OREGON DEPARTMENT OF TRANSPORTATION

RESEARCH, DEVELOPMENT, AND TECHNOLOGY TRANSFER PROGRAM

Annual Report Fiscal Year 2023

RESEARCH

Oregon Department of Transportation

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Oregon Department of Transportation
Research Section
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1.0 INTRODUCTION

1.1 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 more than 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 100 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 Policy Data and Analysis 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:

- Active and Sustainable Transportation,
- Construction and Maintenance,
- Policy, Planning, Freight and Economic Analysis,
- Geotechnical Hydrology Environmental Science and Engineering

- Pavement and Materials,
- Structures,
- Traffic Safety and Human Factors,

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 seven research coordinators, an executive support assistant, and three part-time trainers.

1.2 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, and other state agencies.

1.3 CONTENTS OF THIS REPORT

For Fiscal Year 2023 this report documents the research projects we completed (Section 2); a review of the implementation of projects completed 5 years ago (Section 3); research publications, progress, and spending (Section 4); other research activities (Section 5). 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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2.0 COMPLETED PROJECTS

Pursuant to 23 CFR 420.209 (a)(6), the State must have procedures for documenting RD&T activities through the preparation of final reports. Each completed research project results in a report that documents the data collected, analyses performed, conclusions, and recommendation. This section lists the projects completed in Fiscal Year 2023. Table 2.1at the end of this section lists the published report number and publication date. All completed projects listed below resulted in a final report that is available online at: https://www.oregon.gov/ODOT/Programs/Pages/Research-Publications.aspx **SPR 719 Baseline Data for Assessing Climate Change and Future Enhanced Surface Water Passage Impacts on the Salmon River Estuary**

The Oregon Department of Transportation (ODOT) monitored the surface waters in and around the Salmon River Estuary on the Pacific coast of Oregon for approximately ten years. Two ODOT highways are associated with this estuary. Oregon State Route 18 runs along a portion of the southern margin of the estuary while U.S. Route 101 runs directly across the estuary. Water level, conductivity, temperature, and dissolved oxygen measurements were collected at 10-minute intervals from 20 stations for varying periods from 2011 until 2021. Numerous researchers have been monitoring the flora and fauna in the estuary for decades. Comparatively little longitudinal data regarding the hydrology and water in and around the estuary has been published. This report documents the water data ODOT collected from 2011 through 2021. This report describes the data to make them usable by researchers from diverse disciples. It is hoped that many future publications will interpret these data.

SPR 824 Evaluation of Site Effects Utilizing Cascadia Subduction Zone Ground Motions

The potential Cascadia Subduction Zone (CSZ) megathrust earthquake is recognized as one of the major natural hazards affecting the Pacific Northwest of the United States. The estimation of expected ground-motions is complicated by the long-duration motions from CSZ as well as site effects from deep sedimentary basins in northwest Oregon. This study evaluates the combined effects of long duration motions and basin effects on site amplification factors due to propagation of earthquake waves in surficial soils. Nonlinear and equivalent linear one-dimensional site response analyses were performed using broadband synthetic CSZ ground motions from the M9 Project. A web-based tool was developed to synthesize the vast data and geographically visualize the M9 ground motions as well as the subsequently computed response spectra. Five soil profiles representing a range of site classes from Site Class C to Site Class E were considered for the analyses. Ground motions were extracted at three locations inside major basins in Northwest Oregon (Portland basin, Tualatin basin, and North Willamette basin) and three comparable locations outside the basins. The effect of basin on soil amplification factor was characterized by comparing the soil amplifications inside and outside basins for the same soil profiles. The basin amplification factors calculated for CSZ broadband synthetic ground motions at bedrock (Site Class B/C) for selected sites within the three basins in Oregon were found to be noticeably larger than the ratios calculated from empirical correlations that are incorporated in New Generation

Ground Motion Attenuation Models (NGA-West2). The soil amplification ratios calculated from the site response analyses were generally within the envelope of code-based site coefficients in ASCE 7, except for very short periods (<0.5 seconds). The effect of basins on soil amplification ratios ranged from 50% increase to 30% decrease at periods close to the natural period of the basin (generally between 1 sec and 2 sec). The implication of these findings on the use of code-based site coefficients and advantages of performing site-specific site response analysis are discussed.

SPR 829 Rumble Strip Design Analysis to Contribute to Low Exterior Noise Using Finite Element Modeling

Optimal rumble strips/stripes are critical to ensure traffic safety and simultaneously avoid disturbance to the surrounding environment. In this project, we have utilized a commercial Finite Element modeling tool to calculate the amount of noise in the tires while rolling over the rumble strips. The sound level is determined within the tire cavity. We have evaluated three types of designs: conventional, sinusoidal, and sawtooth. In total, we have simulated 19 conventional designs, 21 sinusoidal designs, and 6 sawtooth designs at 3 varying vehicle speeds for a passenger car and a truck tire. We have observed that the sinusoidal designs produced lower sound outputs than the conventional designs, and the sawtooth designs with a longer wavelength produced similar sound outputs to a sinusoidal design at the same depth. Furthermore, we have developed a non-zero angle of landing for different conventional and sinusoidal designs. Overall, our numerical simulations produced expected trends in the sound outputs for different rumble strip dimensions. Furthermore, when a chosen sound output level is determined, a specific dimension can be found among the simulated cases to guide the construction.

SPR 831 Design and Life-Cycle Assessment of Gabion Barriers for Rockfall Mitigation using Numerical Modeling

This project developed Graphical User Interface (GUI) software to perform numerical simulations in which gabion barriers are impacted by boulders of various geometries and initial momentum values. The results generated from this tool are used to develop design standards and life-cycle analysis procedures.

