Fiscal 2022 – 2023
BIENNIAL WORK PROGRAM
STATE PLANNING AND RESEARCH

SUBPART B – RESEARCH

June 2, 2021

Research Section

In cooperation with the

Federal Highway Administration

▪ OREGON DEPARTMENT OF TRANSPORTATION ▪

ODOT POLICY STATEMENT - 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, Subpart B1; 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. More information is available online at:

http://www.oregon.gov/ODOT/CS/CIVILRIGHTS/Pages/nd_def.aspx

Oregon
Kate Brown, Governor

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Section 23 CFR 420.209(c) Certification

June 2, 2021

I, Michael Bufalino, Research Manager of the State of Oregon, do hereby certify that the State is in compliance with all requirements of 23 U.S.C. 505 and its implementing regulations with respect to the research, development, and technology transfer program, and contemplate no changes in statutes, regulations, or administrative procedures which would affect such compliance.

Appendix A of the Fiscal 2022 – 2023 Biennial Work Program contains a summary of SPR Subpart B program compliance requirement and Oregon's compliance mechanisms.

Michael Bufalino, Research Manager

FEDERAL APPRVAL LETTER PAGE

FEDERAL APPRVAL LETTER PAGE

BIENNIAL WORK PROGRAM

FOR

STATE PLANNING AND RESEARCH SUBPART B (RESEARCH)

JUNE 2021

Prepared by

Oregon Department of Transportation

In Cooperation With

FEDERAL HIGHWAY ADMINISTRATION

Oregon Fiscal Years 2022 and 2023
July 1, 2021 to June 30, 2023

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BIENNIAL WORK PROGRAM
FOR STATE PLANNING AND RESEARCH (SPR)
SUBPART B – RESEARCH
July 1, 2022 to June 30, 2023

INTRODUCTION

An effective transportation research and development program serves a vital role in improving the efficiency and effectiveness of the transportation system. Properly organized and executed research and development activities can help the Oregon Department of Transportation (ODOT) achieve its strategic vision for the transportation system by developing the necessary supporting technology. In the private sector, an effective research effort has long been recognized as a requisite for keeping products and techniques competitive in the market-place. To enhance the cost-effective use of public funds, research is also needed in the public sector. ODOT established the Research program to administer this work that is funded in part by the Federal Highway Administration's (FHWA) State Planning and Research (SPR) program.

In summary, this work program documents $6,846,128 for a two-year program with an overall SPR research funding provided by FHWA of $5,568,306 and a corresponding Non-Federal Match from ODOT of $1,277,822. The this programmatic funding for the ODOT research covers the period of the Sate Fiscal Years 2022 and 2023 (July 1, 2021 through June 30, 2023). See Table 1

Table 1 Summary of SPR Budget for FY'22 and FY'23

Federal (Table 2)	Non-Federal Match (Table 9)	Total
$5,568,306	$1,277,822	$6,846,128

The FAST Act requires that states set aside 2 percent of the apportionments they receive from four of the core Federal-aid programs for "State Planning and Research" activities. Pursuant to 23 CFR 420.107, states must allocate 25 percent of this amount for research, development, and technology transfer. The allocation for research, development, and technology is referred to as SPR Subpart B ($2,700,153 in FY'20, and $2,700,153 in FY'21).[1] Oregon expects to exceed this minimum by $45,000 in FY'22 and $45,000 in FY'23 with a corresponding reduction in the SPR Part 1 Program. Additionally, $78,000 is expected to remain unspent from past SPR work programs and will be programed into FY'22. In addition to the SPR allocation summarized above, Oregon also expects to receive approximately $60,000 in FY'22, and $25,000 in FY 23 as pooled funds transfer into Oregon. Pooled funding is not documented in Table 1.

The Federal Research spending documented in this work plan is summarized in Table 2. The state matching level varies by program and is documented starting on page 3.

[1] FAST Act core SPR Subpart B Federal-aid values are estimates. These values were forecast assuming full FAST Act core funding of the states. A federal highway authorization does not exist for FY'22 or FY'23; therefore, FY'21 values are used as an estimate. (FHWA) "FY 2021 Apportionment and Obligation Limitation Notices https://www.fhwa.dot.gov/fastact/funding.cfm , Accessed 6/1/2021.

Table 2 Anticipated Federal SPR Research Budget

	FY 22	FY 26
SPR Research Appropriation	$2,700,153	$2,700,153
SPR Request above minimum 25%	$45,000	$45,000
Pooled Fund Transfers into Oregon	$60,000	$25,000
Unspent Past Year Funds	$78,000	
Federal Portion of SPR Research Program Budget	**$2,883,153**	**$2,770,153**

The total combined FY'20 and FY'21 federal portion of the SPR Part B fund expenditure (not including pooled funds) is anticipated to be **$5,568,306**. (With pooled funds the total is expected to be $5,653,306)

Details regarding expenditures may be found in the following pages. Cooperative research (e.g. Pooled Funds, TRB and NCHRP) is documented starting on page 5, and the core SPR research program administered by the Research Section is documented starting on page 3. The available funds documented above in Table 2 are anticipated to be expended in the activities shown in Table 3 below.

Table 3 Anticipated Federal SPR Research Expenditure

	FY'20	FY'21
NCHRP and TRB SPR Research Assessments (Table 4)	$178,509	$178,509
SPR Contributions to Cooperative Research (Table 5)	$60,000	$40,000
Research Led Pooled Funds (Table 8)	$60,000	$25,000
Research Projects for Fiscal 2020 and 2021 (Table 9)	$2,584,645	$2,526,645
Anticipated Federal Portion of SPR and TPF Research Program Expenditures	**$2,883,153**	**$2,770,153**

State matching contributions are documented in the text with the appropriate programs.

The Oregon SPR Subpart B program is administered by the Research Section of the Transportation Development Division of ODOT. The primary objectives for this program at ODOT are to:

- Coordinate, administer, and supervise research activities within the agency.
- Conduct research projects.
- Assure the use of proper research methods.
- Prevent duplication of effort.
- Cooperate and communicate with other agencies doing transportation research.
- Assist other transportation providers by sharing and disseminating new technology and research findings.
- Serve as an information source.
- Promote the implementation of research findings.

Amendments to this work program will be developed and submitted for FHWA approval to document major changes to anticipated research work. Major changes include the addition of a new major project, pooled fund hosted by Oregon.

RESEARCH SECTION RESPONSIBILITIES

The Research Section coordinates research activities and maintains continuing monitoring on transportation-related research throughout the nation. The Section functions with the guidance of a Research Advisory Committee supported by Expert Task Groups. Specific responsibilities of the Section are to:

- Solicit transportation users for research needs.
- Develop strategic direction that identifies the State's transportation research priorities.
- Review all research problem statements and obtain the information necessary to formulate a research program.
- Chair Expert Task Groups in order to recommend promising research projects to the ODOT Research Advisory Committee consideration.
- Select principal investigators and Technical Advisory Committee members for each project.
- Conduct literature research as required.
- Review and determine cost eligibility of research activities and equipment purchase.
- In some cases, conduct research projects.
- Assist in the preparation of reports covering the results of research and make recommendations for application into policies, procedures, standards, and other guides governing the activities of ODOT.
- Promote the implementation of the research findings through distribution of research results to appropriate persons for their consideration and use.
- Provide expertise for ODOT in specialty areas pertaining to research and technology.
- Participate in federal and state-sponsored seminars and training meetings to help implement new research findings.
- Provide a liaison with FHWA, universities, consultants, and other agencies conducting and supporting research for ODOT.
- Provide a continuous liaison and surveillance of progress and expenditures for all research projects.
- Provide liaison with the Transportation Research Board and the Cooperative Research Programs.
- Prepare annual and biennial budgets for research activities.
- Conduct periodic Peer Exchanges.

The research portion of the SPR Program aids in the achievement of the above-named objectives. The research is directed toward the solution of local problems, conditions and materials that prevail in Oregon. The Research Section develops or assists in the development of research study proposals and acts as a coordinator during the projects. The project work may be contracted, conducted by the operating section that has the concern and expertise for the particular program, or carried out by Research Section staff. The Research Section coordinates and maintains oversight of the projects to minimize duplication of effort and to broaden the scope of projects.

Research needs are identified through formal inquiry and through annual solicitation of ideas for State, SPR, multi-state, and national projects. Needs are also identified by the Expert Task Groups and/or the ODOT Research Advisory Committee. Informal identification of research needs is an ongoing activity, and the annual solicitation for ideas takes place in the fall with review continuing through the winter. Topics are reviewed by Expert Task Groups to determine those for consideration by the Research Advisory Committee. The Research Advisory Committee then evaluates the proposals for merit, assigns priorities, and recommends funding.

Funds are budgeted for projects by fiscal year based on forecasted tasks for research project work. Estimates are based on anticipated material, contract labor and staff-time needs. These estimates are based on "Stage 2 Research Problem Statements", and then refined in individual project "Work Plans". Due to the typically fixed costs of the research process, estimated research project costs are relatively accurate. Overall research project cost estimates involve little risk. Project timing of university led research is sometimes highly variable, and project schedules must be flexible. The variably of schedule necessitates the revision of project budgets during the preparation of this Research Work Program to move project funds between fiscal years based on actual expenditures.

The implementation of research varies with the nature of the project. To the extent required, research findings are transmitted to concerned individuals for their consideration and appropriate action by additional means, including implementation workshops, conferences, research notes[2], and articles in the agency-wide "inside-ODOT" newsletter.. The implementation budget in the SPR Work Program provides for preparation of various materials and the conduct of activities to expedite the implementation of research.

OTHER RESEARCH SECTION ACTIVITIES

Research activities in addition to those specifically funded by the SPR Program include the following:

A. The Oregon Technology Transfer (T2) Center provides transportation-related information to local government agencies throughout Oregon. The Center is jointly funded by FHWA, the counties and cities of Oregon, and ODOT. The T2 Center is one of 49 such centers across the country (one in nearly every state and Puerto Rico). These centers are a key part of FHWA's Local Technical Assistance Program (LTAP). The FY'20 budget for the T2 Center is approved under a separate work program.

The Technology Transfer Center is housed with the Research Section. The T2 Director, an assistant, and three part-time "Circuit Riders" are supervised by the Research Manager.

T2 provides the following services at no cost to client agencies:

1. A lending library of audio/visual materials.
2. A lending library of technical publications.
3. Sponsorship and delivery of training courses, workshops, seminars, etc., including a "Roads Scholar" program.

[2] Research Notes are published with select projects online at:
https://www.oregon.gov/ODOT/Programs/Pages/Research-Publications.aspx

4. On-site informational presentations.
5. Response to information requests.
6. A quarterly newsletter of information on transportation related topics.

As its name suggests, the T2 Center strives to make each local public agency in the state aware of the latest and most effective transportation technologies. T2 does this by acting as an information resource and encouraging and strengthening communications between government agencies at all levels.

B. A State-funded Research Account On an ongoing basis, additional funds are budgeted each biennium. This pool constitutes funds for research in addition to the SPR (Subpart B) program of research.

C. A State-funded Indirect Account Approximately $1,008,000 for the 2020-2021 biennium covers facilities rent and maintenance, some travel, office services and supplies, data and word processing, capital outlay, and miscellaneous other services needed to support the Research Section.

COLLABORATIVE RESEARCH

ODOT Research participates in several collaborative research programs using a mix of SPR and other funds. These programs include:

A. Support for the National Cooperative Highway Research Program (NCHRP) utilized 5.5% of the SPR allocation. The anticipated total annual support for FY'22 is anticipated to be $594,034, and support for FY'23 is anticipated to be $594,034. Oregon funds NCHRP using a blend of SPR Part A and Part B funding; with 75 percent from SPR Subpart A and 25 percent from SPR Subpart B. The SPR Subpart B contribution for the NCHRP program is anticipated to be $148,508 for FY'22 and $148,508 for FY'23.

NCHRP is also supported through submittal of problem statements, coordination of ODOT balloting, and service on NCHRP panels. These activities cost approximately $10,000 per year, mainly in staff time. See Table 4 NCHRP and TRB SPR Research Assessments

B. The Transportation Research Board (TRB) subscription fee covers the cost of all publications, information service retrievals, registration, and related services provided to the State by TRB. The fee is expected to be $120,000 for FY'20, and $120,000 for FY'21. As with NCHRP, Oregon's TRB subscription is shared 75-25 percent between Subpart A and Subpart B. The SPR Subpart B TRB contribution is anticipated to be $30,000 for FY'22 and $30,000 for FY'23. (see Table 4)

Table 4 NCHRP and TRB SPR Research Assessments

Title	FY'20	FY'21
Contributions to TRB (25% of assessment)	$30,000	$30,001
NCHRP Contributions (25% of assessment)	$148,508	$148,508
Total NCHRP and TRB SPR Subpart B (This work program)	**$178,508**	**$178,508**

Beginning in FY'06 ODOT Research and ODOT Planning agreed to share the cost of the NCHRP and TRB assessments.

