crash history that could use funding improvements to reduce the number of crashes and the severity of each crash;
- the funding application process through ODOT, and
- determining if a project has enough benefit to be placed in the Statewide Transportation Improvement Program (STIP).

## Research Project Selection

Project selection starts in the fall with modifications and updates to published research priorities. (Priorities for Fiscal Year 2015 are in Appendix A of this report). The process ends in the spring with the annual project selection meeting.

Research project selection is carried out in two stages. Expert Task Groups (ETGs), with support and coordination from the Research Section staff, make initial recommendations. The ODOT Research Advisory Committee (RAC) makes the final decision, selecting projects to go forward from the pool of ideas nominated by the ETGs.

A list of the new research projects selected for FY 2015 is shown in Table 3.1. Figure 3.1 provides a schematic of the project selection timetable.

## Small, Quick Response, and Discretionary Projects

### Small Projects

Each year the Research Section conducts small projects, typically totaling $25,000 or less each. Funds are set aside

for these types of projects so that money may be quickly allocated once a proposal is approved. These quick response or discretionary projects may be funded using SPR funds or using state funds entirely.

### Information Requests

Divisions, sections, and units of ODOT will periodically request information from the Research Section. Information requests typically consist of requests for literature searches, statistical analyses, or small compilation reports. The section also responds to requests from other states about ODOT practices. On occasion, local transportation agencies have requested information, as well.

Though information requests are not tracked individually, it is estimated that the research staff spent 650 hours responding to requests in Fiscal Year 2015, addressing a wide range of topics.

### Discretionary Projects

Twenty-one Federal and state funded discretionary projects were active for Fiscal Year 2015, and ten were completed. Those projects are summarized in Tables 4.3 and 4.4.

## Table 3.1: New Projects Selected for Fiscal Year 2016

| Project No. | Project Title | Sponsor | Scheduled end date | Budget |
|---|---|---|---|---|
| 783 | Truck Parking: An Emerging Safety Hazard to Highway Users | Motor Carrier Transportation Division | 6/30/2017 | $193,000 |
| 784 | Development of Titanium Seismic Retrofits for Deficient Concrete Columns | Tech Services, Bridge Section | 1/31/2018 | $330,000 |
| 785 | Adjusting Asphalt Mixes for Increased Durability and Implementation of a Tester… | Tech Services, Construction Section | 6/30/2017 | $190,000 |
| 786 | Enhancing Landslide Inventorying, LiDAR Hazard Assessment, and Asset Management | Tech Services, Geo/ Environmental Section | 12/29/2017 | $276,000 |
| 787 | Eyes in the Sky: Bridge Inspections with Unmanned Aerial Vehicles | Tech Services Bridge Section | 1/30/2018 | $220,000 |
| 788 | Performance-Based Planning and Decision Making: Understanding Mode Choices | TDD, Transportation Planning Section | 2/28/2017 | $120,000 |
| 789 | Improved Safety and Efficiency of Protected/Permitted Right Turns in Oregon | Tech Service, Traffic Engineering | 8/31/2017 | $175,000 |
| 790 | Work Zone Intrusion Alert Technologies: Assessment and Practical Guidance | State Traffic/Roadway Engineer | 6/3/2016 | $246,000 |
| 791 | Use of Additional Lighting for Traffic Control and Speed Reduction in Work Zones | State Traffic/Roadway Engineer | 6/30/2017 | $192,000 |
| 792 | Construction of Efficient, Cost-Effective, and Sustainable Maintenance Facilities | Facilities Services Branch | 6/30/2017 | $162,000 |
| 793 | Exploring the Relationship Between Freeway Congestion and Safety | TDD, Transportation Planning Section | 9/31/2017 | $179,000 |
| 794 | Multi-Modal Intersections: Resolving Conflicts… | Rail Division, Crossing Safety | 6/30/2017 | $160,000 |
| 796 | Preventing the Remobilization of Captured Metals in Stormwater Treatment Systems | Tech Services, Geo/ Environmental Section | 6/30/2017 | $320,000 |
| 797 | Binder-Grade Bumping and High Binder content to Improve Performance of RAP-RAS… | Tech Services, Construction Section | 6/30/2017 | $186,000 |