SPR 833 Impacts of Intersection Treatments and Traffic Characteristics on Bicyclist Safety

This study assessed the safety impact and performance of three different bicycle-specific intersection treatments (bike boxes, mixing zones, and bicycle signals) using surrogate safety measures (i.e., bicycle-vehicle conflicts and other non-crash measures). To date, limited research had been conducted to analyze how these treatments along with traffic characteristics (e.g., bicycle, pedestrian, and vehicle volumes) impact the frequency and severity bicycle-vehicle conflicts, and research was needed to provide practitioners guidance on when and where to install these treatments. To develop this guidance, this project analyzed data collected from three sources: data reduced from videos at 12 field study sites, microsimulation modeling, and a bicycling simulator experiment. Through estimation of Poisson regression models and other statistical analyses of these data, guidance was developed which provides practitioners information on when and where to consider installation of these treatments based on bicycle, vehicle, and pedestrian volumes, road user speeds, and other bicyclist behavioral characteristics.

SPR 835 Implementation of Laboratory Conditioning and Testing Protocol to Evaluate Moisture Susceptibility of Asphalt Mixtures

Moisture damage in asphalt mixtures can cause early cracking and rutting failures due to the internal damage accumulated by the high internal pore pressures created at the aggregate-binder interface and/or within the binder phase by heavy traffic loads. Due to the high precipitation levels and frequent rain events, distresses originating from moisture damage are commonly observed on roadways in Oregon. ODOT has been mostly using hydrated lime to combat distresses related to moisture damage at the mixture level, while the effectiveness of new chemical anti-strips and warm-mix technologies has also started to be investigated. However, a reliable moisture conditioning method and moisture susceptibility test need to be developed and implemented for Oregon to determine the possible long-term impact of several new additive technologies on pavement longevity. Roadway geometry, asphalt layer density, construction of proper superelevation on the roadway for effective water removal, and functioning drainage facilities can be considered to be the other important factors that control moisture-related failures on roadways. Based on the comprehensive literature review and the results of the laboratory investigations, this study recommends the use of a colorimeter in conjunction with the current AASHTO T 283 (2014) method to determine the adhesion and cohesion-related moisture susceptibility. According to the laboratory test results, vacuum saturation is able to create significant moisture damage in the asphalt microstructure, and no other conditioning method needs to be adapted to replace the vacuum saturation method. Developed tools and test procedures are expected to help ODOT identify the benefits of recent additive technologies that are being developed to combat moisture damage of asphalt mixtures.

SPR 838 Centerline Rumble Strip Effects on Pavement Performance

Despite numerous research studies inspecting the safety benefits of CLRS on pavements, there has been limited exploration into the impact on pavement durability as a result of the installation of CLRS. The major purpose of this study was to corroborate what specific factors are controlling the cracking failures due to the installation of CLRS and find solutions to mitigate CLRS-related failures on the roadway. The first component of the study was Finite Element Analysis (FEA) modeling. FEA was conducted to simulate moving tire loads over a full-scale asphalt pavement section containing CLRS. The optimal CLRS configuration included sinusoidal rumble strips installed adjacent to the longitudinal joint with a shorter wavelength. The FEA results verified the findings of the laboratory testing while allowing for the examination of additional factors not tested in the laboratory component of this study. In the second phase of this study, a test strip was constructed at the Knife River facility in Corvallis, Oregon where CLRS were milled into the asphalt pavement. The primary findings showed that sinusoidal CLRS had optimal performance, shallower and smaller rumble strips had a less structural impact, and chip seal surface treatment is an effective method to prevent moisture infiltration, which is expected to be a major factor controlling CLRS performance. The next portion of the study was X-ray Computed Tomography (CT) imaging to determine the presence of microcracks in the asphalt pavement due to rumble strip milling. Results demonstrated the presence of microcracks at all milled rumble strip locations. This finding pointed out the importance of applying a surface treatment on the CLRS right after installation to reduce moisture-related cracking failures. Potential failure mechanisms and construction recommendations were developed based on the results of laboratory testing, X-ray CT imaging, and FEA.

SPR 837 Automated Identification of Traffic Detector Malfunctions

There is a need to improve signalized intersection operations through identifying malfunctioning detectors, as recent work has shown that errors in data quality and accuracy may be widespread due to issues with aging equipment and unmet maintenance needs. Accordingly, there is a desire for policies, procedures, and techniques to identify malfunctioning detection equipment and evaluate the quality of data produced by detectors. Current tools, including those available through newer Advanced Traffic Controller (ATC) standards, are able to detect major detector failures by examining the presence, absence, or frequency of data being sent by a detector, but these tools are not able to assess the quality of the information sent; therefore, the health of the detector is commonly unmonitored. To address this issue, using event-based data, researchers isolated saturated flow from individual presence detectors at signalized intersections, and using detector activations and occupancy, were able to calculate volume and density metrics for individual green intervals. These data points were then used to approximate the undersaturated portion of a Volume vs. Density fundamental diagram for detectors at various sites in Oregon. Using the mathematical concept of percent difference between integrals, several performance datasets were developed for this work for use in algorithms also developed as part of this work. These algorithms assess detector health, both initially and over time. Finally, a system design and implementation plan was developed to aid in the deployment of this system.

SPR 839 Best Practices for Work Zone Safety during Traffic Control Placement, Removal, and Modification

Studies have shown that drivers are at a higher risk of being involved in a crash when travelling through a work zone compared to normal driving conditions. Research further suggests that the crashes that occur in work zones are, on average, more severe than crashes that occur outside of work zones. The periods while temporary traffic control is being set-up, removed, or modified are also especially concerning given the exposure of the workers to traffic and the transition in the driving environment. This study aims to investigate the safety hazards and risk present during set-up, removal, and modification of temporary traffic control on high-speed roadways, and identify potential practices for improving safety during the traffic control deployment and removal processes. To date, the researchers have performed a comprehensive literature review on the study topic and conducted a survey of state department of transportation and highway construction contractor personnel. The results reveal a lack of a standard process/procedure and detailed guidance for setting up and removing traffic control. The survey results expose steps in the process that pose high risk to workers and motorists, such as when the traffic control is being placed to initially set the taper to close a lane. This document is an interim report that describes the study results to date and provides a proposed methodology for the remaining study tasks.