C. Transportation Pooled Fund Projects Oregon will contribute SPR funds to at least four Pooled Fund projects in FY'22 and three in FY'23. For each fiscal year funds are set aside for unidentified projects that could benefit ODOT. For budgeted funds set aside for unidentified pooled fund opportunities; the ODOT Research Manager may independently commit up to $10,000. For commitments greater than $10,000, the Research Advisory Committee must be consulted. RAC pooled fund commitment decisions are usually made via e-mail. The SPR funded cooperative research pooled funds are summarized in Table 5.

Table 5 SPR Contributions to Cooperative Research

Study No.	Title	FY'22	FY'23
TPF-5(358)	Wildlife Vehicle Collision Reduction and Habitat Connectivity	$20,000	
TPF-5(399)	Improving the Quality of Pavement Surface Distress and Transverse Profile Data Collection and Analysis Phase II	$15,000	$15,000
TPF-5(433)	Behavior of Reinforced and Unreinforced Lightweight Cellular Concrete for Retaining Walls	$15,000	$15,000
TPF-5(442)	Transportation Research and Connectivity	$10,000	$10,000
	Subtotal for SPR Part B Pooled Fund Projects	**$60,000**	**$40,000**

In addition to SPR funds, the Research Section facilitates the investment of State funds in cooperative research. These fund contributions are provided under the budgets of the sponsoring ODOT unit. See Table 6 for a summary of the current State funded cooperative research.

Table 6 State Funded Cooperative Research

Study No.	Title	FY'22	FY'23
TPF-5(398)	Moving Forward with the Next Generation Travel Behavior Data Collection and Processing	$25,000	
TPF-5(456)	EconWorks - Improved Economic Insight	$4,000	$4,000
TPF-5(437)	Technology Transfer Concrete Consortium (FY20-FY24	$8,000	$8,000
TPF-5(470)	Traffic Signal Change and Clearance Interval Pooled Fund Study	$15,000	

Note these projects are not funded with SPR Part B funds and are not a part of this work program.

ODOT continues to monitor all open pooled funds that have received a contribution of funds from Oregon. These projects are still active but will not receive new funds in FY'20 or FY'21. These projects are listed in

Table 7. ODOT is the lead state for five pooled fund projects. The Research Section is administering TPF-5(301) Support Services for Peer Exchanges, and TPF-5(371) Highway Capacity Manual" Capacity Adjustments for Agency Connected and Autonomous Vehicle Operational Planning Readiness under Varying Levels of Volume and Market Penetration. For these two projects we anticipate receiving transfers of approximately $100,000 in FY'20, and $100,000 in FY'21 from other states. TPF-5(288), TPF-5(355) and TPF-5(451) are being administered by other ODOT units with research staff assistance. Table 8 includes anticipated expenditures on Oregon Research led pooled funds.

Table 7 Continuing Projects with Previous FY Contributions

Study No.	Title
TPF-5(218)	Clear Roads Winter Highway Operations
TPF-5(241)	Western States Rural Transportation Consortium (WSRTC)
TPF-5(255)	Highway Safety Manual Implementation
TPF-5(260)	Next-Generation Transportation Construction Management (TCM)
TPF-5(264)	Passive Force-Displacement Relationships for Skewed Abutments
TPF-5(272)	Evaluation of Lateral Pile Resistance Near MSE Walls at a Dedicated Wall Site
TPF-5(283)	The Influence of Vehicular Live Loads on Bridge Performance
TPF-5(288)	Western Road Usage Charging Consortium
TPF-5(299)	Improving the Quality of Pavement Surface Distress and Transverse Profile Data Collection and Analysis
TPF-5(301)	Support Services for Peer Exchanges
TPF-5(307)	Validation of Tsunami Design Guidelines for Coastal Bridges
TPF-5(313)	Tech Transfer Concrete Consortium
TPF-5(316)	Traffic Control Device (TCD) Consortium
TPF-5(317)	Evaluation of Low Cost Safety Improvements
TPF-5(338)	Simplified **CPT** Performance-Based Assessment of Liquefaction and Effects
TPF-5(343)	Roadside Safety for MASH
TPF-5(349)	Western Alliance for Quality Transportation Construction (WAQTC)
TPF-5(350)	Development of NGL Database for Liquefaction-Induced Lateral Spread
TPF-5(353)	Clear Roads Phase II
TPF-5(355)	Stormwater Testing and Maintainability Center
TPF-5(357)	Connecting the DOTs: Implementing ShakeCast Across Multiple State Departments of Transportation for Rapid Post-Earthquake Response
TPF-5(367)	Evaluation and Full Scale Testing of Concrete Prefabricated Bridge Rails
TPF-5(369)	Collaborative Development of New Strategic Planning Models
TPF-5(371)	Developing "Hiqhway Capacity Manual" Capacity Adjustments for Agency Connected and Autonomous Vehicle Operational Planning Readiness under Varying Levels of Volume and Market Penetration
TPF-5(386)	Gravel-Bed River Assessment Tool for Improved Resiliency of Engineering Design
TPF-5(440)	Support for Urban Mobility Analyses
TPF 5(384)	NonTraditional Methods Vehicle Volume
TPF-5(442)	Transportation Research and Connectivity
TPF-5(451)	RUC West

Table 8 Research Led Pooled Funds

Project #	Name	FY'22	FY'23
TPF-5(288)	Western Road Usage Charging Consortium	State funded	State funded
TPF 5(301)	Peer Exchange Support	$25,000	$25,000
TPF-5(355)	Stormwater Testing and Maintainability Center	State funded	State funded
TPF 5(371)	Developing "Highway Capacity Manual" Capacity Adjustments for Agency Connected and Autonomous Vehicle Operational Planning Readiness under Varying Levels of Volume and Market Penetration	$35,000	0
TPF-5(451)	RUC West	State funded	State funded
	RESEARCH LED POOLED FUNDS	**$60,000**	**$25,000**

Additional information about the Transportation Pooled Fund Program and individual pooled fund projects may be found online at: http://www.pooledfund.org/.

Core Research Program Funding Summary

Table 9 documents the core of the SPR research program. The details of each project can be found on the following pages.

Table 9 Research Projects for Fiscal 2020 and 2021

Project #	Name	FY'20	FY'21
301	SPR Project Development	$233,084	$263,000
302	Technology Transfer	$10,000	$10,000
303	Unallocated Funds (FY'23)		$727,885
304	Small Projects Discretionary Fund	$34,500	$36,500
TNI	Transportation Needs and Issues	$45,000	$45,000
719	Climate Change Impact on Coastal River Estuaries in Oregon	$15,996	
807	Coastal Landslide and Bluff Retreat Monitoring for Climate Change Adaptation	$94,333	$82,815
812	Modeling Chloride Accumulation in Streams from Winter Road Salt Application for Federal…	$1,000	
820	Development of Reliable Geotechnical Standards in Diatomaceous Silt	$102,202	$49,000
823	Improving Constructability and Durability of Concrete Pavements	$-	
824	Cascadia Ground Motion Estimates in Comparison to ODOT Design Criteria	$54,203	
829	Rumble strip design analysis and the durability of inlaid stripEs	$44,341	
830	Exploring Seismic Soil-Pile-Superstructure Interaction	$129,000	$-
831	Leveraging Numerical Modeling for Development of Design Criteria for Gabion Rockfall…	$32,158	$-
832	Expanding the Oregon Motor Carrier Safety Action Plan: Best Return on Investment	$31,342	$-
833	Impacts of Intersection Treatments and Traffic Characteristics on Bicyclist Safety	$40,510	$-
834	Enhancing Design and Maintenance of Horizontal Landslide Drain…	$105,728	$98,847
835	Implementation of a Laboratory Conditioning and Testing Protocol… Asphalt Mixtures	$28,500	$-
836	Prioritizing Wildlife Collision Mitigation Zones for Long Range Planning Efforts	$84,000	$71,000
837	Automated Detection of Traffic Sensor Malfunctions	$60,006	$-
838	Center Line Rumble Strip Effects on Pavement Performance	$72,069	$-
839	Work Zone Safety During Traffic Control Setup, Removal, and Changes	$96,000	$57,000
840	Safest Placement for Crosswalks at Intersections	$94,000	$35,200
841	Pedestrian Equity Analysis	$7,313	$50,783
842	Constructing High-Density Longitudinal Joints to Improve Pavement Longevity	$110,400	$35,200
843	Vulnerability and Risk Prioritization for Coastal Highway Erosion Areas of Concern	$144,000	$62,000
844	Evaluation of Curb Ramp Compliance	$109,000	$75,000
845	Optimizing Maintenance Priorities for Driving Safety	$97,500	$97,500
846	Last Mile Delivery: Impact of More Delivery Vehicles on Safety and Congestion	$147,153	$59,000
847	Alternative Bridge Deck Overlays	$179,000	$63,456
848	Trucking Platooning Impact on Bridge Loading – Policy and Regulatory Implications	$108,600	$74,400
849	Improved Systematic Analysis to Predict Roadway Safety Performance	$80,600	$61,400
850	Automating Lidar Data to Develop and Manage Active Transportation Asset Inventories	$79,568	$116,550

Project #	Name	FY'20	FY'21
851	Evaluation of Electronic Enforcement of Motor Carrier Compliance and Safety	$59,000	$80,000
852	Implementation of Balanced Mix Design Methods in Oregon to Meet Long-Term Performance Goals	$94,000	$77,000
853	Predicting Near Real-Time Post-Fire Landslide Debris Flows Along ODOT Corridors	$102,000	$153,000
854	Validation of the New Speed Zoning Method in Terms of Speed Compliance and Safety Outcomes	$70,000	$120,070
855	Removing Residual Lane Markings to Reduce Driver Confusion	$88,000	$103,500
856	Automated Methods for Correcting ODOT's Real-Time GNSS Network for Surveying and Post Disaster Recovery	$57,000	$67,000
857	Active Transportation Counts from Existing On-Street Signal and Detection Infrastructure	$50,500	$88,500
858	Development of Procedures and Technologies for Chip Seal Construction Quality Control in Oregon	$82,000	$115,000
859	Real-Time Continuous Bridge Scour Monitoring for Improved Safety and Cost Savings	$78,000	$92,500
860	Piloting Smart Work Zone Technologies to Improve Oregon Highway Safety and Mobility	$79,200	$90,200
	Federal Total	**$2,584,645**	**$2,526,645**
	State Total	**$646,161**	**$631,661**
`	**TOTAL SPR Research Projects**	**$3,230,806**	**$3,158,306**

301 PROJECT DEVELOPMENT

OVERVIEW AND OBJECTIVES

Funds are not available for individual research studies until a study work plan has been developed and approved. Funds budgeted under this item will be used to develop or assist in the development of SPR projects.

In the fall of each year the Research Program issues an open call for research ideas, or research problem statements. Participation is open to literally anyone. Historically, up to 100 or more new problem statements are received every year. For the most part, problem statements are prepared by ODOT employees, university researchers, other state and local transportation agencies, other research organizations, and consultants emphasizing the "bottom up" approach.

The money will cover the costs of soliciting new projects, organizing and facilitating expert task groups, developing stage 1 and stage 2 problem statements, identifying potential investigators, preparing work plans and executing agreements (if any) to carry out the research.

ACCOMPLISHMENTS

The Research Section selects between 10 and 12 research projects each year. The intensive project development and selection process helps identify research with a high potential to produce a benefit to the State's efforts to provide for transportation within Oregon. This process includes coordination with experts throughout the agency and with University Transportation Centers. In FY'20 the Section initiated nine new projects and has selected ten projects forecasted to start FY'21.

RESPONSIBLE PARTIES

Responsibility for this activity rests with Research staff and with members of Technical Advisory Committees (TAC). TAC membership is drawn from ODOT professional, technical and operational units, Oregon universities, other transportation agencies, resource agencies and the FHWA.

COST INFORMATION

SPR 301	FY'16	FY'17	FY'18	FY'19	FY'20	FY'21	FY'22	FY'23
BUDGET	$200,000	$200,000	$250,000	$250,000	$250,000	$250,000	$233,084	$263,000
SPENT TO DATE	$304,919	$323,952	$326,785	$333,232	$393,118	$253,207	$0	
REVISED BUDGET	**$304,919**	**$323,952**	**$326,785**	**$333,232**	**$393,118**	**$300,000**		

FY'16 through FY'20 expenditure values are actual. FY'21 expenditure values are actual plus estimated through the end of the fiscal year. FY'22 budget values are estimated based on forecasted project work.

302 TECHNOLOGY TRANSFER

OVERVIEW AND OBJECTIVES

Technology transfer means those activities that lead to the adoption of a new technique or product by users and involves dissemination, demonstration, training, and other activities that lead to eventual innovation.