# ODOT Research Project Selection Timetable

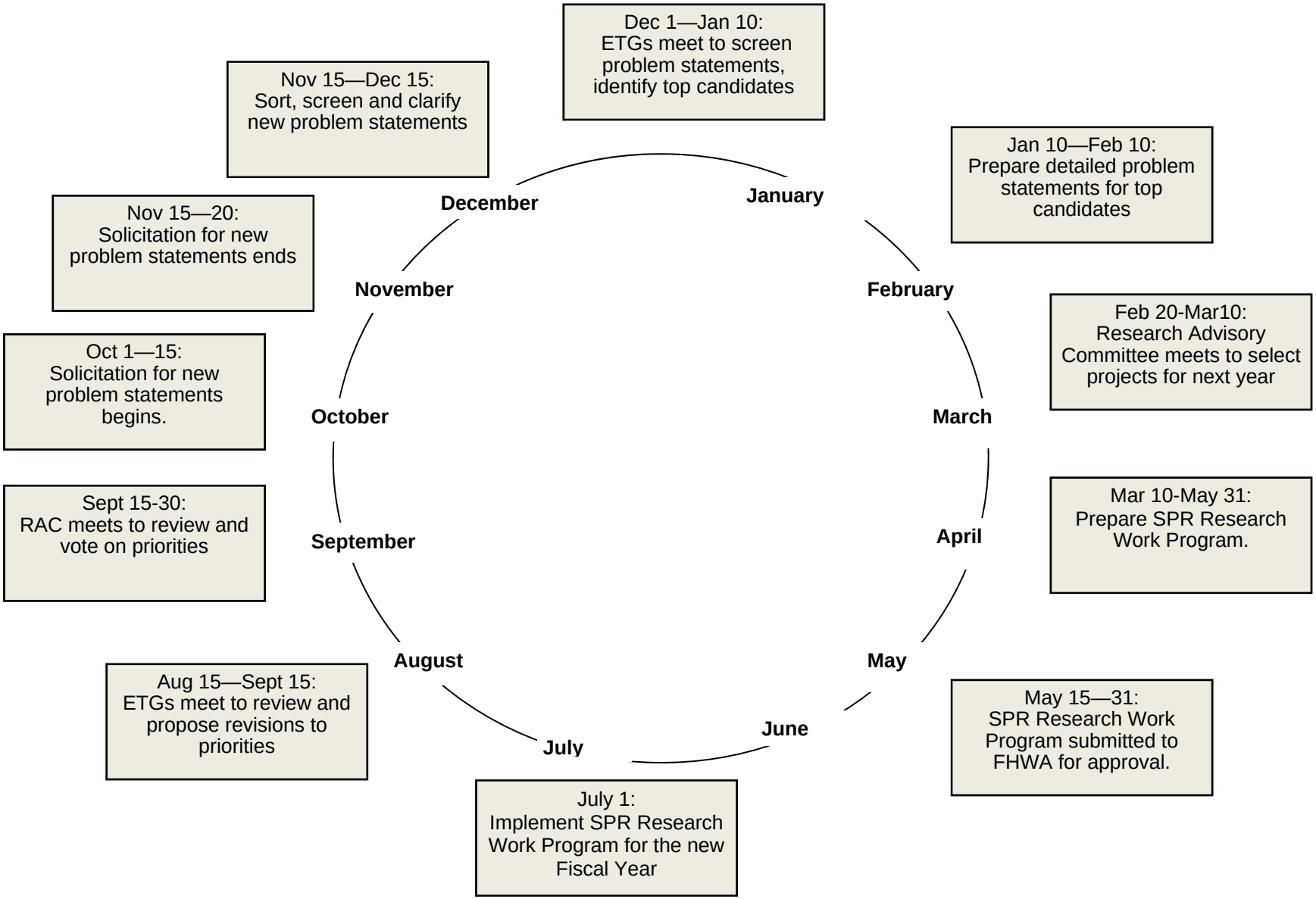


Figure 3.1: ODOT Research Project Selection Timetable

## Pooled Fund Projects

The Research Section has committed to working with other states to fund research through the Transportation Pooled Fund (TPF) program. This program offers significant advantages.

One advantage is cost sharing. For every ODOT dollar invested in these pooled fund projects, about $15 is leveraged from other organizations.

A second advantage is that TPF projects are approved for 100% federal funding, which means participating states do not need to use state matching funds.

In Fiscal Year 2015 ODOT led three and contributed to ten pooled fund projects (Table 3.2). ODOT Research continues to monitor 15 ongoing pooled fund projects from previous years and is the lead state for two pooled funds projects with no committed ODOT Research funds (Table 3.3).

## Table 3.2: Transportation Pooled Fund Project Summary

| Study No. | Title | ODOT Contact | Lead Agency | Oregon Funds 2015 | Oregon Total Committed | National Total Committed |
|---|---|---|---|---|---|---|
| 1397 | Stormwater Testing and Maintainability Center | Paul Wirfs | Oregon | $3,000 | $6,000 | $300,000 |
| TPF-5(064) | Western Alliance for Quality Transportation Construction (WAQTC) | Greg Stellmach | Utah | $15,000 | $45,000 | $535,000 |
| TPF-5(218) | Clear Roads Winter Highway Operations Pooled Fund | Luci Moore | Minnesota | $25,000 | $50,000 | $3,130,000 |
| TPF-5(237) | Transportation Library Connectivity and Development | Laura Wilt | Missouri | $15,000 | $75,000 | $1,270,878 |
| TPF-5(255) | Highway Safety Manual Implementation | Doug Bish | FHWA | $20,000 | $80,000 | $1,155,000 |
| TPF-5(283) | The Influence of Vehicular Live Loads on Bridge Performance | Bruce Johnson | FHWA | $25,000 | $50,000 | $1,090,000 |
| TPF-5(288) | Western Road Usage Charging Consortium | Randal Thomas | Oregon | $50,000 | $175,000 | $1,030,000 |
| TPF-5(299) | Improve the Quality of Pavement Surface Distress and Transverse Profile Data Collection and Analysis | Cole Mullis | FHWA | $15,000 | $90,000 | $1,160,000 |
| TPF-5(307) | Validation of Tsunami Design Guidelines for Coastal Bridges | Bruce Johnson | Oregon | $120,000 | $180,000 | $355,000 |
| TPF-5(331) | Toolkit for the Deployment of Alternative Vehicle and Fuel Technologies | Art James | Oregon | $10,000 | $30,000 | $230,000 |
| | **Total** | | | **$298,000** | **$781,000** | **$10,255,878** |

**Table 3.3: Active Pooled Fund studies with ODOT participation but no FY'15 Contribution**

| Study No. | Title | ODOT Contact | Lead Agency | Oregon Funds 2015 | Oregon Total Committed | National Total Committed |
|---|---|---|---|---|---|---|
| SPR-2(208) | Pavement Subgrade Performance Study | Luci Moore | FHWA | $0 | $45,000 | $1,945,000 |
| TPF-5(065) | Traffic Control Device (TCD) Consortium | Michael Kimlinger, P.E. | FHWA | $0 | $40,000 | $2,890,000 |
| TPF-5(178) | Implementation of the Asphalt Mixture Performance Tester (AMPT) for Superpave Validation | Larry Ilg | FHWA | $0 | $105,000 | $2,331,488 |
| TPF-5(191) | Northwest Transportation Consortium | None | Washington | $0 | $25,000 | $100,000 |
| TPF-5(209) | Support of the Transportation Curriculum Coordination Council (TCCC) | None | FHWA | $0 | $45,000 | $1,055,000 |
| TPF-5(227) | Continued Advancements in Load and Resistance Factor Design (LRFD) for Foundations, Substructures and Other Geotechnical Features | Paul Wirfs | FHWA | $0 | $40,000 | $580,000 |
| TPF-5(238) | Design and Fabrication Standards to Eliminate Fracture Critical Concerns in Two Girder Bridge Systems | Steven C. Lovejoy | Indiana | $0 | $20,000 | $860,000 |
| TPF-5(241) | Western States Rural Transportation Consortium (WSRTC) | Galen McGill | Washington | $0 | $10,000 | $370,000 |
| TPF-5(253) | Member-level Redundancy in Built-up Steel Members | Bruce Johnson | Indiana | $0 | $10,000 | $600,000 |
| TPF-5(254) | Evaluation and Analysis of Decked Bulb T Beam Bridge | Ben Tang | Michigan | $0 | $60,000 | $415,500 |
| TPF-5(259) | Imaging Tools for Evaluation of Gusset Plate Connections in Steel Truss Bridges | Joe Li | Oregon | $0 | $90,000 | $475,000 |
| TPF-5(264) | Passive Force-Displacement Relationships for Skewed Abutments | Bruce Johnson | Utah | $0 | $30,000 | $285,000 |
| TPF-5(272) | Evaluation of Lateral Pile Resistance Near MSE Walls at a Dedicated Wall Site | Jan Six | Utah | $0 | $30,000 | $292,000 |
| TPF-5(301) | Support Services for Peer Exchanges | Michael Bufalino | Oregon | $0 | $0 | $67,000.00 |
| TPF-5(253) | Member-level Redundancy in Built-up Steel Members | Steven C. Lovejoy | Indiana | $0 | $10,000 | $600,000 |
| | **Total** | | | **$0** | **$560,000** | **$12,865,988** |

## Regional and National Research Program Coordination

ODOT participates directly or indirectly in a number of national research programs and initiatives. In general, the role of ODOT Research is that of liaison, or point of contact. Among the responsibilities carried out by ODOT Research in Fiscal Year 2015 are the following.

### Transportation Research Board

The Research Section Manager is the Oregon DOT representative to the Transportation Research Board (TRB). This responsibility involves a range of duties that relate to coordination of communication and services between ODOT and TRB.