SPR 840 Safest Placement for Crosswalks at Intersections

This research studied the relationship between crosswalk setback and intersection safety. The study included field-based and driving simulator experiments. Video data was collected at 10 crosswalks in Oregon to examine the frequency pedestrian-vehicle conflicts (measured using PET), including how these conflicts vary between corner and setback crosswalks. A total of 507 pedestrians and 47 conflicts with post-encroachment times of less than 5 seconds were observed. The 50 participants driving simulator experiment was used to determine how setback distances, curb radii, and presence of pedestrians affect driver stopping decision and position, speed choice, visual attention, and level of stress. Observations of drivers' speed in a similar scenario were taken from field and simulator data to enhance the evidence provided by each experiment. Stop line speeds were found to be consistent between experiments and turning speeds were found to be slightly higher in the driving simulator experiment. The study results suggest that curb radius should be smaller to control driver speed. Additionally, setback distance of the crosswalk of 20ft is a suitable upper bound when reconstructing intersections.

FY 2023 Oregon Transportation Needs and Issues Survey

The Oregon Transportation Needs and Issues Survey was first conducted in 1993 and has been done roughly every two years. The latest survey was completed in Summer 2022 (State fiscal year (FY) 2023). This report summarizes the results of the FY 2023 survey. For some reoccurring questions, results are also compared to past surveys.

Table 2.1: Research Reports Published in FY 2023

Report No.	Report Title	Date Published
719	Baseline Data for Assessing Climate Change and Future Enhanced Surface Water Passage Impacts on the Salmon River Estuary	9/8/2022
824	Evaluation of Site Effects Utilizing Cascadia Subduction Zone Ground Motions	6/27/2023
829	Rumble Strip Design Analysis to Contribute to Low Exterior Noise Using Finite Element Modeling	8/8/2022
831	Design and Life-Cycle Assessment of Gabion Barriers for Rockfall Mitigation using Numerical Modeling	6/27/2023
833	Impacts of Intersection Treatments and Traffic Characteristics on Bicyclist Safety	8/17/2022
835	Implementation of Laboratory Conditioning and Testing Protocol to Evaluate Moisture Susceptibility of Asphalt Mixtures	3/13/2023
838	Centerline Rumble Strip Effects on Pavement Performance	6/8/2023

Report No.	Report Title	Date Published
837	Automated Identification of Traffic Detector Malfunctions	9/12/2022
839	Best Practices for Work Zone Safety during Traffic Control Placement, Removal, and Modification	12/6/2022
840	Safest Placement for Crosswalks at Intersections	6/20/2023
TNIS	FY 2023 Oregon Transportation Needs and Issues Survey	12/22/2022

3.0 FIVE YEAR REVIEW OF PAST PROJECTS

The Oregon DOT works to actively implement appropriate research findings and should document benefits to track the active implementation of appropriate research finding, projects completed five years ago are identified in this section. Where appropriate, findings and benefits are discussed. In particular this each project is assessed for the following implementation actions:

- Updates to ODOT documentation (e.g. policy, procedures, specifications, or other implementation documents) that have been updated as a result of this research.
- Use of the research to inform ODOT's position regarding any state statutes or administrative rules?
- Support of the work of national partners such as AASHTO, FHWA, to update national standards or guidance?
- Creation of a new program, position, or organizational unit?

This section of the report is part of Oregon's compliance with 23 CFR 420.209 (a)(5) , to determine the utilization of the State DOT's RD&T outputs, and of 23 CFR 420.209 (a)(6) documenting the department's efforts to implement appropriate research findings and benefits of our work.

All the completed projects listed below are available online at:
https://www.oregon.gov/ODOT/Programs/Pages/Research-Publications.aspx

SPR 765 Effects of High Strength Steel Bars and Steel Casing on the Response of Drilled Shafts

The main objective of SPR765 is to improve the understanding of the axial and lateral load transfer of drilled shaft foundations constructed with high strength steel reinforcement and with steel casing for overall better drilled shaft design. This work is especially important given the limited full-scale testing of drilled shafts currently available to practitioners. To accomplish this objective, four full-scale test shafts were instrumented, installed, and axially and laterally tested at the Oregon State University (OSU) Geotechnical Engineering Field Research Site (GEFRS). Two uncased shafts were constructed, one using mild steel and one using high strength steel reinforcement, designated MIR and HSIR, respectively, and two shafts with steel casing and with and without internal mild steel reinforcement, designated CIR and CNIR, respectively. The findings from this research will be broadly presented to ODOT's Geotechnical and Bridge Group Designer Exchange in September. The lead researcher will also work to implement the findings from this research by coauthoring language to be incorporated in the GDM and the BDDM regarding drilled shaft design.

ODOT has adopted the use of high strength reinforcement in drilled shafts (ODOT Bridge Design Manual, Section 1.5.5.15.4.) but limited to shafts that are not expected to experience inelastic deformation under seismic loads. Also, in one of our recent signature projects, the widening and seismic retrofit of Abernethy Bridge, we are using permanent steel casing for the new drilled shafts and, high strength reinforcing on these shafts.

ODOT is now working on developing more comprehensive design specifications for drilled shafts with permanent casing, which in most scenarios it will be combined with the use of high strength reinforcement. These design specifications are expected to be incorporated into our Bridge Design Manual in the near future.

SPR 775 Application of Titanium Alloy Bars for Strengthening Reinforced Concrete Bridge Girders

Near-surface mounting (NSM) of supplemental reinforcing bars has emerged as a common retrofit method for strengthening reinforced concrete structures. In this method, bars are bonded with an adhesive within grooves that are cut into the surface of the member. The most common reinforcing material used in the NSM application is fiber reinforced polymer (FRP). FRP materials are elastic until fracture thus providing no ductility. In addition, they can debond prematurely limiting the effectiveness of the repair. For this reason, new titanium alloy bars (TiABs) were developed as a potential alternative for FRP bars in NSM applications. Results showed that NSM TiABs provided significant increases in the strength when compared to similar unstrengthened specimens. The TiABs were observed to achieve the yield stress prior to/at ultimate. Anchorage of the TiABs was sufficient to produce rupture over the main diagonal cracks. The double leg TiABs were easier to construct and provide additional confinement across the beam soffit. It was determined that some reduction in strength was observed for one of the epoxy materials due to the combined fatigue and environmental effects. Three methods were used to analyze the experimental results which could conservatively predict strength. Strength reduction factors were developed for each method to be used in design.
As a result of this research ODOT has updated the Bridge design manual section 1.15.1.1.4 Bonded Strengthening Systems/Near Surface Mounted System, and ODOT has developed standard boilerplate 00567 Titanium Alloy Reinforcement System. Due to this research, AASHTO published the AASHTO design guide (3rd Bullet). The strengthening method is also mentioned in AASHTO Historic Bridge Preservation Guide 1st Edition published in 2020.