When a project ends and the report is published the project budget is no longer available for continuing activities related to dissemination and technology transfer of results. These funds combine implementation activities across projects. The objective is to provide a resource for more effective, ongoing implementation of research findings and to ensure research is focused on high priority projects.

RELATIONSHIP OF OBJECTIVES TO OVERALL PROGRAM

Research findings have no practical value until they are implemented. Design and operations offices and other ODOT programs are concerned with keeping abreast of new technology, but time restraints prohibit review of many research reports. This budget item will be utilized to more effectively inform potential users of promising research results. Interaction with maintenance and construction employees will bring new issues to light, as well as facilitating sharing of potential solutions and ideas developed by staff.

PROPOSED MAJOR ACTIVITIES

Research Notes will be distributed widely to management and maintenance crew leaders. Research will use electronic media and ODOT Internet to make updates and research information more accessible. Research Notes on project progress will be developed for major projects of interest. Implementation Guides will be developed, if appropriate, and distributed to those who would use the research findings.

As in the past, research results will be available on the Transportation Research Information Database (TRID) maintained by the Transportation Research Board (TRB) and the Bureau of Transportation Statistics (BTS). Investigators are also encouraged to present ODOT results at regional, national, and international conferences, and to publish ODOT supported work in engineering and scientific journals.

Finally, as in the past, on a project by project basis, specific implementation efforts will be identified and carried out as needed to assure that key implementation agents within ODOT have the information and the means to make optimal use of implementable research results.

Tech Transfer activities should focus on the implementation of the findings from completed research into practice. Expected actions include:

- Training classes based on research findings
- Workshops
- Based on completed research reports support the development of ODOT documentation (e.g. policy, procedures, specifications, or other implementation documents) to integrate research findings into practice.

- Support development of new state statutes or administrative rules, or the revision of existing statutes and ruled.
- Distribution and documentation to inform the efforts national partners such as AASHTO, FHWA, to update national standards or guidance.
- Support the development of a new program, intuitive, position, or organizational unit within ODOT to implement the research findings.

The primary focus of these funds is to support the transfer of ODOT sponsored SPR research. In rare cases the transfer of research findings completed by outside entities (e.g. FHWA, AASHTO, TRB or a UTC) may be supported by these funds if it fulfills an identified need of the agency.

ACCOMPLISHMENTS

On numerous occasions, the Research Section has recommended the implementation of promising research findings. The implementation item in the SPR Work Program will permit this activity to be accomplished more thoroughly, and in some cases, more formally.

Projects

Twelve major projects were completed in FY'21. Five additional projects are expected to be completed by the end of FY'21. When a project moves into final stages, the Technical Advisory Committee discusses implementation issues and proposes an implementation strategy, which may or may not entail specific, post-publication efforts from the Research Section .The FY'22 budget will be used to support research staff time, follow-up analysis, and technology transfer activities for the following projects ending in FY'21 or in early FY'22 (Bold indicates a project published prior to June 2021):

SPR-801
SPR-802
SPR-805
SPR-808
SPR-809
SPR-810
SPR-813
SPR-816
SPR-821
SPR-822
SPR-825
SPR-826
SPR-827
TPF-5(307)
STIC Chip Seal Contracting
Transportation Needs & Issues Survey

METHODOLOGY

A cornerstone of our implementation effort is to include key agents of implementation from within ODOT on the project Technical Advisory Committee. These individuals are expected to carry the majority of the responsibility for keeping the project focused on implementable objectives, making sure information is delivered into the right hands, and to identify key steps in implementation such as revision of standards and specifications, incorporation into procedures and best practices manuals and guidebooks, etc.

It is not feasible from the standpoint of staff and time to expect operations staff to review all available research reports, but studies identified as being of major importance will be distributed to appropriate offices. In particular, reports generated from research projects conducted in Oregon will be reviewed for implementable findings and brief reports presenting suggested

implementation procedures will be circulated to potential users. It should be noted that Oregon is transferring the editing and publication of final reports to state funds, this will be reflected in a reduction of the budget in the FY'21/22 biennium.

SPR funds must be focused on the process of turning research into practice. SPR funds, expenditures on materials, equipment, and construction activities, planning activities, are not permitted. Funding materials, equipment, and construction activities must be the responsibility of the implementation champion or other partner.

RESPONSIBLE PARTIES

Implementation is the responsibility of primary users of the research in ODOT Divisions and Regions, with the support and assistance of the Research Section. In order to facilitate the most seamless research implementation, key users are engaged in research project development, management, and review, by participation on project Technical Advisory Committees.

The use of SPR Technology Transfer funds will be approved by the Research Section Manager based on one of the following conditions:

- Identified need documented in an SPR research project implementation memo
- Stage 1 or Stage 2 research problem statements where ODOT discovers a previously researched solution already exists, implementation has strong agency support, and the agency needs some research support to transfer existing research into practice
- Or to address an identified need of the agency that is solved by an established body of research, implementation has strong agency support, and the agency needs some support to transfer existing research into practice

COST INFORMATION

SPR 302	**FY'16**	**FY'17**	**FY'18**	**FY'19**	**FY'20**	**FY'21**	**FY'22**	**FY'23**
BUDGET	$50,000	$50,000	$55,000	$75,000	$62,917	$65,000	$10,000	$10,000
SPENT TO DATE	$51,692	$39,852	$14,931	$20,097	$26,087	$31,046		
REVISED BUDGET	**$51,692**	**$39,852**	**$14,931**	**$20,097**	**$26,087**	**$35,000**		

FY'15 through FY'20 expenditure values are actual. FY'21 expenditure values are actual plus estimated through the end of the fiscal year. FY'22 budget values are estimated based on forecasted project work.

303 FUNDS RESERVED FOR NEW PROJECTS STARTING IN FY'23

This two year work program estimates work for both FY'22 and FY'23. In the fall of 2021 the Section plans to conducted a solicitation for ideas for new research projects that will start in FY'23. In March of 2022 the ODOT Research Advisory Committee will meet and and prioritize the proposed projects. In June of 2022 Oregon anticipates amending this work program to program funds for these future projects.

304 SMALL PROJECTS DISCRETIONARY FUND

OVERVIEW AND OBJECTIVES

Through the course of the fiscal year the Research Section receives requests for information and a variety of other requests to perform research typically related to evaluation of new products and methods. These projects typically require a quick response from the Research Section because someone in the organization has made a commitment to the application of an innovation that could benefit from monitoring and evaluation, but will go forward whether Research Section participates or not. The discretionary fund gives us greater funding flexibility to participate when these opportunities arise.

Similar opportunities arise when universities and other organizations propose small projects involving cost sharing. In the past a number of projects have been undertaken when a medium priority project could be launched because the cost was small, raising the benefit-cost ratio. Many such projects have been, or will be, funded partially by one of five University Transportation Centers in the region. In addition, projects that would previously have been funded under the "Experimental Features" program will draw on the Research Discretionary Fund. Evaluations of experimental features will continue as appropriate, but combining the funds into a single pool simplifies administration. This fund provides a means of evaluating innovative products or non-standard methods and materials on an experimental basis. It also provides the flexibility to respond quickly to other research needs that emerge through the fiscal year, and to commit to small projects without specific approval from the Research Advisory Committee.

This work program anticipates an expansion of these projects as the pace of innovation accelerates. An increase in budget has been set aside for these projects.

ACCOMPLISHMENTS

In FY'21 the Research Section managed several sub-projects under project 304, and in March of Ongoing work included TRB Liaison and NCHRP Activity, supporting the AASHTO Technology Implementation Group, and Multi-State Research Coordination.

PROPOSED ACTIVITIES

Project 304 allows for a limited number of discretionary transportation research projects.

Expected activities include:

- ODOT staff time.
- Consultant payments.
- ODOT Staff travel.
- Equipment for the exclusive use of the defined discretionary research project. This allows the purchase of specialized research equipment.
- Other activities that are necessary and reasonable for proper and efficient accomplishments of the identified transportation research.

Small projects limited to the above activities may be conducted without amendments to this work program. All discretionary transportation research project activities funded under Project 304 will be limited to activities that are necessary and reasonable pursuant to 23 CFR 420.113(a) (3).

Sub-projects

Sub-projects under Project 304 include discrete research efforts and research functions that occur continuously, or cyclically. The current sub-projects are listed below, with the balance of funds to be spent on yet to be identified FY'20 and FY'21 research projects. Current and planned sub-projects include:

- **Liaison and NCHRP Activity.** This covers coordination of annual NCHRP balloting, coordination of problem statement submittal and panel participation (status is *ongoing*).
- **AASHTO Technology Implementation Group (TIG).**TIG identifies useful and implementable new technologies and invests in their deployment through various means. TIG is supported through an assessment on member Departments. This year ODOT paid our $6,000 TIG assessment using the Research Discretionary Fund (status is *ongoing*).
- **Northwest Transportation Conference** Funds are set aside for speakers, staff time and other conference expenses for the Northwest Transportation Conference, which is held biennially during even numbered years. The conference is described more fully under on research implementation above and is intended as a major part of the Section's technology transfer efforts (status is *ongoing*).
- **Multi-state Research Coordination** Provide support for multi-state research coordination, including response to other states' requests and support of the AASHTO Research Advisory Committee and Transportation Research Board (status is *ongoing*).
- **Modeling Soil Response with CPT data**: Construction activity and earthquake ground motions generate excess pore pressure, which in turn reduce soil stability through reduction in shear strength. Commonly used Standard Penetration Test (SPT) based methods for estimating this loss in shear strength were not developed using soils commonly found in Western Oregon and use of these methods are often associated with significant uncertainty. This uncertainty prohibits cost-effective solutions for static and seismic stability for ODOT infrastructure. To improve the ability to accurately and consistently predict the dynamic behavior of our Western Oregon soils, this project will investigate the use of Cone Penetration Test (CPT) based methods to develop models for undrained shear responses of Oregon soils. (status is ongoing)

- **Soil Mix Design**: ODOT water quality designers/erosion control specialists have a need to better characterize the performance of water quality soil mixtures for infiltration rates, shear strength, plant/seed germination and establishment. Currently there is only one ODOT recommended soil mix design, which is comprised of mixed sand and compost. Given the variability in applications from a flat detention pond to a sloped roadside drainage channel with differing climate zones, this mixture is subject to highly variable conditions. As a result, performance issues have been identified and continue to arise on construction projects where this material fails to foster grass and plant growth and is easily washed away even under erosion control matting/channel liner matting. The objective of this quick hit research is to better understand the mode of failure and the performance characteristics of the current soil mix design, as well as develop improved soil mixtures that can be successfully tailored across regions and applications. (status is ongoing)

- **Real Time Scour Pilot**: Supplementing field measurements with real-time analysis of scour can deliver standardized, quality data to inform decisions during high water scour events under ODOT's FHWA scour mandate, while also potentially providing an economical and safe means of developing asset management plans. The main objective for this research is to extend the pilot trial for monitoring scour in real time at ODOT's Trask Bridge site. (status is *ongoing*).
- **GNSS-RTN Survey Methods Updates** The objective of this research is to enable modernization of ODOT's survey protocols by integrating recent advances in GNSS and RTN methodologies for increased cost efficiency and quality standardization across all ODOT regions, districts, and consultants. Considering that not all tasks and projects require the same level of project control accuracy, this guidance will also include updating ODOT project control requirements that reflect individual project complexity and needs. Specific objectives include: 1) Develop modernized ODOT survey procedures; and 2) Develop guidance and best practices decision matrix for tailoring survey procedures to project needs. (status is *ongoing*).
- **Mapping Fish Presence pre-STIP Mitigation** Lack of fish presence information at ODOT's culvert locations has hampered ODOT's ability to efficiently plan culvert repair and replacement projects. Effectively predicting fish presence at a culvert can aid in long-term planning of culvert repair projects and identify which approach to Oregon's fish passage requirements are appropriate. The main objective of this research project is to provide a GIS based method to predict fish presence at ODOT's small culverts. (status is *ongoing*).
- **Designing Fish Passage Flow Control Structures in Steep Slopes to Maintain ODOT Compliance** ODOT must comply with Oregon fish passage statutes when working in a fish-bearing stream. As a part of this requirement, ODOT hydraulic design incorporates engineered features to provide upstream and downstream passage for migratory fish. While design tools for flow structures exist for sizing streambed materials, these tools are reasonably well developed ***only*** for projects with low gradient stream channels. When designing streambed materials for flow structures within steeply sloped stream corridors practitioners often overlook design tool limitations, resulting in high-cost failures to ODOT and non-compliance with Oregon fish passage statutes. Recently, ODOT constructed an artificial stream realignment of Brush Creek along I-84 near La Grande. This design included streambed material sizing specifically considering steep slopes by partially integrating methodology from Brohmann (1991). This research project will evaluate the post-construction, long-term design performance of this steep-slope methodology for sizing streambed materials. (status is ongoing).
- **Piloting the Use of Lidar for Monitoring Seasonal Streambed Material Movement** Many of ODOT's installed flow structures have degraded with time, emphasizing the need for the development of an efficient methodology for monitoring the post-construction state of fish passage control structures so that ODOT continues to meet the full intent of Oregon's fish passage statues. Recently, ODOT addressed the need for fish passage during a road-widening project on I-84 outside of La Grande Oregon. This project involved the artificial realignment of 3,500ft of Brush Creek through Ladd Canyon. This design involved the cutback of an existing landslide as well as the construction of stream simulation features along steep slopes

with grades ranging from 1-12%. This research will pilot the use of Lidar based change detection analysis as a useful methodology for monitoring the long-term stability of engineered stream features for seasonal streams. (status is ongoing).