### SHRP 2 Coordination

The Moving Ahead for Progress in the 21st Century Act (MAP-21) includes a provision to fund the second Strategic Highway Research Program (SHRP 2) from a percentage of State Planning and Research (SP&R) funds to be determined by a three-quarter majority of the States. American Association of State Highway and Transportation Officials' (AASHTO) Board of Directors recently approved an assessment of four percent of each state's SPR funds; Oregon contributed about $380,000 in 2013 and 2014. With this investment the SHRP 2 program is managed by the TRB and is launching ambitious programs of research in the areas of safety, infrastructure renewal, travel reliability, and transportation system capacity.

SHRP 2 draws heavily on the expertise of state DOT personnel to review proposals and serve on project oversight panels. TRB has also launched a "loaned staff" program to support SHRP 2 activities. To facilitate coordination, each state was asked to designate a SHRP 2 Coordinator. The Coordinator works with SHRP 2 staff to help identify key staff to provide SHRP 2 input and assistance. For Oregon, the SHRP 2 Coordinator is the ODOT Research Manager.

In FY 2015 the department coordinated two applications for SHRP 2 implementation assistance, including ODOT's Round 2 proposal "R09 – Managing Risk in Rapid Renewal Projects" and Portland Metro's Round 3 proposal "C20 – Freight Demand Modeling and Data Improvement: An organizational approach to achieving improved freight data sets and freight modeling practices."

### AASHTO Research Advisory Committee (RAC)

The Research Section Manager is also a member of the AASHTO Research Advisory Committee (RAC). The RAC has several important functions within AASHTO and in setting the national transportation research agenda, as well as serving as the principal point of contact for transportation research between states.

The RAC meets annually. In addition, RAC members meet regionally via bi-monthly conference calls. Specific functions and duties of the Research Advisory Committee include the following.

***Review and rating of projects submitted to the National Cooperative Highway Research Program (NCHRP)***

Every year, problem statements are submitted to NCHRP for funding. The TRB, on behalf of AASHTO and the state Departments of Transportation, allocates approximately $37 million each year for research benefiting highways. The AASHTO RAC member in each state is responsible for submitting an advisory ballot, used to select projects for funding.

***Nomination of NCHRP project panel members***

Each NCHRP project is managed by a panel of experts. Many of those panelists are drawn primarily from the 50 state Departments of Transportation. AASHTO RAC members are responsible for nominating panel members from their respective states.

***Coordination of synthesis data collection***

One component of NCHRP is a sub-program called NCHRP Synthesis, which consists of small studies of the state of knowledge and current practice in a particular area of highway technology. Each synthesis project includes a questionnaire survey of current practice by state Departments of Transportation. The AASHTO RAC members are responsible for coordinating that data collection within their own departments.

***Other support for NCHRP***

RAC members pay their state's annual NCHRP contribution ($529,686 for Oregon in FY 2015), provide assistance to DOT employees who wish to submit problem statements, and disseminate NCHRP research results within their departments.

***National RAC listserv***

Members of the Committee are members of an electronic mail listserv, which is used to communicate on a variety of topics. A key use that has evolved is the gathering of information about practices in other states, particularly with regard to the applications of new technology. ODOT Research coordinates hundreds of such requests for information from other states every year.

***Task forces***

At the 2006 Annual Research Advisory Committee Meeting in Columbus Ohio, the AASHTO RAC adopted a subcommittee structure. Nine task forces were originally created, two of which have since been dissolved or combined. The current task forces include: Administration and Education, Value of Research, Research Funding, Research Coordination and Collaboration, Program Management and Quality, Future Needs, and Transportation Knowledge Networks.

The ODOT Research Manager is a member of the Administration Task force, and lead the planning effort for the July 2015 RAC meeting in Portland, Oregon.

## University Transportation Centers

In addition to providing full project funding, ODOT Research Section funds are also used to leverage funds contributed by other organizations and centers to jointly sponsor research projects. University Transportation Centers (UTCs), including the Portland State University led Transportation Research and Education Consortium (TREC), Pacific Northwest Transportation Consortium (PacTrans) in which Oregon State University is a full member, and Western Transportation Institute have been important partners in funding research.

## Title VI of the Civil Rights Act

The Oregon Department of Transportation ensures compliance with Title VI of the Civil Rights Act of 1964; 49 CFR, part 21; related statutes and regulations to the end that no person shall be excluded from participation in or be denied the benefits of, or be subjected to discrimination under any program or activity receiving federal financial assistance from the U.S. Department of Transportation on the grounds of race, color, sex, or national origin. The Research Section actively collects Title VI compliance information from our contractors on an annual basis.

In FY'15 ODOT Research contracted 34 major SPR funded projects to universities and one project to a consultant. The contracted projects involved 13 female investigators (four of these identified as a minority) and 16 male minority investigators. The research projects also employed 32 female students (eleven of these identified as minorities) and 25 male minority students.

# Publications, Activity, and Spending

The following section summarizes activities of the Research Section, including the status of active projects, cost information, and lists of reports that have been published

## Research Project Status

The status of 117 research projects initiated from FY 2005 through FY 2015 is summarized in Table 4.1.

The 16 reports published in FY 2015 are listed in Table 4.2

Table 4.3 summarizes 38 major projects that were active in FY 2015. Major projects are defined as those that were selected by the Research Advisory Committee or had a budget of at least $70,000 and lasted at least one year.

Table 4.4 summarizes all other research projects and related activities, and includes the Research Discretionary Fund and miscellaneous continuing activities. These activities were described in Chapter 3.

**Table 4.1: Project Status Summary, FY 2005 – FY 2015**

| Fiscal Year | Inactive | | Active | | Total New Projects |
|---|---|---|---|---|---|
| | Complete | Cancelled | On Schedule | Behind Schedule | |
| *2005* | 10 | 0 | 0 | 0 | 10 |
| *2006* | 4 | 4 | 0 | 0 | 8 |
| *2007* | 8 | 1 | 0 | 0 | 9 |
| *2008* | 12 | 1 | 0 | 0 | 13 |
| *2009* | 9 | 1 | 0 | 0 | 10 |
| *2010* | 8 | 2 | 1 | 0 | 11 |
| *2011* | 12 | 0 | 0 | 0 | 12 |
| *2012* | 7 | 0 | 0 | 1 | 8 |
| *2013* | 8 | 0 | 3 | 2 | 13 |
| *2014* | 0 | 0 | 9 | 3 | 12 |
| *2015* | 0 | 0 | 11 | 0 | 11 |
| **Total** | **78** | **9** | **24** | **6** | **117** |