To date the methods developed by this research was used for the following projects: Mosier Bridge, I-205 Main St Bridge, D River Bridge, Schooner Creek Bridge, Siltcoos River Bridge, Gold Beach Bridge, and Caveman Bridge, Mill Creek Bridge, McKercher Bridge, Arthur Street Bridge, and I-5 Terwilliger On-ramp. Reports indicate that other states including Texas and New York are also using these methods.

SPR 783 Truck Parking: An Emerging Safety Hazard to Highway Users

It is recognized nationwide that commercial motor vehicle operators are often unable to find safe and adequate parking to meet hours-of-service (HOS) regulations. This holds true in Oregon, where high-use corridor rest areas and truck stops are experiencing a demand for truck parking that exceeds capacity. With such a demand for truck parking, there is an inherent safety concern for all highway users, primarily due to trucks parking in undesignated areas or commercial motor vehicle drivers exceeding their HOS to find safe and adequate parking. This work takes a closer look at truck parking along a high-use corridor in Oregon, namely US-97. To accomplish this, a stated-preference survey is administered to truck drivers that utilize Oregon roadways to gather opinions in regards to truck parking. Next, a parking demand analysis is conducted to assess current and future truck parking demand along US-97. To finish, historical Oregon crash data is used to identify crash trends, crash hot spots, and crash harm estimates along US-97. Survey results indicate that nearly two-thirds of surveyed truck drivers encountered trouble when looking for safe and adequate parking. Further, crash trends in terms of time-of-day, day of the week, and month of the year follow the time periods drivers stated having trouble finding safe and adequate parking. Crash harm estimates suggest a substantial impact on the economy.

This research was directly implemented via the statewide Truck Parking Study published in 2020. The Study was a critical piece of work that recommended Oregon install a truck parking information management system as well as plan for strategic increases to truck parking supply in the future.

SPR 785 Adjusting Asphalt Mixes for Increased Durability and Implementation of a Performance Tester to Evaluate Fatigue Cracking of Asphalt

Cracking is a common failure mechanism in asphalt concrete pavement structures. It is one of the main reasons for large road maintenance and rehabilitation expenditures, as well as reduced user comfort and increased fuel consumption due to high road roughness. The resistance of the pavement to this distress mechanism is dependent upon the ductility of the asphalt pavement mixture.

The goal of this study was to provide a better decision-making structure during the pavement design stage to address fatigue cracking susceptibility, with the intent of avoiding premature pavement failure and expensive early maintenance and rehabilitation. Additionally, the study reliably facilitated an increase in recycled materials content in asphalt pavement through advanced testing procedures and design recommendations proposed in this study.

SPR 786 Enhancing Landslide Inventorying, Lidar Hazard Assessment and Asset Management

The main objective of this research was to refine a landslide identification tool to decrease subjectivity and improve the speed of landslide mapping processes for prioritization of landslide mitigation along our highway system. This report introduces a new workflow to improve the efficiency of landslide inventorying and mapping efforts using semi-automated tools for mapping scarps and delineating the deposits of deep-seated and translational landslides. These tools include a scarp delineation tool called ScarpID and a landslide deposit delineation algorithm called the Contour Connection Method, or CCM. This combined workflow, known as SICCM, can automatically identify landslide scarps and deposits within DEMs. With varying levels of intervention, this process can be used to rapidly generate landslide inventories for large areas or can be integrated into more detailed processes such as Special Paper 42 (SP-42, DOGAMI's current standard process) by providing initial information. These tools will be used by ODOT and DOGAMI to 1) map large areas quickly as an initial assessment, 2) provide an initial map as a starting point for completing DOGAMI's SP-42 process, and 3) provide ODOT advanced tools for infrastructure hazard/risk assessment.

SPR 787 Eyes in the Sky: Bridge Inspections with Unmanned Aerial Vehicles
Bridge inspections are important for assessing the safety of a bridge and are done typically at an arm's length from the inspection point(s). Bridge inspection is inherently dangerous. In order to access and view necessary bridge elements, inspectors are often required to stand in vehicles that are costly to mobilize and at times dangerous. Some inspections require extensive climbing or use of rescue boats. The purpose of this research is to evaluate the capabilities and limitations of Unmanned Aerial Vehicle (UAV) technology for use in visual structural inspections. UAVs are capable of flying a pre-loaded path and can carry digital cameras and other sensors. They are excellent for accessing spots that are dangerous or hard to reach by humans without the use of specialized climbing equipment. During flights, operators can view live video from the camera to determine areas that may need detailed inspection.

The completion of this research was a key part of establishing the agency's Unmanned Arial Systems program.

SPR 789 Improved Safety and Efficiency of Protected/Permitted Right-Turns in Oregon
The goal of the research was to develop an understanding of the safety and operational implications of using the Flashing Yellow Arrow to indicate a permitted right turn, and to provide general guidance as to when Protected/Permitted Right Turns (PPRT) phasing should be used to maximize the safety of non-motorized road users and the overall efficiency of ODOT's signalized intersections.

The signal head configurations recommended by this project have been incorporated into the standard for Flashing Right Turn Arrows for the 2022 ODOT Signal Design Manual. That signal head (Type 3RCF) now appears as an option in ODOT Standard Drawing TM 460 for Vehicle Signal Details.