- **UTC project management** ODOT is providing project management and analysis for a NITC Tier for research Exploring Data Fusion Techniques to Derive Bicycle Volumes on a Network. The objective of this research is to 1) explore data fusion techniques to determine bicycle volumes on a network using a variety of sources, 2) explore which sources lead to the best results, and 3) determine the accuracy of the various techniques. The following tasks are proposed to arrive at this objective. (status is *ongoing*).

PROCEDURES FOR SMALL PROJECTS (304)

The ODOT Research procedures manual will include procedures for selection and administration of 304 projects. These procedures will include the following limits:

- Quick Hit Research will need to be shorter than 2 years and cost less than $50,000 per year, not including potential departmental matches in resources. Any Research commitment more than $50,000 requires vote of the ODOT Research Advisory Committee.
- Any commitment over 2 years that requires more than $10,000 per year requires a RAC vote.
- All projects must be consistent with the Agency's mission statement, strategic direction and the Oregon Research Advisory Committee Priorities
- Per 23 CFR 420.209 (a)(6) these projects will be documented through the preparation of final reports. As a minimum, the documentation must include the data collected, analyses performed, conclusions, and recommendation.
- Per 23 CFR 420.209 (a)(6) the research staff will work with Project Champions and use Technology Transfer to actively implement appropriate research findings and should document benefits.

RESPONSIBLE PARTIES

This activity is the responsibility of the ODOT Research Section, as well as members of the technical advisory committee formed to manage each project.

COST INFORMATION

SPR 304	FY'16	FY'17	FY'18	FY'19	FY'20	FY'21	FY'22	FY'23
ORIGINAL BUDGET	$100,000	$100,000	$45,861	$50,000	$160,000	$175,000	**$34,500**	**$36,500**
SPENT TO DATE	$42,802	$72,385	$52,157	$55,218	$136,364	$54,986		
REVISED BUDGET	**$42,802**	**$72,385**	**$52,157**	**$55,218**	**$136,364**	**$60,000**		

FY'16 through FY'20 expenditure values are actual. FY'21 expenditure values are actual plus estimated through the end of the fiscal year. FY'22 budget values are estimated based forecasted project work.

TNIS TRANSPORTATION NEEDS AND ISSUES SURVEY

OVERVIEW

In spring and summer of 2022, the Transportation Needs and Issues Survey will randomly sample of Oregon residents their opinions on a number of issues related to transportation.

OBJECTIVES

This survey continues to provide data on transportation issues for research and planning purposes to many parts of ODOT.

More detailed information regarding the project and its objectives can be found at the link below: https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES

Funds will be used to pay for staff time; consultants and professional services; travel expenses; and other services and supplies**.**

These activities will result in:

- Literature review.
- Methods for analysis and design.
- Survey
- Data.
- Reporting.

More information on proposed activities can be found in the ODOT active research projects webpage at the link above.

ACCOMPLISHMENTS

The research program has produced the Transportation Needs and Issues Survey every two years since 1996. The most recent report having been published in January 2021.

More information on proposed activities can be found in the ODOT active research projects webpage at the link above.

RESPONSIBLE PARTIES

ODOT Research Section

This project is currently not under contract, expect contract to start early 2022 under FY22.

COST INFORMATION

TNIS	FY'20	FY'21	TOTAL
ORIGIONAL BUDGET	$45,000	$45,000	$90,000
SPENT TO DATE	$0	$0	$0
REVISED BUDGET			

FY'22 and FY'23 expenditure values are estimated based on forecasted project work.

719 CLIMATE CHANGE IMPACT ON COASTAL RIVER ESTUARIES IN OREGON

OVERVIEW

U.S. Route 101 and other ODOT highways traverse numerous estuaries along Oregon's coast. These roadways affect, and in turn are affected by, changes in the function of the estuary caused by both the presence of the roadway as well as changes in sea level. Likewise, future climatic changes may also affect the function of both the roadways and the estuaries. A great deal of money and effort continues to be focused on restoring estuaries to their more natural function. To validate present methods, develop improved future methods, and to adapt to changing future conditions it is important to monitor conditions in the estuaries and along the roadways.

OBJECTIVES

The objective of this research is to improve our understanding of the interactions of ODOT's facilities with estuary system. Specifically the intent is to gather data to verify that changes in ODOT's facilities and in the estuary produce the expected results or give new understanding to what really happened.

By monitoring conditions and changes in the Salmon River Estuary a better understanding will be gained of how the roadway/estuary system functions and how it responds to changes of all kinds. In general, ODOT will be able to make more informed responses to current and future changes to fulfill our agency mission.

More detailed information regarding the project and its objectives can be found at the link below: https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES

Funds will be used to pay for staff time; consultants and professional services; travel expenses; and other services and supplies. Funds will be used to pay for Technical Equipment required to conduct the research.

These activities will result in:

- Literature Review.
- Water quality, water level, and weather recording devices being used for this project may need to be replaced, in the event of failures, damage, or theft.
- Monitoring the hydrology of the estuary around the highway.
- Interim Reports.
- Final Report.

More information on proposed activities can be found in the ODOT active research projects webpage at the link above.

ACCOMPLISHMENTS

Information on accomplishments may be viewed by selecting ODOT active research projects webpage at the link above.

RESPONSIBLE PARTIES

ODOT Research Section: Dr. Matthew Mabey as Principal Investigator

ODOT Geo-Environmental Section

ODOT District 4

US Forest Service

National Marine Fisheries Service

Oregon Department of Environmental Quality

COST INFORMATION

SPR 719	FY'10	FY'11	FY'12	FY'13	FY'14	FY15	FY'16
STAGE 2 BUDGET	$65,778	$24,358	$24,358	$24,358	$34,358	$26,000	$26,000
WORK PLAN BUDGET	$15,000	$47,000	$20,000	$20,000	$21,000	$62,000	$22,000
SPENT TO DATE	$16,344	$49,842	$21,088	$20,008	$19,595	$50,069	$22,376
REVISED BUDGET	**$16,344**	**$49,842**	**$21,088**	**$20,008**	**$19,595**	**$50,069**	**$22,376**

COST INFORMATION *(Continued)*

SPR 719	FY'17	FY'18	FY'19	FY'20	FY21	FY22	TOTAL
STAGE 2 BUDGET	$26,000	$26,000	$27,790	$0	$0	$0	$305,000
WORK PLAN BUDGET	$23,000	$23,000	$25,000	$27,000	$0	$0	$305,000
SPENT TO DATE	$23,058	$17,765	$17,138	$24,115	$8,238	$0	$289,635
REVISED BUDGET	**$23,058**	**$17,765**	**$17,138**	**$24,115**	**$15,996**	**$7,606**	**$305,000**

FY'10 through FY'20 expenditure values are actual. FY'21 expenditure values are estimated as of May 2021 based on billings to date and forecast of fourth quarter invoice. FY'22 expenditure values are estimated based on forecasted project work.

807 COASTAL LANDSLIDE AND BLUFF RETREAT MONITORING FOR CLIMATE CHANGE ADAPTATION AND TARGETED RISK ASSESSMENT

OVERVIEW

Rising seas and extreme coastal weather events pose significant risks for the safety, reliability, and effectiveness of ODOT infrastructure and operations along the coast. Coastal landslides and shore cliff erosion are particularly sensitive to climate drivers with sea-level rise, storm frequency and intensity, wave scour, and rainfall amounts influencing landslide movement and coastal bluff erosion. Coastal bluff retreat rate is also directly proportional to climate change effects and in many locations directly threatens disruption of ODOT's coastal infrastructure. Though landslides and coastal bluff erosion are common processes that affect coastal highways every year, bluff retreat and rate of movement are not well characterized. In 2014, ODOT's Coastal Climate Change Vulnerability Assessment identified this limited information regarding coastal bluff retreat as an issue of concern. Research to directly address this concern is needed in order to optimize ODOT infrastructure planning, secure lifeline routes, and address the climate change adaptation focus of the Oregon Transportation Commission work plan. In sum, given the limited research on coastal landslide movement and bluff retreat with respect to changing climate drivers, a more long-term and in-depth monitoring study with modeling potential is needed to provide useful information for ODOT infrastructure planning.

OBJECTIVES

The goal of this research for ODOT is to develop a more comprehensive data driven framework for prioritizing coastal asset management. This is new research for ODOT building upon recent smaller-scale foundational efforts and recommendations.

More detailed information regarding the project and its objectives can be found at the link below: https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES

Funds will be used to pay for staff time; consultants and professional services; computational needs, travel expenses; and other services and supplies. Funds will be used to pay for Technical Equipment required to conduct the research.

Tasks for this research include: select representative coastal landslide and bluff sites for monitoring; literature review; purchase of MEMS equipment, geophones, piezometers; obtain and organize pre-existing geotechnical data; Establish protocol for 7 year monitoring project; equip and monitor selected sites bi-annually for a 7 year duration; analyze and model data; deliver final report.

More information on proposed activities can be found in the ODOT active research projects webpage at the link above.

ACCOMPLISHMENTS

Information on accomplishments may be viewed by selecting ODOT active research projects webpage at the link above.

RESPONSIBLE PARTIES

ODOT Research Section

ODOT Geo-Environmental Section

Oregon State University with Dr. Ben A. Leshchinsky and Dr. Michael J. Olsen as Principal Investigators (OSU Agreement for $639,209 ending July 31, 2024, approximately $450,717 expended through March 31, 2021).

COST INFORMATION

SPR 807 (years 1-5)	**FY'17**	**FY'18**	**FY'19**	**FY'20**	**FY'21**
STAGE 2 BUDGET	$295,000	$36,000	$36,000	$40,000	$36,000
WORK PLAN BUDGET	$305,857	$49,857	$48,565	$51,280	$48,577
SPENT TO DATE	$323,843	$62,119	$59,926	$83,421	$52,835
REVISED BUDGET	**$323,843**	**$62,119**	**$59,926**	**$83,421**	**$72,987**

SPR 807 (years 6-8, total)	**FY'22**	**FY'23**	**FY'24**	**FY'25**	**TOTAL**
STAGE 2 BUDGET	$80,000	$60,000	$2,000		$585,000
WORK PLAN BUDGET	$102,886	$68,815	$17,000		$692,837
SPENT TO DATE	$0	$0	$0		$582,144
REVISED BUDGET	**$94,333**	**$82,815**	**$22,986**		**$802,431**

FY'17 through FY'20 expenditure values are actual. FY'21 expenditure values are estimated as of May 2021 based on billings to date and forecast of fourth quarter invoice. FY'22 through FY'25 expenditure values are estimated based on forecasted project work.

812 MODELING CHLORIDE ACCUMULATION IN STREAMS FROM WINTER ROAD SALT APPLICATION FOR FEDERAL COMPLIANCE

OVERVIEW

This proposed research aims to provide ODOT with a salt application management tool for predicting chloride exceedances. Providing a safe and efficient transportation system that supports environmental sustainability during adverse winter weather conditions is a pressing challenge for ODOT. To improve driving conditions while minimizing negative chloride impacts on the environment and infrastructure, corrosion inhibiting chloride based liquid deicer (magnesium chloride, $MgCl_2$) is proactively applied to the highway prior to a winter storm to prevent ice and snow from bonding to pavement. Using $MgCl_2$ in this way often means lower quantities of chloride are applied to the highway compared to traditional winter maintenance methods that utilize sodium chloride (NaCl) as a highway deicer. However, during extreme winter events optimized application of NaCl could be more efficient than $MgCl_2$ alone in controlling snow and ice. To improve estimates of pollutant loads and concentrations for better highway stormwater management, the United States Geological Survey (USGS) in cooperation with the Federal Highway Administration (FHWA) developed the Stochastic Empirical Loading and Dilution Model (SELDM). SELDM is a lumped parameter model that can facilitate scenario simulation and sensitivity analysis to determine the potential risk of water quality exceedances from runoff into surface waters. Through this project SELDM will be further enhanced to improve chloride specific modeling through 1) calibration with Oregon specific data, and 2) consideration of groundwater systems to account for future chloride inputs from flowpaths to streams.

OBJECTIVES

This research is presented as a two-phase research proposal. The following objectives are for research Phase 1:

1. Evaluate and adjust ODOT's Winter Salt Pilot project data collection methods.
2. Evaluate SELDM model results, including probability of exceeding water quality standards in a given year and the effect of using BMPs .
3. Determine the preliminary degree of groundwater infiltration at Site 1 using previous and supplemental well/spring data. .