**Table 4.2: Research Reports Published in FY 2015**

| Report No. | Report Title | Date Published |
|---|---|---|
| FHWA-OR-RD-15-01 | Bluetooth Data Collection System for Planning and Arterial Management | Aug-14 |
| FHWA-OR-RD-15-02 | Seismic Performance of Circular Reinforced Concrete Bridge Columns Constructed with Grade 80 Reinforcement | Aug-14 |
| FHWA-OR-RD-15-03 | Transportation Performance Measures for Outcome Based System Management and Monitoring | Sep-14 |
| FHWA-OR-RD-15-04 | Safe and Effective Speed Reductions for Freeway Work Zones – Phase 2 | Sep-14 |
| FHWA-OR-RD-15-05 | The Use of Synthetic Blended Fibers to Reduce Cracking Risk in High Performance Concrete | Sep-14 |
| FHWA-OR-RD-15-06 | Impacts of Potential Seismic Landslides on Lifeline Corridors | Oct-14 |
| FHWA-OR-RD-15-07 | Review of Studded Tires in Oregon | Dec-14 |
| FHWA-OR-RD-15-08 | Understanding and Mitigating Effects of Chloride Deicer Exposure on Concrete | Sep-14 |
| FHWA-OR-RD-15-09 | Safe and Effective Speed Reductions for Freeway Work Zones – Phase 3 | Feb-15 |
| FHWA-OR-RD-15-10 | Understanding Residential Location Choices for Climate Change and Transportation Decision Making – Phase 1 | Jan-15 |
| FHWA-OR-RD-15-11 | Understanding Residential Location Choices for Climate Change and Transportation Decision Making – Phase 2 | Jan-15 |
| FHWA-OR-RD-15-12 | Understanding and Mitigating Effects of Chloride Deicer Exposure on Concrete | Feb-15 |
| FHWA-OR-RD-15-13 | Assessment of Copper removal from Highway Stormwater Runoff using Apatite II (TM) and Compost: Laboratory and Field Testing | Mar-15 |
| FHWA-OR-RD-15-14 | Corrosion Monitoring System for Reinforced Concrete Structures | May-15 |
| OR-RD-15-15 | Seismic Retrofit Benefit Considering Statewide Transportation Assessment | Jun-15 |
| FHWA-OR-RD-15-16 | Premature Asphalt Concrete Pavement Cracking | Jun-15 |

## Table 4.3: Budget, Expenditures and Status for Major Projects Active in FY 2015

| Project No. | Project Title | Spent in FY'2015 | Expected End Date | Status |
|---|---|---|---|---|
| | **Major Projects Ended During FY 2013** | | | |
| 730 | Copper Removal From Storm Water Runoff Using Fish Bone Meal | $68,938 | NA | Complete |
| 734 | Premature Asphalt Concrete Pavement Cracking | $11,290 | NA | Complete |
| 736 | Corrosion Monitoring System for Reinforced Concrete Structures | $7,496 | NA | Complete |
| 740 | Impacts of Potential Seismic Landslides on Lifeline Corridors | $0 | NA | Complete |
| 742 | Mitigating Effects of Chloride Deicer Exposure on Concrete | $3,734 | NA | Complete |
| 745 | Residential Location Choices for Transportation Decision Making | $40,208 | NA | Complete |
| 753 | Transportation Performance Measures for Statewide Outcomes-Based Management | $3,795 | NA | Complete |
| 757 | Bluetooth Data Collection System for Planning and Arterial Management | $15,511 | NA | Complete |
| 769 | Safe and Effective Speed Reductions for Freeway Work Zones – Phase 2 | $17,820 | NA | Complete |
| | | | | **Continuing Projects** |
| 719 | Climate Change Impact on Coastal River Estuaries in Oregon | $50,069 | 6/30/2020 | Continuing |
| 741 | Bridge Seismic Retrofit Measures Considering Subduction Earthquakes | $72,352 | 7/31/2015 | Continuing |
| 750 | Strengthening Methods for Deficient Flexural Steel Anchorages in Bridge Girders | $10,576 | 8/31/2015 | Continuing |
| 755 | Performance Based Selection of RAP-RAS in Asphalt Mixtures | $23,266 | 12/30/2015 | Continuing |
| 756 | Improved Safety Performance Functions for Signalized Intersections | $82,122 | 8/31/2015 | Continuing |
| 758 | Width of Filter Strips for Natural Dispersion of Stormwater in Western Oregon | $83,279 | 11/30/2015 | Continuing |
| 760 | Multimodal Performance Measures: Developing a Transportation Cost Index | $104,435 | 3/31/2015 | Continuing |
| 761 | Evaluation of weather Based Variable Speed Limit Systems | $35,731 | 12/31/2017 | Continuing |
| 762 | High Strength Steel Reinforcement for Bridges | $103,766 | 6/30/2016 | Continuing |
| 763 | Mechanistic Design Data | $68,964 | 9/1/2016 | Continuing |
| 764 | Road Map for Connected Vehicle/Cooperative Systems | $72,003 | 3/31/2015 | Continuing |
| 765 | High Strength Steel Bars and Casing on Response to Drilled Shafts | $131,621 | 6/30/2017 | Continuing |
| 766 | Effective Measures to Restrict Turning Movements | $109,579 | 11/30/15 | Continuing |
| 767 | Design Treatments for Right Turns at Intersections with Bicycle Traffic | $103,183 | 11/30/15 | Continuing |
| 768 | Crowdsourcing as a Data Collection Method for Bicycle Performance Measures | $138,136 | 8/31/15 | Continuing |
| 770 | Impact of Cascadia Earthquake on Seismic Evaluation Criteria of Bridges | $101,894 | 3/31/2016 | Continuing |
| 771 | Risk Factors Associated with High Potential for Serious Crashes | $125,132 | 9/1/2016 | Continuing |
| 772 | Investigation of Bicycle and Pedestrian Count Technologies | $49,227 | 9/30/2016 | Started |
| 773 | Optimal Timing and Detection Practices for Red Clearance Extensions | $70,164 | 3/1/2016 | Started |

| | | | | |
|---|---|---|---|---|
| 774 | Road User Charge Economic Analysis | $75,469 | 4/1/2017 | Started |
| 775 | Titanium for Strengthening Existing Reinforced Concrete Bridges | $214,961 | 12/30/2016 | Started |
| 776 | Quantifying Noise Impacts from ODOT Aggregate Source Operations | $10,358 | 6/30/2017 | Started |
| 777 | Chip Seal Design and Specifications | $116,238 | 3/30/2017 | Started |
| 778 | Safety Effectiveness of Pedestrian Crossing Enhancements | $35,621 | 9/30/2016 | Started |
| 779 | Risk Factors for Pedestrian and Bicycle Crashes | $36,085 | 8/31/2016 | Started |
| 780 | Strategies to Increase the Service Life of Bridge Decks | $155,526 | 12/30/2016 | Started |
| 781 | Improving Adaptive/Responsive Signal Control Performance | $77,813 | 9/1/2016 | Started |
| 782 | HMAC Layer Adhesion Through Tac Coat | $10,320 | 10/30/2016 | Started |
| 17PF043 | Needs and Issues Survey FY 17 | $14,608 | 1/1/2017 | Continuing |