SPR 791 Use of Additional Lighting for Traffic Control and Speed Reduction in Work Zones
Performing roadway construction work at night exposes workers to hazards that are not present or as great during the daytime. Working at night requires illuminating the area where work is taking place in order to provide sufficient lighting for the workers to see their work and to illuminate the workers. Work area lighting may also have a positive impact on the speed of passing vehicles. Based on previous studies vehicle speed reduction in the work zone during nighttime operations is assumed to be due in part to the lighting provided to conduct the work. This study evaluated the impact of temporary work zone lighting on vehicle speeds. The research findings indicate that additional temporary roadway lighting helps to make workers more visible to motorists and equipment operators, and leads to slightly higher vehicle speeds. Implementation of additional temporary roadway lighting is recommended where the work

operations contain concerns regarding visibility. Personal, wearable lights are also recommended for workers who are located away from large equipment and other light sources.

Based on this research ODOT has updated the following documents: the ODOT TCP Design Manual – Chapter 3.4.28, Work Zone Presence Lighting; the ODOT Standard Detail DET4772 and Specification for Construction, Section 00227, Work Zone Presence Lighting System.

SPR 794 Multi-Modal Intersections: Resolving Conflicts Between Trains, Motor Vehicles, Bicyclists and Pedestrians

This research report investigates the relationship between pedestrians and bicyclists on paths parallel to railroad tracks and with a road perpendicular to the path. The possible conflicts at intersections within these design parameters are of concern to ODOT, and therefore, has been recognized as an opportunity to conduct research that improves this type of intersection. The report contains an extensive literature review, including existing railroad treatment options, and a description of the conducted field surveys and pedestrian, bicycle, vehicle, and train counts from the video. The report could help future work, such as developing more design solutions for paths parallel to tracks and the road perpendicular to the path. The contents of this report may be used for information purposes.

SPR 797 Binder-Grade Bumping and High Binder Content to Improve Performance of RAP-RAS Mixtures

The purpose of this study is to be able to make performance and cost-benefit comparisons of using binder-grade bumping and increased binder content strategies in RAP/RAS mixture production in Oregon. Using the results of this study should aid developing asphalt mixture design procedures and blending requirements of RAP with virgin binder.

Binder-grade bumping and high binder content strategies recommended in this study are expected to increase the RAP/RAS content in asphalt mixtures, reduce the life-cycle cost, improve the cracking performance and encourage the widespread use of high RAP/RAS asphalt mixtures in Oregon.

SPR 803 Statewide Data Standards to Support Current and Future Strategic Public Transit Investment

Since completion, the ODOT Public Transportation Division purchased a web domain to host the standard and related material. Using funding from a STIC grant data from six Oregon public transit agencies are working with the research team to convert and compile transit ridership data into the GTFS-ride standard. Using STIF funding from PTD Cherriots, Lane Transit District, and Cascades East Transit have worked with Oregon State University researchers to allow for translation of their raw ridership data into the GTFS-ride standard. Additionally, research to develop systemic safety analysis tools are benefiting from the use of standardized ridership data. These ridership data are helping to understand pedestrian exposure at study sites across Oregon

SPR 804 A Method to Estimate Annual Average Daily Traffic for Minor Facilities for MAP-21 Reporting and Statewide Safety Analysis

This research project develops a simple and reliable method to estimate AADT on non-state roadway segments. Two separate analysis was conducted - non-state upper functional classification roadway segments with AADT less than 10000 and local roads. As the AADT varied based on location, we categorized region 2 non-state upper functional classification roads into four sub-regions and developed default values for each functional classification. For local roads, we determined default values based on sub-regions and the presence of Google Street View. Local roads without Google Street View had lower ADT than local roads with Google Street View. These default values can be used to quickly predict AADT if no other information is available. The analysis of the models developed in the literature review revealed that roadway and geometric information is more important than land use and socio-demographic information in predicting missing AADT. In this research, a simple point based model was developed to predict AADT based on the roadway, geometric, and signage information. We developed a stratified random sampling procedure to select roadway segments while ensuring all sub-regions and functional classification was adequately represented. The relevant variables were collected using Google Street View. An overall region 2 as well as separate sub-regional models were developed. The prediction accuracy of the models was tested on separate validation data. For the non-state upper functional classification roadway system model, the model errors were found to be reasonable on roadway segments with an AADT less than 5000. The sub-regional models provided lower median errors for the coast and valley-rural sub-regions. For local roads, the overall model had a median error of -32 which indicates that the model slightly under-predicts the ADT. The overall model has the lowest median error of 4 for the valley-rural sub-region. The gains in accuracy by using the sub-region model are not high.

4.0 PUBLICATIONS, ACTIVITY, AND SPENDING

The following section summarizes activities of the Research Section, including the status of active projects, cost information.

4.1 RESEARCH PROJECT STATUS

The status of 112 research projects initiated from FY 2014 through FY 2023 is summarized in Table 4.1. The reports published in FY 2023 are discussed in detail in Section 2 above. Table 4.2 summarizes the major projects that completed in FY 2023, and Table 4.3 documents the major projects continuing past FY 2023. 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.

Table 4.1: Project Status Summary, FY 2014 – FY 2023

Project Start Fiscal Year	Inactive		Active		Total New Projects
	Complete	Cancelled	On Schedule	Behind Schedule	
2014	11	1	0	0	12
2015	11	0	0	0	11
2016	14	1	0	0	15
2017	9	0	1	0	10
2018	11	0	0	0	11
2019	8	1	1	0	11
2020	6	0	2	1	9
2021	1	0	7	3	11
2022	0	0	11	0	11
2023	0	0	11	0	11
Total	71	3	33	4	112