If the results from Phase 1 reveal that chloride is reaching groundwater systems at high concentrations, Phase 2 will be initiated. For Phase 2 the main objectives are to evaluate chloride direction, mass, and rate of movement in groundwater systems for inclusion as baseflow input for SELDM chloride stream exceedance prediction. More detailed information regarding the project and its objectives can be found at the link below:
https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES

Funds will be used to pay for staff time; consultants and professional services; travel expenses; and other services and supplies. Funds will be used to pay for Technical Equipment required to conduct the research. These activities will result in:

- Literature review.
- Regional analysis of chloride levels.
- Preliminary SELDM runs with stormwater facilities.
- Collect and evaluation of groundwater data and surface water measurements
- Construct or refine numerical groundwater model to evaluate pathways and travel times for chloride contaminated groundwater.
- TAC presentations and a final report.

More information on proposed activities can be found in the ODOT active research projects webpage at the link above.

ACCOMPLISHMENTS

Information on accomplishments may be viewed by selecting ODOT active research projects webpage at the link above.

RESPONSIBLE PARTIES

ODOT Research Section

ODOT Geo/Environmental Section

ODOT Maintenance and Operations Branch provided $65,000 in of funding to this project. These funds are *not* included in the SPR budge below.

FHWA Office of Project Development and Project Review provided $136,000 of funding to this project. These funds were authorized by memos which were received by ODOT in June of 2017 and February of 2018 and are included in the SPR budget below. (See Appendix B for copies of these memos).

USGS: Mr. Adam Stonewall, Hydrologist as principal investigator (Agreement for $362,000 ending September 30, 2021. Amended to increase ODOT share to $396,450. Approximately $343,037 expended through May 2 Of this $167,141 was billed to SPR funds) USGS is committed to contributing $195,000 to this project.

COST INFORMATION

SPR 812	**FY'18**	**FY'19**	**FY'20**	**FY'21**	**FY'22**	**FY'23**	**TOTAL**
STAGE 2 BUDGET	$100,000	$30,000	$100,000	$95,000			$170,000
WORK PLAN BUDGET	$165,000	$30,000	$100,000	$95,000	$4,000		$394,000
SPENT TO DATE	$95,957	$129,672	$81,639	$35,769	$0		$343,09
REVISED BUDGET	**$95,957**	**$129,672**	**$81,639**	**$54,150**	**$1,000**	**$29,850**	**$392,268**

FY'18 through FY'20 expenditure values are actual. FY'21 expenditure values are estimated as of May 2021 based on billings to date and forecast of fourth quarter invoice. FY'22 expenditure values are estimated based on forecasted project work.

816 RESILIENT AND RAPID REPAIR MEASURES FOR SEISMICALLY VULNERABLE BRIDGES

OVERVIEW

Seismic retrofit or replacement of the entire ODOT vulnerable bridge inventory is unlikely in the foreseeable future. This leaves Oregon with a large bridge inventory of seismically vulnerable bridges. Simultaneously, the CSZ earthquake has a considerable probability of occurrence within the lifetime of these vulnerable bridges (~30% in next 50 years). One of the major issues facing the transportation infrastructure during and following the CSZ earthquake is not the intensity of shaking at any particular site, but the extensive and varied damage distributed throughout the western part of the state. Damaging aftershocks will likely continue for months to possibly years. Variability in the shaking intensity and individual bridge responses will mean that the extent of damage throughout the inventory will vary from minor to significant.

Bridge repair in lieu of replacement will be a necessity following the CSZ earthquake. Restoring mobility will be a priority and thus ODOT must implement repairs quickly. In many cases, these repairs will need to remain for the useful life of the bridge.

OBJECTIVES

The proposed research aims to identify practical post-earthquake repair methodologies that can be rapidly implemented and that incorporates low damage earthquake resilience for future shaking. Existing repair methods will be reviewed whilst considering rapid installation and susceptibility to future earthquake damage. These will be contrasted to alternative concepts that might utilize an external collar, which is secured to the non-damaged parts of the bent. Such collars might be fabricated shortly following the earthquake from standard drawings; or prefabricated and stock piled for common geometries. Researchers at PSU have developed a similar concept as retrofit of slender equipment support structures. New Zealand has proposed similar approach for new, precast, ABC bridge construction in New Zealand.

The proposed repair measure would be best suited for bents that have significant damage, yet have not lost gravity capacity. This might encompass a majority of bridges statewide. The difficulty is in repairing for ductility and providing future resiliency, which be a focus of this research. The collar concept might utilize externally attached ductile fuses to bypass the damaged zone and restore the lateral capacity. Such an approach offers the advantage of bypassing the internal rebar continuity within the damaged zone. Doing this could significantly simplify the repair. The number of replaceable fuses and their individual capacity could control the lateral behavior, leaving the rest of the repair to be relatively generic and conventional. Following capacity design, subsequent earthquake damage would be forced into the replaceable fuses and thereby provide significant resilience into the future.

More detailed information regarding the project and its objectives can be found at the link below:
https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES

A draft of the final report is in hand. ODOT Research will publish the final report earlier in FY'22.

More information on proposed activities can be found in the ODOT active research projects webpage at the link above.

ACCOMPLISHMENTS

Information on accomplishments may be viewed by selecting ODOT active research projects webpage at the link above.

RESPONSIBLE PARTIES

ODOT Research Section

ODOT Bridge Section

Portland State University: Dr. Peter Dusicka as principal investigator (Agreement for $238,783 originally ending February 28, 2020, amended to end November 30, 2020, and amended a second time to May 31, 2021. Approximately $208,783 expended through May 2021.)

COST INFORMATION

SPR 816	FY'18	FY'19	FY'20	FY'21	FY'22	TOTAL
STAGE 2 BUDGET	$80,000	$115,000	$45,000			$240,000
WORK PLAN BUDGET	$86,215	$111,188	$56,380			$253,783
SPENT TO DATE	$97,439	$82,397	$45,716	$3,413		$228,965
REVISED BUDGET	**$97,439**	**$82,397**	**$45,716**	**$33,999**	**$1,000**	**$260,551**

FY'18 through FY'20 expenditure values are actual. FY'21 expenditure values are estimated as of May 2021 based on billings to date and forecast of fourth quarter invoice. FY'21 expenditure values are estimated based on forecasted project work.

820 DEVELOPMENT OF RELIABLE GEOTECHNICAL METHODS AND STANDARDS FOR DESIGN AND CONSTRUCTION OVER DIATOMACEOUS DEPOSITS

OVERVIEW

Due to the lack of reliable geotechnical engineering standards of practice for building in diatomaceous silt, engineering difficulties and associated costly project delays are often encountered during ODOT construction in this soil type. Further complicating engineering design, the liquefaction susceptibility of these materials is also unknown—presenting significant public safety risk in the face of an impending Cascadia seismic event. Diatomaceous silt is composed of highly abrasive diatom microfossils that contain substantial intra-particle porosity. These unique properties of diatom microfossils strongly impact the engineering properties of the material relative to other "textbook" soils. Though many common geotechnical designs use typical assumptions of "sand-like" or "clay-like" soil behavior to determine engineering properties, these empirically-based equations are not suitable for predicting the behavior of diatomaceous soils. Oregon has at least twenty-five lake-bed basins with diatomaceous silts at engineering depths of interest to ODOT. Numerous ODOT bridges have been constructed in diatomaceous soils. Engineering standards of practice are needed for this soil type.

Multiple studies with diatomaceous silt confirm the incongruity of using existing engineering equations for estimating diatomaceous soil parameters; however, design correlations have yet to be developed or validated. Field-based studies on diatomaceous soils also report that engineering behavior varies between deposits, consistent with ODOT observations of diatomaceous material ranging from "pudding-like" to "chalk-like". Targeted field and lab based research together with advanced computational modeling is essential for developing quality standards of practice for diverse ODOT project sites containing diatomaceous soils.

OBJECTIVES

Current design standards do not provide guidance for selecting engineering properties, anticipated behavior, or construction quality control in diatomaceous material. The goal of this proposed research is to provide ODOT needed engineering design parameters for Oregon's diatomaceous silts. Specific objectives include:

1. Develop a site-specific predictive model for estimating geotechnical properties of diatomaceous silt, leveraging available data from existing ODOT diatomaceous projects together with targeted field-directed geotechnical testing.

2. Develop a standard of practice for geotechnical design in Oregon's diatomaceous silts, including suggested edits to ODOT's Geotechnical Design Manual (GDM), a summary map with descriptions of Oregon's diatomaceous basins and associated ODOT project sites, and a short-course reviewing the results of this research project.

More detailed information regarding the project and its objectives can be found at the link below:
https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES

Funds will be used to pay for staff time; consultants and professional services; computational needs, travel expenses; and other services and supplies. Funds will be used to pay for technical equipment required to conduct the research. Tasks for this research will include: literature review; pilot testing; data acquisition (in field and laboratory); data analysis for multiple sites; TAC presentations, drilling for samples, final report; short course.

More information on proposed activities can be found in the ODOT active research projects webpage at the link above.

ACCOMPLISHMENTS

Information on accomplishments may be viewed by selecting ODOT active research projects webpage at the link above.

RESPONSIBLE PARTIES

ODOT Research Section

ODOT GeoEnvironmental

ODOT Regions 4 and 5: ODOT Region 4 will be supplementing this project with $50,000 with available non-SPR ODOT funds for additional drilling depth and testing in FY20.

Oregon State University: Dr. Matthew Evans as principal investigator (Agreement for $431,765 ending December, 2022. Approximately $242,563 expended through May 2021.)

COST INFORMATION

SPR 820	**FY'19**	**FY'20**	**FY'21**
STAGE 2 BUDGET	$168,000	$82,000	$82,000
WORK PLAN BUDGET	$276,669	$81,458	$84,894
SPENT TO DATE	$224,621	$51,906	$72,744
REVISED BUDGET	**$224,621**	**$51,906**	**$134,987**

SPR 820	**FY'22**	**FY'23**	**TOTAL**
STAGE 2 BUDGET	$102,000	$76,000	$510,000
WORK PLAN BUDGET	$102,000	$4,500	$549,521
SPENT TO DATE			$349,271
REVISED BUDGET	**$102,202**	**$49,000**	**$562,716**

FY'19 through FY'20 expenditure values are actual. FY'21 expenditure values are estimated as of May 2021 based on billings to date and forecast of fourth quarter invoice. Note that FY'20 in above Table does not include $50,000 in expenditures from ODOT Region 4 Contributions.

824 ASSESSMENT OF THE LATEST CASCADIA GROUND MOTION ESTIMATES IN COMPARISON TO ODOT DESIGN CRITERIA

OVERVIEW

The Cascadia Subduction Zone (CSZ) earthquake has a high probability of occurrence within our lifetime (approx. 30% in the next 50 years) and subsequently ODOT has implemented this hazard explicitly as the operational design criteria for bridges in Western Oregon. In the absence of actual recorded earthquakes from the CSZ, the basis of this hazard characterization is rooted in knowledge from subduction zone earthquakes in Japan and Chile. A recently completed fundamental research project referred to as M9, funded by the National Science Foundation and conducted by the University of Washington (UW) and the United States Geological Survey (USGS), has considered relevant Pacific Northwest (PNW) geology in developing a detailed numerical model of the CSZ. This effort culminated in a large database of CSZ specific earthquake ground motions for the entire PNW, including Oregon.

Potential implications have thus far been only looked at for buildings and for the Puget Sound area. These initial findings have found that the CSZ ground motions can differ significantly from the anticipated current design; in some cases giving spectral values 2 to 3 times higher at the long periods. The largest differences have been observed within geologic basins, which also exist in Oregon's highly populated, and economically sensitive, areas of Tualatin and Beaverton. These areas have regular highway bridges as well as major river crossings, which can exhibit long period response. Hence, there is a need for applied research to assess the implications of this new data on ODOT's bridge design.

OBJECTIVES

The object of this project is to integrate the latest research about strong motions from subduction zone earthquakes into the ODOT design process.

More detailed information regarding the project and its objectives can be found at the link below: https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES

Consultant Payments; Staff Time; Literature Review; Pilot Testing; Data Acquisition (In-Field);Data Analysis for Multiple Sites; TAC Presentations, Final Report; and Travel;

These activities will result in:

- Literature review
- Updated ARS tool.
- Update and expansion of response spectra from earthquake scenarios.
- Recommended basin effect adjustments for design spectra.
- Final Report.

More information on proposed activities can be found in the Project Work Plan at the link above.

ACCOMPLISHMENTS

Accomplishments may be viewed by selecting Quarterly Reports at the link above.