**Table 4.4: Other FY 2015 Research Activities**

(Research Discretionary Fund, State Research Program, Continuing Activities)

| Project # | Project Title | Spent FY 2015 | End/Due Date | Status |
|---|---|---|---|---|
| **Projects Ended During FY 2013** | | | | |
| 301-000 | SPR Project Selection and Development | $306,337 | Ongoing | NA |
| 302-000 | SPR Implementation | $69,334 | Ongoing | NA |
| 304-481 | AASHTO Technology Implementation Group | $6,000 | Ongoing | NA |
| 304-541 | ODOT Solar Highway | $3,126 | Ongoing | NA |
| 304-641 | LED Illumination | $477 | Ongoing | NA |
| 500-030 | Small Project Implementation | 0 | Ongoing | NA |
| 500-040 | Information Requests | $37,173 | Ongoing | NA |
| 500-420 | Pooled Fund Support | $1,877 | Ongoing | NA |
| 500-570 | Photo Radar Workzone Speed monitoring | $5,938 | Ongoing | NA |
| 304-121 | National Research Liaison and NCHRP Activity | $6,057 | Ongoing | NA |
| 304-661 | Corrosion Sensor | $1,778 | 3/31/2016 | Continuing |
| 304-671 | 2014 Review of Studded Tires in Oregon | $29,544 | | Complete |
| 304-701 | Drilled Shaft Torsion | $510 | | |
| 304-711 | 2014 Research Peer Exchange | $11,920 | | Complete |
| 304-721 | Western Juniper Certification Testing and Analysis | $8,125 | | Continuing |
| 500-480 | Prioritization for Seismic Retrofit with Statewide Transportation Assessment | $7,651 | 5/30/2015 | Complete |
| 500-530 | Deer Migration – Phase 2 | | See note 1 | Continuing |
| 500-600 | Gusset Plate Pooled Fund (Digital Image Rectification – Phase 2) | $12,892 | 9/30/2014 | Continuing |
| 500-610 | Seismic Performance of Circular Reinforced Concrete Bridge Columns Constructed With Grade 80 Reinforcement | $11,813 | | Complete |
| 500-620 | The Use of Synthetic Blended Fibers to Reduce Cracking Risk In High Performance Concrete | $2,981 | | Complete |
| 500-630 | Incinerator Calibration Factors | $0 | 3/30/2015 | Complete |

1. The role of ODOT Research in this project is limited to the purchase of equipment to be used in monitoring wildlife use of grade separated animal crossings in the Lava Butte area. Ongoing work is being carried out by ODOT Environmental and ODFW staff.

## Other Publications and Presentations

In addition to reports published by ODOT and FHWA, investigators disseminate research findings through books, journals, and conferences. Below is a partial listing of research publications and presentations that resulted directly or indirectly from ODOT research projects.

### Publications

*Downey, M., and Bertini, R.L., "Capturing the Benefits of a Variable Advisory Speed System in Portland, Oregon: An Empirical Before and After Evaluation," *Transportation Research Record: Journal of the Transportation Research Board*, 2016 (accepted).

Bertini, R.L., Wang, H., Knudson, A., and *Carstens, K. "Toward Assessing State Department of Transportation Readiness for Connected Vehicle/Cooperative Systems Deployment Scenarios: An Oregon Case Study," *Transportation Research Record: Journal of the Transportation Research Board*, 2016 (accepted).

*Riggins, G., Bertini, R.L., *Ackaah, W., and Bogenberger, K., "Measurement and Assessment of Driver Compliance with Variable Speed Limit Systems: Comparison of the U.S. and Germany," *Transportation Research Record: Journal of the Transportation Research Board*, 2016 (accepted).

Ko, S.S., Yu, W., Park, S., Kim, D.S. (2015), "Arterial road incident detection based on time moving average method in Bluetooth- based wireless vehicle identification system" Journal of Transportation Engineering, Vol. 141, No. 3.

Yu, W., Ko, S.S., Park, S., Kim, D.S., "Arterial Incident Detection Procedure Utilizing Real-Time Vehicle Re-Identification Travel Time Data" Journal of Intelligent Transportation Systems, Accepted, revisions submitted April 2013. Accessible online until in print.

R. Bazaez, P. Dusicka, "Design Implementation of Buckling Restrained Braces for Seismic Retrofitting of Reinforced Concrete Multi-Column Bridge Bents", SEI Structures Congress, American Society of Civil Engineers (ASCE), Portland, OR, 2015.

Ph.D. Dissertation, Oregon State University, Mafruhatul Jannat, "Right-Hook Crash Causality at Signalized Intersections" 12/16/2014.

M.S. Thesis, Oregon State University, Jennifer Warner, "The Evaluation of Engineering Treatments for Right-Hook Crashes at Signalized Intersections with Bicycle Treatments" 05/22/2015.

Liu Z and Higgins CW. "Does temperature affect the accuracy of vented pressure transducer in fine-scale water level measurement?" Geosci. Instrum. Method. Data Syst. Discuss., 4, 533-561, 2014. doi:10.5194/gid-4-533-2014.

Stewart RD, Liu Z, Rupp DE, Higgins CW, and Selker JS. "A New Instrument to Measure Plot-Scale Runoff". Geosci.

Instrum. Method. Data Syst., 4, 57-64, 2015. doi:10.5194/gi-4-57-2015

## PRESENTATIONS

Bathaee, N., Mohseni, A., Park S., Porter, J.D., Kim, D.S., “Differentiating Transportation Modes Using Bluetooth Sensor Data “, ISERC – Montreal, June 2014.

Bertini, R.L., *Downey, M., Al-Kaisy, A., Ewan, L., and Veneziano, D., "Evaluation of Weather Responsive Variable Advisory Speed System in Portland, Oregon," *21st World Congress on Intelligent Transport Systems*, Detroit, Michigan, September 9, 2014.

Bertini, R.L., and *Downey, M. "Evaluation of a Weather and Traffic Responsive Variable Advisory Speed Limit System in Portland, Oregon," *Proceedings of the International Symposium on Enhancing Highway Performance (ISEHP)*, Berlin, Germany, June 14-16, 2016 (submitted).

Bertini, R.L., Wang, H., and *Riggins, G. "Preparing a Roadmap for Connected Vehicle/Cooperative System Deployment Scenarios: Case Study of the State of Oregon," *Proceedings of the International Symposium on Enhancing Highway Performance (ISEHP)*, Berlin, Germany, June 14-16, 2016 (submitted).

Bertini, R.L. and Wang, H., "Preparing a Roadmap for Connected Vehicle/Cooperative System Deployment Scenarios: Case Study of the State of Oregon, USA," *Proceedings of Mobil.TUM 2015*, International Scientific Conference on Mobility and Transport, Munich, Germany, June 30, 2015

Bertini, R.L., *Downey, M., Al-Kaisy, A., Ewan, L., and Veneziano, D., "Evaluation of Weather Responsive Variable Advisory Speed System in Portland, Oregon," *Proc. of the 21st World Congress on Intelligent Transport Systems*, Detroit, Michigan, September 2014.

Bertini, R.L., *Borkowitz, T. and Wang, H., "Preparing a Possible Oregon Road Map for Connected Vehicle/Cooperative Systems Deployment Scenarios," *Proc. of the 21st World Congress on Intelligent Transport Systems*, Detroit, Michigan, September 2014.

Bertini, R.L., *Borkowitz, T. and Wang, H., "Extending Connected Vehicle and Cooperative System Concepts to Non-motorized and Vulnerable Transportation System Users," *Proc. of the 21st World Congress on Intelligent Transport Systems*, Detroit, Michigan, September 2014.