Table 4.2: Expenditures and Status for Major Projects Ended During FY 2023

Project No.	Project Title	Spent in FY'2023	Publication Status	Status
719	Baseline Data for Assessing Climate Change and Future Enhanced Surface Water Passage Impacts on the Salmon River Estuary	$2,737	Published	Completed
812	Modeling Chloride Accumulation in Streams from Winter Road Salt Application for Federal…	$44,025	Published	Completed
824	Evaluation of Site Effects Utilizing Cascadia Subduction Zone Ground Motions	$11,395	Published	Completed
829	Rumble Strip Design Analysis to Contribute to Low Exterior Noise Using Finite Element Modeling	$0	Published	Completed
831	Design and Life-Cycle Assessment of Gabion Barriers for Rockfall Mitigation using Numerical Modeling	$1,579	Published	Completed
833	Impacts of Intersection Treatments and Traffic Characteristics on Bicyclist Safety	$0	Published	Completed
835	Implementation of Laboratory Conditioning and Testing Protocol to Evaluate Moisture Susceptibility of Asphalt Mixtures	$10,110	Published	Completed
837	Automated Identification of Traffic Detector Malfunctions	$0	Published	Completed
838	Centerline Rumble Strip Effects on Pavement Performance	$23,169	Published	Completed
840	Safest Placement for Crosswalks at Intersections	$13,824	Published	Completed
TNIS	FY 2023 Oregon Transportation Needs and Issues Survey	$83,900	Published	Completed

Table 4.3: Expenditures and Status for Ongoing Major Projects FY 2023

Project No.	Project Title	Spent in FY'2023	Expected End Date	Status
	Continuing Projects			
807	Coastal Landslide and Bluff Retreat Monitoring for Climate Change Adaptation	$93,141	9/29/2024	Continuing
820	Development of Reliable Geotechnical Standards in Diatomaceous Silt	$40,471	4/1/2024	Pre-Publication
830	Exploring Seismic Soil-Pile-Superstructure Interaction	$40,545	4/1/2024	Pre-Publication
834	Enhancing Design and Maintenance of Horizontal Landslide Drain…	$96,247	4/1/2024	Pre-Publication
836	Prioritizing Wildlife Collision Mitigation Zones for Long Range Planning Efforts	$66,852	12/31/2024	Continuing
839	Best Practices for Work Zone Safety during Traffic Control Placement, Removal, and Modification	$79,240	4/1/2024	Pre-Publication
841	Pedestrian Equity Analysis	$38,251	04/1/2024	Continuing
842	Constructing High-Density Longitudinal Joints to Improve Pavement Longevity	$68,178	04/1/2024	Continuing
843	Vulnerability and Risk Prioritization for Coastal Highway Erosion Areas of Concern	$65,202	2/29/2024	Continuing
844	Evaluation of Curb Ramp Compliance	$93,370	03/1/2024	Pre-Publication
845	Optimizing Maintenance Priorities for Driving Safety	$42,791	7/31/2023	Continuing
846	Last Mile Delivery: Impact of More Delivery Vehicles on Safety and Congestion	$76,866	6/30/2024	Continuing
847	Alternative Bridge Deck Overlays	$75,097	04/1/2024	Pre-Publication
848	Trucking Platooning Impact on Bridge Loading – Policy and Regulatory Implications	$53,036	04/1/2024	Pre-Publication
849	Improved Systematic Analysis to Predict Roadway Safety Performance	$51,375	3/3/2024	Pre-Publication
850	Automating LIDAR Data to Develop and Manage Active Transportation Asset Inventories	$105,411	06/30/2024	Continuing
851	Evaluation of Electronic Enforcement of Motor Carrier Compliance and Safety	$112,879	12/31/2024	Continuing
852	Implementation of Balanced Mix Design Methods in Oregon to Meet Long-Term Performance Goals	$163,128	06/30/2025	Continuing
853	Predicting Near Real-Time Post-Fire Landslide Debris Flows Along ODOT Corridors	$149,049	06/30/2025	Continuing
854	Validation of the New Speed Zoning Method in Terms of Speed Compliance and Safety Outcomes	$69,273	06/30/2024	Continuing
855	Removing Residual Lane Markings to Reduce Driver Confusion	$102,129	06/30/2024	Pre-Publication
856	Automated Methods for Correcting ODOT's Real-Time GNSS Network for Surveying and Post Disaster Recovery	$103,881	4/30/2025	Continuing
857	Active Transportation Counts from Existing On-Street Signal and Detection Infrastructure	$102,262	8/31/2024	Pre-Publication

Project No.	Project Title	Spent in FY'2023	Expected End Date	Status
858	Development of Procedures and Technologies for Chip Seal Construction Quality Control in Oregon	$182,888	06/30/2024	Continuing
859	Real-Time Continuous Bridge Scour Monitoring for Improved Safety and Cost Savings	$58,333	6/30/2026	Pre-Publication
860	Piloting Smart Work Zone Technologies to Improve Oregon Highway Safety and Mobility	$133,836	06/30/2024	Continuing
861	Signal-Controller-in-the-Loop Simulation for Testing and Deploying Advanced Signal Operations on Arterial Roadways	$96,516	6/30/2025	Continuing
862	Increasing Asphalt Recycling to Reduce Paving Costs, Improve Pavement Longevity, and Reduce Environmental Impact	$119,718	11/30/2025	Continuing
863	Effects of Trucking Regulatory Relaxations on Freight Safety in Oregon	$70,321	12/31/2024	Work Started
864	Phase 2: Quantitative Evaluation Process for Improved Rockslope Safety and Reduced Maintenance	$98,235	6/30/2026	Work Started
865	Low-Carbon Ultra-High Performance Concrete for Use in Highway Infrastructure	$118,758	9/29/2025	Work Started
866	Prototyping Automated Framework for Asset Extraction and Characterization from Mobile Lidar Data	$119,061	06/30/2025	Work Started
867	Automated Wildlife Detection for Wildlife Vehicle Collision Reduction	$111,359	06/30/2027	Work Started
868	Develop a new VisionEval Land Use Model for Strategic Evaluation of Land Use Scenarios	$34,327	6/30/2025	Work Started
869	Safety and User Perceptions of Auxiliary Bike Lanes	$32,460	6/30/2024	Work Started
870	Placement Options for In-street Pedestrian Crossing Signs (R1-6a)	$31,319	6/30/2026	Work Started
871	Validation of HSM Crash Prediction Methods for Specific Intersection Types in Oregon	$35,639	6/30/2025	Work Started