RESPONSIBLE PARTIES

ODOT Research Section

Portland State University: Dr. Peter Dusicka as principal investigator (Original agreement for $178,594 ending September 30, 2020. Amended to end March 31, 2021 and amended a second time to end January 31, 2022. Approximately $126,843.53 expended through May 2021.)

COST INFORMATION

SPR 824	FY'19	FY'20	FY'21	FY'22	TOTAL
STAGE 2 BUDGET	$78,400	$98,000	$19,600		**$196,000**
WORK PLAN BUDGET	$85,227	$104,617	$750		**$190,594**
SPENT TO DATE	$43,436	$48,989	$43,558	$0	**$135,983**
REVISED BUDGET	**$43,436**	**$48,989**	**$53,000**	**$54,203**	**$199,628**

FY'19 through FY'20 expenditure values are actual. FY'21expenditures are estimated as of May 2020 based on billings to date and forecast of fourth quarter invoice. FY'22 expenditure values are estimated based on forecasted project work.

829 RUMBLE STRIP DESIGN ANALYSIS TO CONTRIBUTE TO LOW EXTERIOR NOISE AND THE DURABILITY OF INLAID STRIPES

OVERVIEW

Rumble strips are an effective and relatively inexpensive safety treatment for the Oregon Department of Transportation (ODOT). Installation involves grinding/milling semi-circle 'grooves' at a set width with regular intervals (lengthwise) into the pavement. These can be installed in the median or on the shoulder and are designed to alert drivers when they depart the lane with both auditory and tactile (vibration) sensations. Recently, DOTs have been experimenting with different patterns, like an irregular or sinusoidal pattern, when installing rumble strips. Combinations of inlaid markings with rumble strips are called rumble "stripEs" (with "E"). Rumble stripEs are rumble strips cut into the pavement where the edge-line or centerline are to be placed and the pavement marking is then placed over the milled portions. Inlaid pavement markings are a continuous length of grooved pavement, which allows the pavement marking to be inset below the road surface level. This typically extends the pavement marking life.

ODOT has been looking at different milled patterns for more effectiveness to drivers and also to lessen external noise. In one instance on US 97, ODOT reported that one section of rumble strips was torn out due to an unacceptable exterior noise level to the nearby community and the expense of this task was high. Vehicle tires produce a noise spectrum while rolling over the uneven grooved surfaces that are the signature safety aspect of these strips. ODOT has completed prior research modeling noise characteristics for tires going over rumble strips as well as research to standardize methodology in capturing 'ground-truth' noise samples from traffic going over rumble strips.

Research is needed to evaluate rumble strip designs including rumble stripEs and potentially rumble strips with inlaid markings. Other variables which will be modelled that may affect noise outputs include wear patterns on older rumbles and rain water. Specifically, the research will focus on modelling implementable solutions (designs) that are acceptable to achieving similar safety benefits for drivers as well as reducing external noise for residential communities. A secondary aspect of the research will look at ranking those acceptable designs which modelling indicates would be longer-lasting lifespans of strips/stripEs or inlaid combinations.

OBJECTIVES

The goal of the research is for ODOT to identify an implementable rumble design (strip, stripe, or combination inlaid), which is acceptable in noise output to communities who live close to the highway, but without the rumble losing its safety benefit of alerting drivers when they depart the road. This work will produce:

- A literature review and interviews with ODOT staff will identify acceptable noise level limits for rumble noise and characteristics of rumble noise (e.g. frequency, pitch, tone, repetitive nature, etc). Literature will also review characteristics of noise and similar noise studies, which examine changes in public opinion over time of similar noises in communities.
- Documentation of strip design criteria for both noise and driver feedback that must be met to meet the goal of the project.

- Modeling with the goal to adjust the rumble design to affect external noise output, yet keep the safety aspect to alert drivers. This research work will model external noise spectrum characteristics from tires with a variety of variables related to rumble strips/stripEs/combinations.
- Roadside tire noise data and validation of the model predictions against roadside tire noise data.
- Documentation of rumble strip/stripE designs that meet the previously documented strip design criteria. This documentation will be delivered in the format of a proposed design specification for use by ODOT and other road authorities.

More detailed information regarding the project and its objectives can be found at the link below: https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES

Consultant Payments; Staff Time; Literature Review; Pilot Testing; Data Acquisition (In-Field);Data Analysis for Multiple Sites; TAC Presentations, Final Report; and Travel; This project may include the purchase of Technical Equipment

More information on proposed activities can be found in the ODOT active research projects webpage at the link above.

ACCOMPLISHMENTS

Information on accomplishments may be viewed by selecting ODOT active research projects webpage at the link above.

RESPONSIBLE PARTIES

ODOT Research Section

Oregon State University (Agreement for $295,000 ending January 2022. Approximately $247,715 expended through May 2021.)

COST INFORMATION

SPR 829	**FY'19**	**FY'20**	**FY'21**	**FY'22**	**TOTAL**
STAGE 2 BUDGET	$94,500	$126,000	$94,500		**$315,000**
WORK PLAN BUDGET	$100,000	$120,000	$95,000		**$315,000**
SPENT TO DATE	$101,134	$151,374	$39,840		**$292,348**
REVISED BUDGET	**$101,134**	**$151,374**	**$70,767**	**$44,341**	**$367,616**

FY'19 through FY'20 expenditure values are actual. FY'21 expenditure values are estimated as of May 2021 based on billings to date and forecast of fourth quarter invoice. FY'22 expenditure values are estimated based on forecasted project work

830 BRIDGE COLUMN FOOTING PERFORMANCE AND SEISMIC RETROFIT EVALUATION CONSIDERING SOIL-STRUCTURE INTERACTION

OVERVIEW

Hundreds of older bridges in the Oregon bridge inventory are supported on seismically deficient reinforced concrete substructures that consist of the supporting columns and foundations. Two types of foundations are commonly found in the inventory: spread footings and timber pile-supported pile caps, both of which were not designed to resist the forces produced during earthquakes with magnitudes and durations expected to affect Oregon. ODOT considers aging timber pile foundations to be highly uncertain and cannot be counted on to provide seismic resistance. Thus, they are not considered for retrofit and will not be directly considered in this study. In the case of spread footings, while they lack proper reinforcing details, significant cost savings can be achieved if they can be used as-is or moderately retrofitted to achieve required seismic performance. Efforts to evaluate whether replacement or retrofit of these substructures is more efficient have been complicated due to the lack of sufficient design guidelines for incorporating the effects of soil-structure interaction (SSI). Recent ODOT funded research has led to the development of a seismic retrofit solution for columns using titanium alloy bars that produced predictable response with high ductility and large energy dissipation when the foundation is considered rigid (typical structural assumption). As part of this same study, the influence of SSI was evaluated using a soil simulant and indicated that this effect produced a rocking response that increased overall system drifts but reduced the moment gradient along the column height and reduced the demands in the column at the footing elevation. This has practical and important ramifications for retrofit designs for the entire substructure, including both footings and columns. SSI can be both beneficial and deleterious across different criteria and improvements in understanding are needed to ensure desired seismic performance of retrofitted substructures. Mitigation of collapse risk of the Oregon bridge inventory requires investments to *efficiently* improve their seismic resilience. To make best use of limited resources, retrofit design guidance that can properly account for the potential benefit or detriment of SSI of bridge-column footings must be developed to support design guidance within the ODOT Bridge Design and Drafting and Geotechnical Design Manuals (BDDM and GDM). Such design guidance must include a clear decision matrix and corresponding analytical and design protocol, which in turn must be based on experimental evidence developed from the evaluation of full-scale specimens. In addition, directed retrofit approaches need to be advanced and structural models need to be developed for spread footings to permit estimation of force and moment capacity and demands to enable system seismic performance and eliminate needless and costly foundation retrofits. Although some test data based on previous research efforts exist, further SSI tests that include real soils under seasonally extreme conditions are necessary to help inform the design guidance that is required for the evaluation of appropriate retrofit/replacement options.

OBJECTIVES

The objectives of this research are to improve the experimental basis for assessing bridge column-footing performance with and without retrofits subject to SSI and to provide clear design guidance for the evaluation of retrofit/replacement alternatives, with full consideration of the moment capacity at the top of the columns as well as the evolution of the force flow within the spread footing. The proposed experiments will be coupled with numerical modeling to extend the experimental work, inform design guidance, and show the effect of various foundation soil conditions. Although the focus of this work is on spread footings, the outcomes may be applicable to retrofits of timber pile-supported substructures, if the pile caps can be retrofitted similar to spread footings under the assumption that deteriorated timber piles make the pile cap act like a spread footing under an extreme seismic event. The development and implementation of these guidelines in the BDDM and GDM will allow for improved, less conservative design recommendations and the potential for improved cost savings as ODOT improves the seismic resilience of its transportation infrastructure network.

More detailed information regarding the project and its objectives can be found at the link below: https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES

Consultant Payments, Staff Time, Literature Review, Pilot Testing, Data Acquisition (Lab and possibly field), Data Analysis, TAC Presentations, Final Report; and Travel.
This project is under development in May of 2018. Once it begins, More information on proposed activities can be found in the ODOT active research projects webpage at the link above.
These activities will result in:

- Literature review
- Testing of full-scale column, footing, soil specimens
- Extension of testing through numerical models
- Progress reports
- Final Report.

ACCOMPLISHMENTS

Information on accomplishments may be viewed by selecting ODOT active research projects webpage at the link above.

RESPONSIBLE PARTIES

ODOT Research Section
Oregon State University: Dr. Armin W. Stuedlein as principal investigator. (Agreement for $470,000 ending October 31, 2022. Approximately $248,340 expended through May 2021.)

COST INFORMATION

SPR 830	**FY'20**	**FY'21**	**FY'22**	**FY'23**	**TOTAL**
STAGE 2 BUDGET	$150,000	$135,000	$135,000	$50,000	**$470,000**
WORK PLAN BUDGET	$198,000	$195,000	$90,000	$7,000	**$490,000**
SPENT TO DATE	$131,441	$96,424	$0	$0	**$227,865**
REVISED BUDGET	**$131,441**	**$185,000**	**$129,000**	**$45,533**	**$490,974**

FY'20 expenditure values are actual. FY'21 expenditure values are estimated as of May 2021 based on billings to date and forecast of fourth quarter invoice. FY'22 through FY'23 expenditure values are estimated based on forecasted project work.

831 DESIGN AND LIFE CYCLE ASSESSMENT OF GABION BARRIERS FOR ROCKFALL MITIGATION USING NUMERICAL MODELING

OVERVIEW

For many rock slopes along ODOT corridors, gabion baskets are the preferred rockfall mitigation method from an economic, environmental, and maintenance perspective due to their low cost to build, more natural appearance, ability to be covered with landscaping, and ease of repair by maintenance crews. However, there is considerable risk in deploying gabion barriers without design criteria to support their use and assess their continued efficacy post rockfall impact. Design procedures for gabions as rockfall barriers do not currently exist because the science behind their performance under dynamic impact loading has not been fully investigated. In large part, this is due to the difficulty of quantifying repetitive impact loads and deformations. To-date, full-scale physical impact tests on gabion barriers have not been performed for this application. Thus, gabion barriers are currently designed by ODOT for the static loads associated with soil retention, similar to typical earth retaining walls. Clearly, this is not equivalent to (repetitive) impact loading. To initially address this deficiency, this project will use numerical modeling to assess the life-cycle of gabion rockfall barriers. Numerical modeling to determine gabion basket failure curves during progressive rockfall events will provide a science-based approach for development of design criteria and vet the efficacy, safety and design life of gabion rockfall barriers.

OBJECTIVES

Objectives for this research project include delivery of decision support tools for both design and life cycle assessment as well as delivery of design criteria for gabion rockfall barriers. Specifically, this research aims to provide Oregon engineers with a predictive and proactive tool to estimate gabion basket system response at impact based on various site conditions and design parameters, enhancing confidence in the safety and efficiency of the design, and will inform decisions to modify or replace existing gabion barriers. Gabion impact barrier design criteria will provide ODOT with an efficient tool for mitigating rockfall hazards, greatly improving safety along critical lifeline corridors. Most importantly, by providing Oregon engineers with a quantitative, science-based understanding of the performance of gabion baskets under impact conditions, the decision-making process during both design and remediation after a natural disaster will be more seamless and defensible.

More detailed information regarding the project and its objectives can be found at the link below:
https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES

Funds will be used to pay for the following: staff time, consultants and professional services, computational needs, technical equipment, travel expenses, and other services and supplies. Tasks include: literature review; 2D preliminary model development; 3D simulation and parametric analysis; sequential impact and serviceability analysis; Graphical User Interface development; training and reporting; and proposal for full-scale testing for model validation.

More information on proposed activities can be found in the ODOT active research projects webpage at the link above.

ACCOMPLISHMENTS

Information on accomplishments may be viewed by selecting ODOT active research projects webpage at the link above.

RESPONSIBLE PARTIES

ODOT Research Section

ODOT Geo/Environmental Section

ODOT Regions

Oregon State University (Agreement for $235,243 ending August 31, 2022. Approximately $166,909 expended to date).