Bertini, R.L., *Borkowitz, T., and Wang, H., "Preparing a Possible Oregon Road Map for Connected Vehicle/Cooperative Systems Deployment Scenarios," *21st World Congress on Intelligent Transport Systems*, Detroit, Michigan, September 9, 2014.

Bertini, R.L., *Borkowitz, T., and Wang, H., "Extending Connected Vehicle and Cooperative System Concepts to Non-motorized and Vulnerable Transportation System Users," *21st World Congress on Intelligent Transport Systems*, Detroit, September 10, Michigan, 2014.

Bertini, R.L., "Perspectives on Degrees of Vehicle Connectivity, Automation and Autonomous Vehicles," EV Roadmap 7, Drive Oregon, Portland, Oregon, July 25, 2014.

"Current Research on Bridge Seismic Performance with the Cascadia Subduction Hazard in Mind", ACEC (American Council of Engineering Companies) of Oregon, Portland, OR, 2015.

*Downey, M., and Bertini, R.L., "Evaluation Of a Traffic and Weather Responsive Variable Advisory Speed System In Portland, Oregon," *Proc. of the 93rd Annual Meeting of the Transportation Research Board*, Washington, D.C., 2015.

"The Future of Transportation and the Environment," plenary speaker, Oregon Department of Transportation Geo-Environmental Conference, Eugene, Oregon, April 22, 2015.

IGERT Seminar, David Hurwitz, "Toward Effective Design Treatments for Right-Hook Crashes at Intersections with Bicycle Traffic", OSU, Corvallis Oregon, 04/14/2015.

Kim, D.S., Porter, J.D., Mohseni, A., Park, S. Bathaee, N., "Development and Application of Portable Low-cost Bluetooth-based data Collection Units", Presented at the Northwest Transportation Conference, February, 2014, Corvallis, Oregon.

Kim, D.S., Porter, J.D., Mohseni, A., Park S., Bathaee, N. "Development and Application of Portable Low-cost Bluetooth–based Data Collection Units" INFORMS Annual Meeting, November 2014, San Francisco, California.

Monsere, C. (Invited) Washington State DOT – Safer Streets, Safer People Kick Off Meeting, Olympia, WA, Nov 7, 2014

Podium Session, David Hurwitz & Chris Monsere, "Towards Effective Design Treatments for Right-Turns at Intersections with Bicycle Traffic", Oregon Transportation Summit, PSU, Portland, Oregon, 09/15/14.

Poster Session, Jennifer Warner, "Engineering countermeasures for Right-Hook Crashes at Signalized Intersections", Oregon Transportation Summit, PSU, Portland, Oregon, 09/15/14.

"Structural Behavior During Long-Duration Strong Ground Motions", SEI Structures Congress, American Society of Civil Engineers (ASCE), Portland, OR, 2015.

ThreeMinuteThesis, Jennifer Warner, "Out of Sight, Out of Mind…Right-Hook Crash Solutions", OSU, Corvallis, Oregon 05/06/15.

ThreeMinuteThesis, Jennifer Warner, "Treatments for Mitigating Right-hook Crashes at Signalized Intersections with Bicycle Traffic, Oregon Transportation Summit, PSU, Portland, Oregon, 09/15/14.

"Variable Advisory Speed System: Performance Measures and Outlook," Institute for Transport and Regional

Planning, University of the Federal Armed Forces, Munich, Germany, June 29, 2015.

Wang, Liming, Bud Reiff, Brian Gregor, Huajie Yang, and Jenny Liu, 2015. Transportation Cost Index: "A Comprehensive Multimodal Performance Measure of Transportation and Land Use Systems", presented at the 94th Annual Meeting of Transportation Research Board, Washington, DC, January 11-15, 2015.

Wang, Liming, Bud Reiff, Brian Gregor, Huajie Yang, and Jenny Liu, 2014. Transportation Cost Index:"A Comprehensive Multimodal Performance Measure of Transportation and Land Use Systems", presented at The 54th Annual Conference of Association of Collegiate Schools of Planning (ACSP), Philadelphia, PA, October 30th-November 2nd, 2014.

## Budget and Funding

Research funding originates from several sources:

### Federal State Planning and Research (SPR)

SPR program funding is set at two percent of each state's FHWA highway funding under 23 U.S.C. 307(c). Of that two percent, *at least* 25 percent (i.e., 0.5%) is specifically identified for Research, Development, and Technology Transfer (RD&T). For Oregon, in recent years this amounts to roughly $2 million per year. SPR RD&T funds support a large share of direct expenditures on research projects. In addition to those funds specifically earmarked for research, in recent years the Research Section also has drawn research project and T2 program funds from the planning portion of SPR.

### Local Technical Assistance Program (LTAP)

FHWA LTAP funding is targeted for technical assistance and training for local agency public works programs. These funds provide half the funding for the programs and activities of the T2 program.

### Oregon Highway Fund

These funds are used in several ways. The Research Section uses state highway funds to cover indirect costs. Also, with some specific exceptions, SPR funds require 20% local participation. In most cases the source of these "matching" funds is the Oregon Highway Fund. Finally, a few research projects are carried out entirely with state highway funds.

### Local Government

LTAP funding requires 50 percent local participation. Most of these required matching funds are provided by the Association of Oregon Counties and the League of Oregon Cities. Members of these organizations are the primary recipients of T2 services.

To an increasing extent, major research projects at ODOT are jointly funded by ODOT and a University Transportation Center (UTC), in which ODOT research funds serve to meet matching or "local participation" requirements for UTC research funds.

There are also two ways that federal SPR funds are accessed. When a project is budgeted and carried out by

the Research Section, ODOT applies for and receives reimbursement for the federal share of any qualifying SPR project expense.

It is also possible to obligate federal SPR funds to a pooled fund project. In this case the funds are never received by ODOT and therefore do not affect the budget; the funds are simply redirected from one federal reimbursement account to another. This option is used to contribute to pooled fund projects managed by FHWA and other states.

Table 4.5 summarizes expenditures by program area and by source of funds. Figure 4.1 presents expenditures by program area in graphic form.

## Table 4.5: Budget and Expenditures Summary by Program and by Source of Funds

| | Federal | | | Oregon | | |
|---|---|---|---|---|---|---|
| **Program** | **SPR Research** | **SPR Planning** | **LTAP** | **Highway Funds** | **Local Government** | **Total** |
| SPR Research Program | $2,873,623 | $85,816.00 | | $86,459 | | $3,045,899 |
| LTAP Program | | $39,084 | $174,012 | | $174,012 | $387,108 |
| TRB Subscription | $208,171 | | | | | $208,171 |
| NCHRP | $442,176 | $87,510 | | | | $529,686 |
| Pooled Fund led by Oregon | $193,175 | | | | | $193,175 |
| Other States Pooled Fund | $252,500 | $85,000 | | | | $337,500 |
| Indirect and State Research | | | | $510,562 | | $510,562 |
| **TOTAL** | $3,969,645 | $297,410 | $174,012 | $597,021 | $174,012 | $5,212,101 |