Table 4.4: Other FY 2023 Research Activities

Project #	Project Title	Spent FY 2023	Status
301-000	SPR Project Selection and Development	$353,677.75	Ongoing
302-000	SPR Implementation	$53,043.17	Ongoing
304-401	Northwest Transportation Conference	$0	Ongoing
304-481	AASHTO Technology Implementation Group	17081.53	Ongoing
304-121	National Research Liaison and NCHRP Activity	$545	Ongoing
304-821	GNSS Surveying methods	$0	Continuing
304-841	Fish Presence	$38,093	Continuing
304-851	Test Hydraulic Design	$5,792	Continuing
304-861	NITC(UTC) Support	$0	Complete
304-871	NITC(UTC) VE BIKE	$734	Complete
304-881	Auto Sig PM Timings	$1,264	Complete
304-881	Steep Slope Brohmann	$23,787	Continuing
304-911	Shear Responses of Soils using CPT Based Methods	$29,259	Continuing
304-921	Improved Erosion Control Performance	$0	Continuing
304-931	Real-Time Scour Monitoring	$21,500	Continuing
500-040	State Information Requests (State funded)	$82,057.66	Ongoing

4.2 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 $2.2 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. In addition, 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.

Table 4.5 summarizes expenditures by program area and by source of funds.

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

	Federal			**Oregon**		
Program	**SPR Research**	**LTAP**	**Other Federal**	**State Funds**	**Local Government**	**Total**
SPR Research Program	$2,981,106			$745,276		$3,726,382
State Research Program				$76,935.9		$76,935.9
LTAP Program		$181,630		$106,630	$75,000	$363,258.7
TRB Subscription	$244,658					$244,658
NCHRP	$876,588					$876,588
OR Led Pooled Fund	$26					$26
External Pooled Fund	$120000					$120000
Research & Library Indirect				$625,798		$625,798
LTAP Indirect		$59,829				$59,829
Other			$24,361.40	$6,090.35		$30,452
TOTAL	$4,222,378	$241,459	$24,361	$1,560,730	$75,000	$6,123,928

5.0 OTHER 2023 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.

5.1 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 53 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.

5.2 RESEARCH PROJECT SELECTION

Project selection begins in the fall with modifications and updates to published research priorities. (Priorities for Fiscal Year 2021 are posted online at: https://www.oregon.gov/odot/programs/pages/research.aspx#step8). 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 2024 is shown in Table 5.1: New Projects Selected for Fiscal Year . Figure 5.1: ODOT research project selection timetable, provides a schematic of the project selection timetable.

5.3 SMALL, QUICK RESPONSE, AND DISCRETIONARY PROJECTS

Small Projects

Each year the Research Section conducts small projects, typically totaling $50,000 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 1820 hours responding to requests in Fiscal Year 2023, addressing a wide range of topics.

Table 5.1: New Projects Selected for Fiscal Year 2024

Project No.	Project Title	Scheduled End Date	Total Project Budget
872	Development of a Diversity, Equity and Inclusion (DEI) Workforce Sustainability Evaluation Tool	June 2026	$214,000
873	Improving Guidance for Automated Speed Enforcement	June 2026	$162,000
874	New Methods for Improving Load Rating of Existing Steel Bridges	June 2026	$392,880
875	E-commerce Impacts on Oregon Household Level Deliveries, Trips, and VMT	June 2026	$250,200
876	Implementation Requirements for Work Zone Intrusion Technologies to Reduce Fatalities	June 2026	$187,000
877	Developing Guidance on Leading Pedestrian Intervals and Curb Extensions to Improve Pedestrian Safety at Signalized Intersections	June 2026	$234,000
878	Real-Time Landslide Surface Monitoring for Improved Safety, Response, and Repair	June 2028	$511,000
879	Phase II: Method Development for Construction Design in Diatomaceous Soils	June 2027	$697,805