COST INFORMATION

SPR 831	**FY'20**	**FY'21**	**FY'22**	**TOTAL**
STAGE 2 BUDGET	$98,000	$98,000	$49,000	**$245,000**
WORK PLAN BUDGET	$97,067	$137,135	$16,041	**$250,243**
SPENT TO DATE	$67,250	$106,930		**$174,180**
REVISED BUDGET	**$67,250**	**$154,452**	**$32,158**	**$253,860**

FY'20 expenditure values are actual. FY'21 expenditure values are estimated as of May 2021 based on billings to date and forecast of fourth quarter invoice. FY'22 expenditure values are estimated based on forecasted project work.

832 EXAMINING THE OREGON MOTOR CARRIER SAFETY ACTION PLAN: DEVELOPING BEST RETURN ON INVESTMENT TOOLS

OVERVIEW

In July of 2016, the Motor Carrier Transportation Division in collaboration with Oregon State University implemented a state-funded pilot program called the 'Oregon Motor Carrier Safety Action Plan' (OMCSAP). The program provided state funds to participating law enforcement agencies to conduct Level 2 truck inspections and identify unsafe driver behaviors in high-crash locations along I-5 (Portland area) and the I-205 corridor. The benefits of the program were both clear-cut and strikingly effective. Continuing and expanding this program will require additional state funds, and the best use of this funding requires research on the optimum level of effort required to achieve the results observed from the pilot program: what level of law enforcement is needed to achieve best value in the reduction of truck-at-fault crashes?

OBJECTIVES

This research seeks to develop an optimal methodology to expand the OMCSAP to viable corridors statewide. Focusing on the leading causes of truck crashes from previous and current ODOT research studies with increased enforcement activities along with education outreach will provide users of the Oregon Roadway System a safer roadway environment.

More detailed information regarding the project and its objectives can be found at the link below: https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES

Funds will be used to pay for staff time; consultants and professional services; travel expenses; and other services and supplies. These activities will result in: Literature review and Data Assembly; Descriptive Statistical Analysis; Perform law enforcement and other state agency surveys; Identify viable corridor locations through spatial analyses; Assess the viability for implementation at identified; Determine optimal cost allocation for the continuation of the OMSCAP program; a Final report.

More information on proposed activities can be found in the ODOT active research projects webpage at the link above.

ACCOMPLISHMENTS

Information on accomplishments may be viewed by selecting ODOT active research projects webpage at the link above.

RESPONSIBLE PARTIES

ODOT Research Section

ODOT Motor Carrier

Oregon State University (Agreement for $113,341 ending September 2021) Approximately $92,057 expended through May 2021.)

Portland State University (Agreement for $59,000 ending September 2021) Approximately $49,301 expended through May 2021.)

COST INFORMATION

SPR 832	**FY'20**	**FY'21**	**FY'22**	**FY'23**	**TOTAL**
STAGE 2 BUDGET	$79,800	$106,400	---	---	**$186,200**
WORK PLAN BUDGET	$97,000	$87,341	$6,000	---	**$190,341**
SPENT TO DATE	$50,420	$102,277	---	---	**$42,025**
REVISED BUDGET	**$50,419**	**$108,579**	**$31,342**	**---**	**$190,340**

FY'20 expenditure values are actual. FY'21 expenditure values are estimated as of May 2021 based on billings to date and forecast of fourth quarter invoice. FY'22 expenditure values are estimated based on forecasted project work.

833 IMPACTS OF INTERSECTION TREATMENTS AND TRAFFIC CHARACTERISTICS ON BICYCLIST SAFETY

OVERVIEW

In urban and suburban locations, intersections are where a variety of transportation modes converge, thus leading to an increased potential for conflicts, including those between bicyclists and motor vehicles. A common crash type involving bicycles at intersections is the "right/left-hook" where a right/left-turning vehicle collides with a through bicyclist. In the 5-year period from 2012-2016 alone, 39 bicyclists were killed and 4,853 were injured in Oregon traffic crashes (source: https://www.oregon.gov/ODOT/Data/Pages/Crash.aspx), and the great majority of these injuries occurred in municipalities with populations over 50,000 where there are likely to be greater numbers of signalized intersections where right/left hook vehicle-bicycle crashes can occur. While various geometric treatments and signal control strategies have been used in attempts to mitigate right-left/hook conflicts, agencies often face questions about optimal treatments and when to use these treatments at intersections. To date, very sparse research has been conducted to analyze how certain treatments (e.g. bike boxes, mixing zones, leading bike interval (LBI), split LBI, and others) along with traffic characteristics (e.g. bicycle, pedestrian, and vehicle volumes) impact the frequency of bicycle-vehicle conflicts, as well as the severity of such conflicts (i.e. how 'close' a conflict is to resulting in an actual crash). Research is needed to ascertain the safety impacts of these different treatments, and to provide practitioners guidance on when and where to install such treatments

OBJECTIVES

This research aims to accomplish three key objectives. The first objective is to determine which factors affect the frequency and/or severity of bicycle vehicle-conflicts at intersections with different bicycle-related treatments (as well as those with no treatments) through analysis of video-recorded field observations and statistical modeling. The second objective would provide data-driven guidance as to the efficacy of certain intersection treatments in mitigating vehicle-bicycle conflicts (thereby improving bicyclist safety by this surrogate measure), including consideration of how traffic and site characteristics impact these conflicts through statistical modeling. Lastly, this research would develop a 'toolbox' which describes the performance (in terms of bicycle-vehicle conflicts) of bicycle-specific intersection treatments under different geometric and traffic conditions, and when/where to consider such treatments. An additional objective of the 'toolbox' will be to provide what can be considered "conflict modification factors" for different treatments and a network screening tool/process.

More detailed information regarding the project and its objectives can be found at the link below:
https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES

Consultant Payments, Staff Time, Literature Review, Pilot Testing, Data Acquisition (Lab and possibly field), Data Analysis, TAC Presentations, Final Report; and Travel.

More information on proposed activities can be found in the ODOT active research projects webpage at the link above.

ACCOMPLISHMENTS

Information on accomplishments may be viewed by selecting ODOT active research projects webpage at the link above.

RESPONSIBLE PARTIES

ODOT Research Section
Northern Arizona University: Dr. Brendan Russo, Dr. Edward Smaglik as principal investigators. (Agreement for $67,500 ending August 2021. Approximately $0.00 expended through May 2021.)

Portland State University: (Agreement for $47,500 ending September 2021. Approximately $3,873.90 expended through May 2021.)

Oregon State University: (Agreement for $42,500 ending September 2021. Approximately $0.00 expended through May 2021.)

COST INFORMATION

SPR 833	**FY'20**	**FY'21**	**FY'22**	**FY'23**	**TOTAL**
STAGE 2 BUDGET	$37,500	$102,500	$10,000		$150,000
WORK PLAN BUDGET	$49,972	$95,715	$26,813		$172,500
SPENT TO DATE	$8,574	$128,642			$6,022
REVISED BUDGET	**$11,615**	**$134,255**	**$40,510**		**$186,380**

FY'20 expenditure values are actual. FY'21 expenditure values are estimated as of May 2021 based on billings to date and forecast of fourth quarter invoice. FY'22 expenditure values are estimated based on forecasted project work.

834 DETERMINING LANDSLIDE DRAIN LIFECYCLE FOR DEVELOPMENT OF MAINTENANCE AND OPERATION MANUALS

OVERVIEW

Horizontal drains stabilize unstable slopes by decreasing the quantity of water in the ground. These drains are the only practical method for mitigating excessive slide movement for many of the large landslides impacting ODOT infrastructure. Effective design and performance criteria do not exist for horizontal drains, resulting in rare delivery of Operations and Maintenance (O&M) manuals and associated budgets to Maintenance teams who are ultimately responsible for their upkeep. Frequently, drain systems are installed with limited means of estimating or measuring how long they will effectively function. Maintenance of horizontal drains is critical for maintaining the integrity of these landslide mitigation systems. Without maintenance, these systems will cease to function and excessive slope movement will resume. To ensure long-term slope stability and driver safety on ODOT right-of-way, development of drain design criteria to inform maintenance operations and projected design life is essential. This research will leverage existing ODOT data and sponsored research (SPR807 and SPR808), including extensive drain data from ODOT's Pioneer Mountain-Eddyville (PME) project, together with targeted instrumentation of horizontal drains and evaluation of maintenance records to generate horizontal drain design and performance criteria, which will in turn be used to inform maintenance schedules and methodologies.

OBJECTIVES

This proposed research will develop a methodology for preparation of O&M manuals for horizontal drains. Building upon existing ODOT and agency partner data, instrumentation and monitoring will be performed on a series of landslide sites with varying soil/rock conditions and drain ages.

More detailed information regarding the project and its objectives can be found at the link below: https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES

Funds will be used to pay for the following: staff time, consultants and professional services, travel expenses, computational needs, and other services and supplies. Funds will be used to pay for Technical Equipment required to conduct the research.

These activities will result in: Literature review and agency outreach; Purchase of flowmeters, data loggers, horizontal drain material, and other equipment to measure pressure; Collection of existing piezometer and drain-weir data; Analysis of long-term drain performance; Graphical user interface development for predicting drain performance and maintainability; Cost efficiency analysis; Compilation of recommendations in a final report

More information on proposed activities can be found in the ODOT active research projects webpage at the link above.

ACCOMPLISHMENTS

Information on accomplishments may be viewed by selecting ODOT active research projects webpage at the link above.

RESPONSIBLE PARTIES

ODOT Research Section

ODOT Geo/Environmental Section

ODOT Regions

Oregon State University: Dr. Ben Leshchinsky as principal investigator. (Agreement for $451,779 ending March 31, 2024. For the OSU Contract approximately $147,063 expended through May of 2021).

COST INFORMATION

SPR 834	**FY'20**	**FY'21**	**FY'22**	**FY'23**	**FY'24**	**TOTAL**
STAGE 2 BUDGET	$140,850	$70,425	$70,425	$93,900	$93,900	**$469,500**
WORK PLAN BUDGET	$109,922	$147,686	$73,954	$95,847	$67,370	**$494,779**
SPENT TO DATE	$74,318	$83,102				**$157,420**
REVISED BUDGET	**$74,318**	**$142,167**	**$105,728**	**$98,847**	**$70,870**	**$491,930**

FY'20 expenditure values are actual. FY'21 expenditure values are estimated as of May 2021 based on billings to date and forecast of fourth quarter invoice. FY'22 through FY'24 expenditure values are estimated based on forecasted project work.

835 IMPLEMENTATION OF A LABORATORY CONDITIONING AND TESTING PROTOCOL TO EVALUATE MOISTURE SUSCEPTIBILITY OF ASPHALT MIXTURES

OVERVIEW

Moisture damage (stripping) in asphalt mixtures can result in early cracking and rutting failures due to the internal damage accumulated by the hydrostatic pressures created at the aggregate-binder interface and/or within the binder phase by heavy traffic loads. Adhesion between the aggregate and the binder is generally expected to be the major factor controlling moisture sensitivity of the asphalt mixture. Due to the high precipitation levels and frequent rain events, distresses originating from moisture damage are commonly observed on highways in Oregon. ODOT has been mostly using hydrated lime to combat distresses related to moisture damage 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.

OBJECTIVES

The objective of this research is to determine the most effective moisture susceptibility test that can identify the impact of chemical anti-stripping agents, warm-mix additives, and lime on stripping resistance, develop a detailed test procedure for the selected experiment, determine test parameter thresholds for Oregon mixes to identify asphalt mixtures with acceptable stripping resistance and determine the impact of different anti-stripping agents and warm-mix additives on moisture susceptibility of Oregon asphalt mixtures.

More detailed information regarding the project and its objectives can be found at the link below:
https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES

Funds will be used to pay for staff time; consultants and professional services; travel expenses; and other services and supplies.

These activities will result in:

- Literature review
- Selection of candidate test and conditioning methods
- Mixture preparation and testing for several asphalt mixtures with antistripping additives will be performed.
- Field sampling and testing will be performed on both poor preforming asphalt sections as well as good performing sections
- TAC presentations
- Prepare final report

More information on proposed activities can be found in the ODOT active research projects webpage at the link above.

ACCOMPLISHMENTS

Information on accomplishments may be viewed by selecting ODOT active research projects webpage at the link above.

RESPONSIBLE PARTIES

ODOT Research Section

Oregon State University: Dr. Erdem Coleri as principal investigator. (Agreement for $225,000 ending November 30, 2021. Approximately $59,195 expended through May 2021.)