## Figure 4.1: FY2015 Research Expenditures

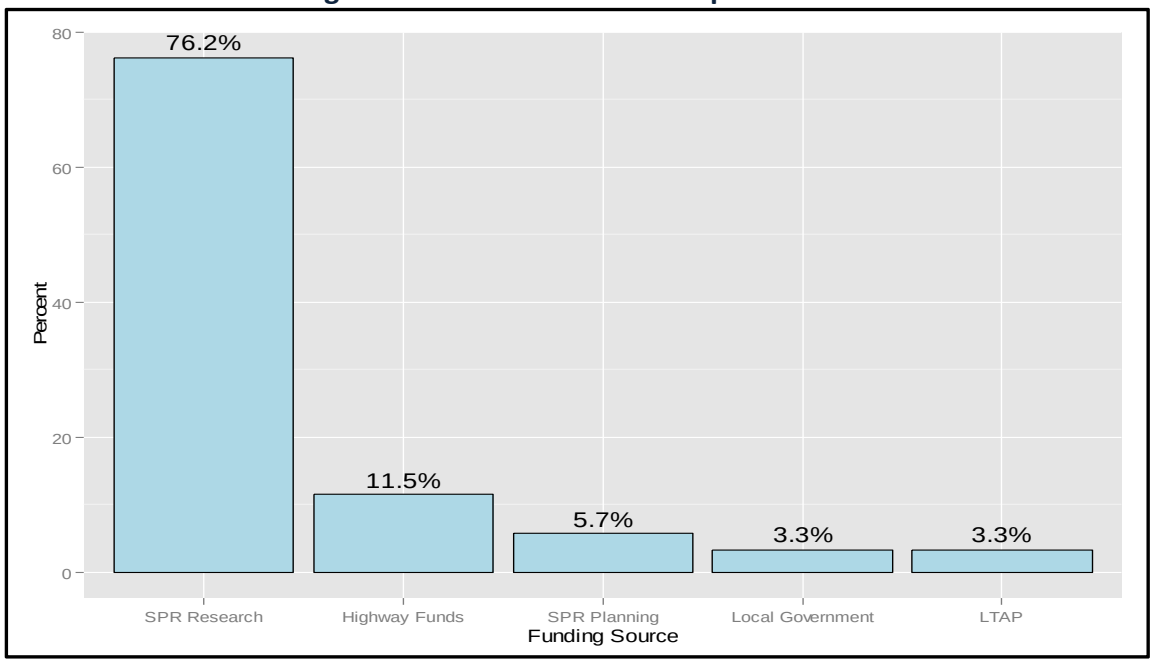

Figure 3 - Work site for evaluating copper removal from storm water runoff

# Appendix A: Research Advisory Committee, Expert Task Groups, Priorities, and Staff

## Research Advisory Committee

The Research Advisory Committee makes final decisions on research priorities and project selection. Eight of nine voting members sit on an Expert Task Group (ETG).

### Voting Members

- Bob Bryant, ODOT Region 4 Manager
- Tom Lauer, ODOT Technical Services Manager/Chief Engineer
- Jerri Bohard, ODOT Transportation Development Division Administrator
- Scott Ashford, OSU Dean of Engineering
- Luci Moore, ODOT State Maintenance and Operations Engineer
- Tom McClellan, DMV Administrator
- Troy Costales, ODOT Safety Division Administrator
- Hal Gard, ODOT Rail and Transit Divisions Administrator
- Chris Monsere, PSU Associate Professor, Civil and Environmental Engineering

### Non-Voting Members

- Jasmine Harris, FHWA Oregon Division
- Jennifer Dill, TREC Director

## Expert Task Groups

Project selection in Fiscal Year 2015 was organized into eight subject areas. Each area has its own ETG. These groups develop and recommend priorities and screen problem statements in their areas of expertise. Membership and Fiscal Year 2015 priorities for each ETG are summarized below.

### Emerging Issues

***Expert Task Group:***

- Xiugang "Joe" Li, Chair, ODOT Research

### Hydraulics, Geotechnical, and Environmental Research

***Expert Task Group:***

- Matthew Mabey, Chair, ODOT Research
- Paul Wirfs, ODOT Geo-Environmental Section
- Darlene Weaver, ODOT Geo-Environmental Section
- Jon Guido, ODOT Geo-Environmental Section
- Dan Gunther, ODOT Geo-Environmental Section
- William Fletcher, ODOT Geo-Environmental Section
- Curan Mohney, ODOT Geo-Environmental Section
- Chris Maguire, ODOT Geo-Environmental Section
- Cindy Callahan, FHWA Western Lands

***Research Priorities:***

- Cost effective management and monitoring of storm water

- Performance of high walls
- Right-of-way vegetation establishment and management
- Impacts and solutions to roadway induced habitat separation
- Bank protection and scour
- Rehabilitation, retrofitting, and replacement of pipes and culverts
- Lifecycle cost analysis of pipes and culverts
- Effects of slopes and embankments on the transportation system
- Practical means and methods for sub-grade stabilization
- Impacts of re-using construction debris and other recycled materials in highway construction and maintenance, including feasibility, long-term financial costs and benefits, and environmental impacts

## Maintenance and Operations Research

***Expert Task Group:***

- Jon Lazarus, Chair, ODOT Research
- Mike Kimlinger, ODOT Traffic
- Galen McGill, ODOT Intelligent Transportation Systems
- John Gambatese, Oregon State University
- Nathaniel Price, FHWA Oregon Division
- Timothy Swift, ODOT District 2
- Mike Stinson, ODOT District 11
- Theodore Miller, Region 1 Maintenance

***Research Priorities:***

- Effective roadside and work zone safety
- Effective project delivery and quality assurance
- Effective pavement delineation
- Efficient and effective maintenance practices

## Construction, Pavements, and Materials Research

***Expert Task Group:***

- Norris Shippen, Chair, ODOT Research
- David Trejo, Oregon State University
- Larry Ilg, ODOT Pavement Services Unit
- Dean Chess, ODOT New Products Coordinator
- Greg Stellmach, ODOT Quality Assurance Engineer
- Cole Mullis, ODOT Pavement Services Engineer
- Joe Squire, ODOT State Construction and Materials Engineer
- Shane Ottosen, ODOT Project Manager
- Justin Moderie, ODOT Pavement Design Engineer
- Anthony Boesen, FHWA Oregon Division

***Research Priorities:***

- Identify design, materials, construction, and maintenance practices that optimize performance
- Develop construction processes that allow construction phase completion to minimize service disruptions
- Identify materials and construction practices that optimize application while minimizing environmental and safety risks
- Evaluate effective project delivery and quality assurance methods

## Planning and Economic Analysis Research

***Expert Task Group:***

- Tony Knudson, Chair, ODOT Research
- Lana Tribbey, ODOT Driver and Motor Vehicle Services Division (DMV)
- Liming Wang, Portland State University
- John Baker, ODOT Governmental Relations
- Erik Havig, ODOT Transportation Planning Section
- Alex Bettinardi, ODOT Transportation Planning Section
- Amanda Pietz, ODOT Transportation Planning Section
- Jack Svadlenak, ODOT Transportation Planning Section
- Satvinder Sandhu, FHWA Oregon Division
- Jon Makler, ODOT Region 1 Planning
- Dan Porter, ODOT Director's Office

***Research Priorities:***

- Identify best practices, tools, and methods that increase understanding of outcomes and capacity to balance goals and objectives resulting in improved project prioritization and strategic investments.
- Create cost effective, high-value approaches for planning, developing, and maintaining intermodal transportation.
- Increase understanding of mode choice, mode shift, factors that influence supply and demand of modes, and multimodal measures of effectiveness.
- Inform long-range planning and policy development, including asset and risk management, performance measures, modeling and analysis, case studies, and new planning methods.
- Identify efficiency gains to the user, to the transportation system, and to the related agency through better technology, innovative business practices, data analytics, partnerships, or cost effectiveness.