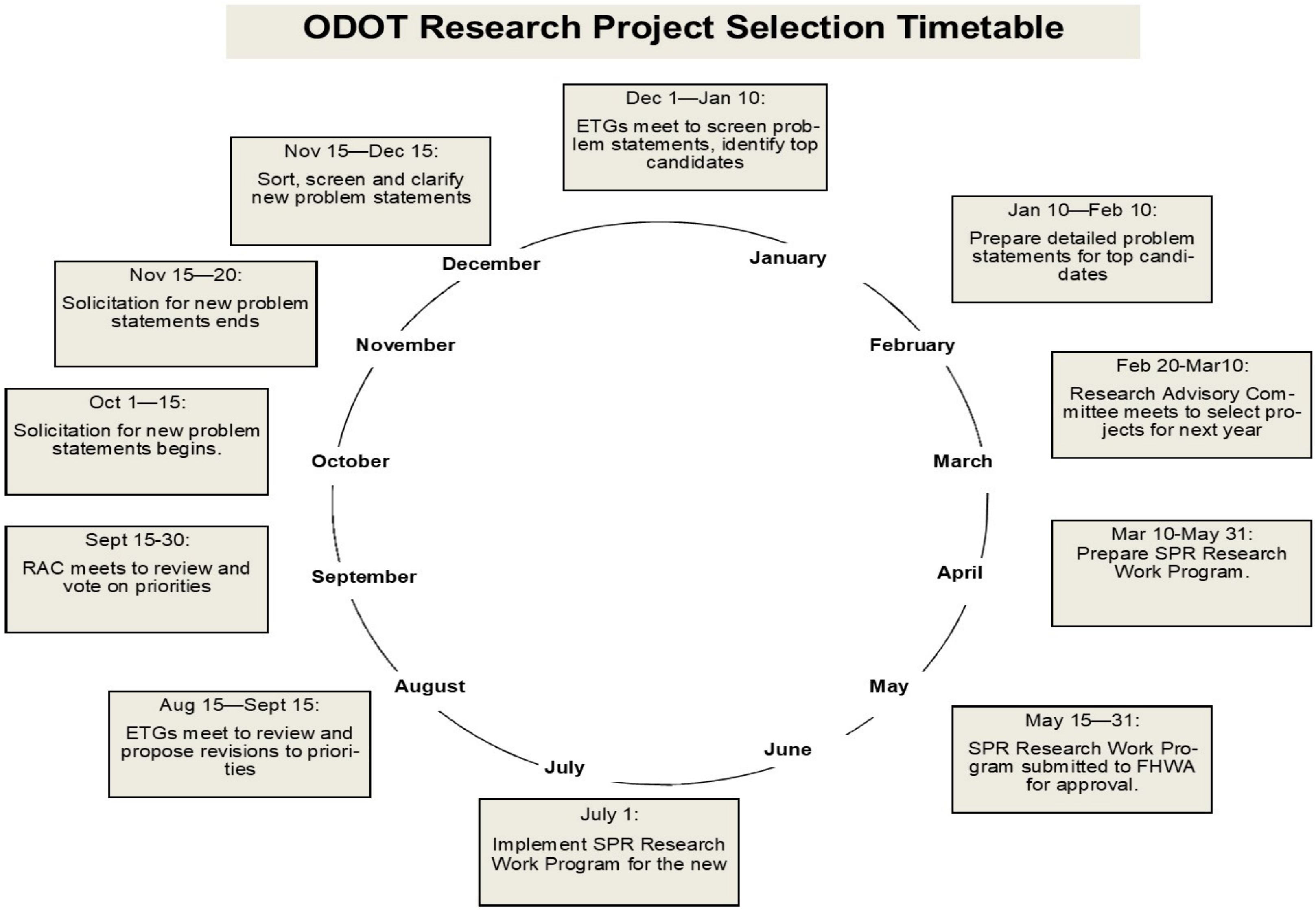

Figure 5.1: ODOT research project selection timetable

5.4 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 2023, ODOT led three and contributed to eight pooled fund projects (Table 5.2). Oregon commits a mix of SPR and state funds to these projects. ODOT Research continues to monitor fourteen ongoing-pooled fund projects from previous years.

Table 5.2: Transportation Pooled Fund Project Summary

Number:	Title:	Lead Agency	Fund Source	ODOT FY 23	Total Project ODOT
TPF-5(178)	Implementation of the Asphalt Mixture Performance Tester (AMPT) for Superpave Validation	FHWA	SPR B	0	$105,000
TPF-5(241)	Western States Rural Transportation Consortium (WSRTC)	Washington State	State	0	$10,000
TPF-5(255)	Highway Safety Manual Implementation	FHWA	State	0	$80,000
TPF-5(260)	Next-Generation Transportation Construction Management (TCM)	Colorado	State	0	$25,000
TPF-5(264)	Passive Force-Displacement Relationships for Skewed Abutments	Utah	SPR B	0	$30,000
TPF-5(288)	Western Road Usage Charging Consortium	**Oregon**	State	0	$175,000
TPF-5(299)	Improving the Quality of Pavement Surface Distress and Transverse Profile Data Collection and Analysis	FHWA	SPR B	0	$90,000
TPF-5(301)	Support Services for Peer Exchanges	**Oregon**	SPR B	26	$ -
TPF-5(316)	Traffic Control Device (TCD) Consortium	FHWA	State	0	$60,000
TPF-5(343)	Roadside Safety for MASH	Washington State	State	0	$300,000
TPF-5(350)	Development of NGL Database for Liquefaction-Induced Lateral Spread	Utah	State	0	$20,000
TPF-5(353)	Clear Roads Phase II	Minnesota	SPR B	0	$125,000
TPF-5(357)	Connecting the DOTs: Implementing ShakeCast Across Multiple State Departments of Transportation for Rapid Post-Earthquake Response	Caltrans	State	$15,000	$105,000
TPF-5(358)	Wildlife Vehicle Collision Reduction and Habitat Connectivity	Nevada	SPR B	0	$100,000
TPF-5(367)	Evaluation and Full Scale Testing of Concrete Prefabricated Bridge Rails	Iowa	State	0	$60,000
TPF-5(369)	Collaborative Development of New Strategic Planning Models	FHWA	SPR A	0	$125,000
TPF-5(384)	Non-Traditional Methods Vehicle Volume	FHWA	SPR B	0	$10,000

Number:	Title:	Lead Agency	Fund Source	ODOT FY 23	Total Project ODOT
TPF-5(386)	Gravel-Bed River Assessment Tool for Improved Resiliency of Engineering Design	Washington State	SPR B		$15,000
TPF-5(398)	Moving Forward with the Next Generation Travel Behavior Data Collection and Processing	FHWA	SPR A		$85,000
TPF-5(399)	Improving the Quality of Pavement Surface Distress and Transverse Profile Data Collection and Analysis Phase II	FHWA	SPR B		$75,000
TPF-5(433)	Behavior of Reinforced and Unreinforced Lightweight Cellular Concrete for Retaining Walls	Utah	SPR B		$40,000
TPF-5(437)	Technology Transfer Concrete Consortium (FY20-FY24)	Iowa	State		$40,000
TPF-5(440)	Support for Urban Mobility Analyses	Texas	SPR A		$50,000
TPF-5(442)	Transportation Research and Connectivity	Oklahoma	SPR B		$50,000
TPF-5(447)	Traffic Control Device (TCD) Consortium (3)	FHWA	State	$30,000	$30,000
TPF-5(451)	RUC West	Oregon	State		$50,000
TPF-5(456)	EconWorks - Improved Economic Insight	Arkansas	SPR A		$20,000
TPF 5(470)	Traffic Signal Change and Clearance Interval Pooled Fund Study	FHWA	SPR A		$30,000
TPF-5(479)	Clear Roads Winter Highway Operations Phase III Pooled Fund	Minnesota	SPR B	$25,000	$125,000

5.5 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 2021 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.

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, 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.

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 Pacific Northwest Transportation Consortium (PacTrans) in which Portland State University is a full member, the Portland State University led Transportation Research and Education Consortium (TREC), Center for Freight Transportation for Efficient and Resilient Supply Chain (FERSC), 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.