## Active and Sustainable Transportation Research

***Expert Task Group:***

- Lyn Cornell, Chair, ODOT Research
- Miguel Figliozzi, Portland State University
- Sheila Lyons, ODOT Bike/Ped Program
- Robert Melbo, ODOT Rail Division
- Dinah Van der Hyde, ODOT Transit Division
- Chris Cummings, ODOT Freight Mobility Section
- Jasmine Harris, FHWA Oregon Division
- David Porter, OSU
- Geoff Crook, ODOT Active Transportation Section

***Research Priorities:***

- Impact of shifting economic conditions and trends affecting multimodal transportation demands and transportation related infrastructure
- Impact of land use and intermodal connectivity choices on safety at the interface of transportation modes

- Regional passenger rail interconnectivity: optimizing existing freight railroad infrastructure with new strategic extensions and connections
- Methods for assessing multimodal transportation needs, capacity development, resource/supply flow, infrastructure maintenance and preservation
- Development of integrated multimodal data warehouses for research and planning use
- Sustainable transportation
- Congestion management using multimodal strategies
- Methods for evaluating multimodal investment programs, such as *Connect*Oregon II
- Studies of changes in regional supply chain trends reducing supply and shipping distances

## STRUCTURES RESEARCH

***Expert Task Group:***

- Tungfei Fu, Chair, ODOT Research Section
- Bruce Johnson, ODOT Bridge Engineering Section
- Solomon Yim, Oregon State University
- Jeff Swanstrom, ODOT Bridge Operations Unit
- Scott Nelson, ODOT Construction Section
- Timothy Rogers, FHWA Oregon Division

***Research Priorities:***

- Load capacity evaluation and improvement of structural members
- Non-destructive evaluation technologies for assessing structures
- Remediation of corrosion in reinforced concrete
- Methods for disaster mitigation
- Technologies for accelerating construction
- Service life design of critical bridge elements
- Improvement of bridge deck integrity

## TRAFFIC, SAFETY, AND HUMAN FACTORS RESEARCH

***Expert Task Group:***

- Mark Joerger, Chair, ODOT Research Section
- Doug Bish, ODOT Traffic Engineering Services
- Anne Holder, ODOT Transportation Safety Division
- Bryce McKenna, ODOT DMV
- Nick Fortey, FHWA
- Sal Hernandez, Oregon State University
- David McKane, ODOT Motor Carrier Transportation Division
- Angela Kargel, ODOT Region 2

***Research Priorities:***

- Safer roadway design
- Safer roadside features
- Safer traffic control devices
- Safety data and analysis
- Driver information and continuing education
- Reducing the number of unsafe drivers on Oregon roads

## RESEARCH STAFF

| | |
|---|---|
| **Michael Bufalino**, *Research Manager* | **Linda Perkins**, *Research Key Contact*<br>Web Support, Grant Administration |
| **Matthew Mabey**, *Research Coordinator*<br>Hydraulics, Geotechnical, and Environmental | **Laura Wilt**, *ODOT Librarian* |
| **Jon Lazarus**, *Research Coordinator*<br>Maintenance and Operations | **Rebekah Jacobson**, *T2 Center Director* |
| **Tengfei Fu**, *Research Coordinator*<br>Structures | **Linda Milligan**, *T2 Training Coordinator* |
| **Lyn Cornell**, *Research Coordinator*<br>Multimodal and Sustainable Transportation | **Robert Raths**, *T2 Center Circuit Rider* |
| **Norris Shippen**, *Research Coordinator*<br>Construction, Pavements, and Materials | **William Kolzow**, *T2 Center Circuit Rider* |
| **Mark Joerger**, *Research Coordinator*<br>Traffic, Safety and Human Factors | **Tony Jobanek**, *T2 Center Circuit Rider* |
| **Tony Knudson,** *Research Coordinator*<br>Planning and Economic Analysis | **Willard Bradshaw,** *T2 Center Safety Circuit Rider* |
| **Xiugang "Joe" Li**, *Research Coordinator*<br>Emerging Issues | |

*For more information on ODOT's research program and projects, contact*

**Research Section**
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Salem, OR 97301-6867
Telephone: 503-986-2700 FAX: 503-986-2844

***Or visit our website at http://egov.oregon.gov/ODOT/TD/TP_RES/***

Oregon Department of Transportation

# Appendix B: Abbreviations

| | Abbreviation | Name |
|---|---|---|
| A | AASHTO | American Association of State Highway and Transportation Officials |
| | AE | acoustic emission |
| | APWA | American Public Works Association |
| | AUTC | Alaska University Transportation Center |
| C | CP | Cathodic protection |
| D | DIP | Driver Improvement Program |
| | DMV | Driver and Motor Vehicle |
| | DOT | Department of Transportation |
| E | ETG | Expert Task Group |
| F | FHWA | Federal Highway Administration |
| | FY | Fiscal Year |
| I | ISB | Information Systems Branch |
| L | LRFR | Load and Resistance Factor Ratings |
| | LTAP | Local Technical Assistance Program |
| | LTPP | Long Term Pavement Performance |
| M | MEPDG | Mechanistic Empirical Pavement Design Guide |
| | MOU | Memorandum of Understanding |
| | MPU | Metropolitan Planning Organization |
| N | NCHRP | National Cooperative Highway Research Program |
| | NIATT | National Institute for Advanced Transportation Technology |
| | NUTRC | Northwest Universities Transportation Research Consortium |
| | NWTC | Northwest Transportation Conference |

| | Abbreviation | Name |
|---|---|---|
| O | ODOT | Oregon Department of Transportation |
| | OIT | Oregon Institute of Technology |
| | OSU | Oregon State University |
| | OTIA | Oregon Transportation Improvement Act |
| | TREC | Transportation Research and Education Center |
| P | PSU | Portland State University |
| R | RAC | Research Advisory Committee |
| | RCDG | Reinforced Concrete Deck Girders |
| | RD&T | Research Development and Technology Transfer |
| S | SAFETEA-LU | Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users |
| | SHRP | Strategic Highway Research Program |
| | SPR | State Planning and Research |
| | STIP | Statewide Transportation Improvement Program |
| T | T2 | Technology Transfer |
| | TPAU | Transportation Planning and Analysis Unit |
| | TPF | Transportation Pooled Fund |
| U | TRB | Transportation Research Board |
| | U of O | University of Oregon |
| | UTC | University Transportation Center |
| W | WIM | Weigh-in-motion |

RESEARCH