COST INFORMATION

SPR 835	**FY'20**	**FY'21**	**FY'22**	**FY'23**	**TOTAL**
STAGE 2 BUDGET	$96,000	$96,000	$48,000		**$240,000**
WORK PLAN BUDGET	$118,123	$124,883	$9,500		**$252,506**
SPENT TO DATE	$12,331	$54,869			**$72,836**
REVISED BUDGET	**$12,331**	**$211,675**	**$28,500**		**$252,506**

FY'20 expenditure values are actual. FY'21 expenditure values are estimated as of May 2021 based on billings to date and forecast of fourth quarter invoice. FY'22 expenditure values are estimated based on forecasted project work.

836 INTEGRATING WILDLIFE CORRIDOR MAPPING WITH COLLISION HOTSPOT DATA TO PRIORITIZE CROSSING PROJECTS

OVERVIEW

Large mammals cross highways to access core habitat areas, presenting significant safety hazards for Oregon drivers. In 2017, more than 7,400 wildlife-vehicle collisions resulting in more than 700 serious injuries and two fatalities occurred throughout ODOT's highway system. Though ODOT has documented progressively increasing animal-vehicle collisions over several years, ODOT lacks a statewide, science-based approach for identifying and prioritizing the most effective project sites for wildlife collision mitigation. Instead, crossing sites are considered on a project-by-project basis, risking both effectiveness for the traveling public and inefficient use of public funds. For migratory animals such as mule deer and elk, current and future projections of road crossing zones can be approximated through computational modeling of movement between core habitats. Using wildlife collision data, telemetry data, and available high resolution spatial data together with recent advancements in statistical methods for connectivity assessment, this research aims to develop landscape-scale habitat connectivity maps for highway corridor project planning.

OBJECTIVES

For effective crossing site project prioritization, integrating collision mapping data together with wildlife corridor models, predicted traffic models, and climate resiliency mapping is required. The specific aim of this research work is the delivery of wildlife corridor maps statewide that consider future traffic scenarios and climate resiliency, with the ability to highlight priority zones along highways.

More detailed information regarding the project and its objectives can be found at the link below: https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES

Funds will be used to pay for the following: staff time, consultants and professional services, travel expenses, and other services and supplies. Funds will be used to pay for Technical Equipment required to conduct the research. These activities will result in:

- Targeted literature review
- Identification and transformation of available datasets
- Generation and validation of corridor models
- Development of wildlife crossing prioritization maps
- Distribution of results across ODOT

More information on proposed activities can be found in the ODOT active research projects webpage at the link above.

ACCOMPLISHMENTS

Information on accomplishments may be viewed by selecting ODOT active research projects webpage at the link above.

RESPONSIBLE PARTIES

ODOT Research Section

ODOT Geo/Environmental Section

ODOT Regions

Oregon Department of Fish and Wildlife. Agreement was finalized and notice to proceed was given in October of 2020, $60,000.00 were transferred to ODFW shortly after that.

Portland State University.

COST INFORMATION

SPR 836	FY'20	FY'21	FY'22	FY'23	TOTAL
STAGE 2 BUDGET		$64,500	$86,000	$64,500	$215,000
WORK PLAN BUDGET		$80,842	$63,253	$79,905	$225,000
SPENT TO DATE	$1,058	$69,089			$67,200
REVISED BUDGET	**$1,058**	**$70,000**	**$84,000**	**$71,000**	**$226,058**

FY'20 expenditure values are actual. FY'21 expenditure values are estimated as of May 2021 based on billings to date and forecast of fourth quarter invoice. FY'22 through FY'23 expenditure values are estimated based on forecasted project work.

837 AUTOMATED DETECTION OF TRAFFIC SENSOR MALFUNCTIONS

OVERVIEW

Proper operation of transportation facilities is dependent upon reliable, accurate traffic sensing equipment; faulty detection equipment can result in unsafe or inefficient operation. A recent ODOT project, SPR-781 entitled, "Improving Adaptive / Responsive Signal Control Performance: Implications of Non-Invasive Detection and Legacy Timing Practices" uncovered wide spread issues of data quality irrespective of sensor technology. Given this, and what is currently known about the operational performance of non-invasive detection units, it is apparent that there is a need for policies, procedures, and techniques to identify malfunctioning detection equipment and evaluate the quality of data developed by detectors. Current tools, including those available through the new ATC standard, are able to detect complete detector failures by looking at the presence or absence of data being sent by a sensor, but these tools may not be able to assess the quality of the information sent; therefore, the health of the sensor is commonly unmonitored. For example, detrimental detector behaviors at signalized intersections such as a flickering loop or video zone may not send a phase into recall, which is easily identified, but the flickering, termed an incomplete failure, would likely go unnoticed, leading to poor performance and potentially unsafe operations. Similar operational issues can take place with detection on free-flow facilities as well. Complete failure of a detection zone is identified, but if the detector is operating, it can be hard to discern the quality of the data provided. To address this issue, it is important to develop sensor health monitoring procedures, including a digital process that is stand-alone, technology agnostic, and can be deployed permanently or in a mobile fashion to identify detection performance issues beyond complete detector failure.

OBJECTIVES

To assess the quality of data provided by traffic sensors, and therefore sensor health, research is necessary to bridge the gap between existing traffic theory and pattern recognition that can identify poor performance (through comparison of data to expected norms) and field ready tools and procedures that can be used to improve operations with prioritized effort by the managing agency.

There are two objectives that need to be achieved to address this problem. First, a reliable robust method of determining poor performance of an individual detector must be developed. This method must not rely on input from other sensors for comparative analysis; it must function based solely on historical data and traffic flow theory, a concept that has been shown to be doable through existing work. Second, a strategy for monitoring performance information from sensors across the state through a management tool, available to ODOT practitioners, must be produced to allow for effective use of this new detector performance information in the prioritization of detection maintenance and repairs.

More detailed information regarding the project and its objectives can be found at the link below:
https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES

Funds will be used to pay for staff time; consultants and professional services; travel expenses; and other services and supplies.

These activities will result in:

- Literature and Practice Review
- Data Collection
- Algorithm Development: a set of algorithms that can identify sensor malfunctions will be developed.
- System Interface: determine the preferred method of deployment, develop a set of procedures and interface to apply these algorithms to various ODOT facilities
- Deployment Plan: develop an implementation plan for ODOT applying the algorithms and interface.
- Final Report

More information on proposed activities can be found in the ODOT active research projects webpage at the link above.

ACCOMPLISHMENTS

Information on accomplishments may be viewed by selecting ODOT active research projects webpage at the link above.

RESPONSIBLE PARTIES

ODOT Research Section, ODOT Traffic-Roadway Section, and ODOT ITS Unit

Northern Arizona University: Dr. Edward Smaglik as principal investigator. (Agreement for $113,000 ending June 2022. Approximately $63,104 expended through May 2021.)

Oregon State University: Dr. David Hurwitz as principal investigator. (Agreement for $32,000 ending June 2022. Approximately $18,342.42 expended through May 2021.)

COST INFORMATION

SPR 837	**FY'20**	**FY'21**	**FY'22**	**FY'23**	**TOTAL**
STAGE 2 BUDGET	$70,000	$70,000	$35,000		$175,000
WORK PLAN BUDGET	$38,750	$78,250	$58,000		$175,000
SPENT TO DATE	$35,385	$78,037			$113,422
REVISED BUDGET	**$35,386**	**$93,000**	**$60,006**		**$188,392**

FY'20 expenditure values are actual. FY'21 expenditure values are estimated as of May 2021 based on billings to date and forecast of fourth quarter invoice. FY'22 expenditure values are estimated based on forecasted project work.

838 CENTERLINE RUMBLE STRIP EFFECTS ON PAVEMENT PERFORMANCE

OVERVIEW

This research proposes to evaluate and quantify the impacts of centerline rumble strips (CLRS) installation on pavement performance and to identify methods to mitigate those impacts. CLRS have high motorist safety benefits and are generally low cost, but involve grinding grooves into the pavement often where the pavement is weakest (at the centerline joint). There are often unintended consequences associated with the installation, particularly in rural, mountainous areas, or snow zones. These consequences include the accumulation of water and ice on or in the CLRS and the potential early deterioration of the pavement centerline paving joint, both of which present concerns.

OBJECTIVES

This research would have three major objectives: i) quantify the impacts of CLRS installation on the performance and maintenance of all the pavement types currently used in Oregon, including in mountainous areas or snow zones; ii) identify the best construction practices for CLRS installation to avoid any negative impacts on pavement performance; and iii) Identify, evaluate, and compare the effectiveness of potential surface treatment options to mitigate any pavement performance issues pre- and post-installation of CLRS by considering performance, cost, and safety.

More detailed information regarding the project and its objectives can be found at the link below: https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES

Consultant Payments; Staff Time; Literature Review; Methodology Review; Data Acquisition (In-Field); Numerical Modeling; Purchasing and fabrication of asphalt slabs; Lab Testing; TAC Presentations, Pilot Site Selection and Installation, Final Report; Research Note, and Travel;

More information on proposed activities can be found in the ODOT active research projects webpage at the link above.

ACCOMPLISHMENTS

Information on accomplishments may be viewed by selecting ODOT active research projects webpage at the link above.

RESPONSIBLE PARTIES

ODOT Research Section

Oregon State University: Dr. Erdem Coleri as principal investigator. (Agreement for $226,350 ending June 2022. Approximately $94,905 expended through May 2021.)

COST INFORMATION

SPR 838	FY'20	FY'21	FY'22	FY'23	TOTAL
STAGE 2 BUDGET	$121,044	$119,456	$9,500	0	**$250,000**
WORK PLAN BUDGET	$76,500	$161,000	$12,500		**$250,000**
SPENT TO DATE	$7,981				**$7,981**
REVISED BUDGET	**$60,732**	**$121,000**	**$72,069**		**$253,801**

FY'20 expenditure values are actual. FY'21 expenditure values are estimated as of May 2021 based on billings to date and forecast of fourth quarter invoice. FY'22 expenditure values are estimated based on forecasted project work.

839 WORK ZONE SAFETY DURING TRAFFIC CONTROL SETUP, REMOVAL, AND CHANGES

OVERVIEW

Past ODOT research studies related to safety in construction and maintenance work zones have focused on the traffic control measures in place during the work operations. The studies collected and analyzed data (typically vehicle speed data) after the traffic control was in place and while the construction and maintenance work was being conducted. The prior studies, however, did not address safety during the placement, removal, and modification of traffic control measures. During these periods of time, the workers installing/removing/modifying the traffic control devices are often exposed to additional risk and/or different risk than during the course of the work after the traffic control is set up. In addition, during these periods, passing motorists are transitioning from the normal traffic flow and patterns to the temporary traffic flow and patterns. These transition periods can be difficult for both drivers and workers when thinking about the driving path, distracted drivers, and when congestion accumulates to form a temporary queue causing both safety and mobility concerns.

The safety issues created during these transition periods were mentioned in a recent ODOT Industry Staging Meeting involving ODOT staff, contractors, the Oregon Trucking Association, and other stakeholders in Fall 2019. During the meeting there was discussion about the prevalence of crashes, near misses, risky driver behavior, and hazardous worker exposures during the periods of time when traffic control measures are being put in place and removed from the roadway. Recent worker fatalities on Oregon roadways have occurred during the operations undertaken to set up or modify the traffic control. Prior research has not focused on best practices for the periods of time when the traffic control is being set up, removed from the roadway, and modified during the work operations (this aspect is the contractor's responsibility). There is research looking at locations surrounding the work zone when considering risks (e.g., transition area). Due to the potential increased risk exposures, research is needed to identify best practices to reduce the risk associated with these traffic control transition periods.

OBJECTIVES

The overall goal of this research is to develop additional knowledge and practices that can be used to improve driver and worker safety in set-up, removal, and modification of temporary work zones on high speed roadways. The research will focus on temporary construction and maintenance operations on multi-lane, high-speed roadways from freeflow conditions to one or two lane restrictions (e.g., repaving or restriping on Interstates 5, 205, and 84) during daytime and nighttime conditions. Appropriate AADT levels for such cases will be reviewed with ODOT and considered within the research. To meet this goal, the proposed research will involve examining the conditions and practices during traffic control set-up, removal, and modification to assess the associated risk and identify potential risk reduction measures. Specifically, the objectives of the research are to:

1. Document the guiding principles, common work practices, and corresponding risk exposures during traffic control transition periods;
2. Identify promising practices to improve safety during the transition periods;

3. Compare differences in risk and implementation feasibility associated with current and promising practices through both quantitative and qualitative measures; and
4. Develop guidance for ODOT and contractors to enhance safety during the transition periods.

More detailed information regarding the project and its objectives can be found at the link below: https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES

Consultant Payments; Staff Time; Literature Review; Interviews, Pilot Testing; Equipment Purchase; Data Acquisition (In-Field); Data Analysis for Multiple Sites; TAC Presentations, Final Report, Guidance Document, Research Note; and Travel.

This project will utilize existing ODOT equipment, which is used to count traffic and measure speed and lane occupancy. However, due to use and age of existing inventory, additional equipment purchases may be needed. Costs for similar devices are approximately $4k and it is anticipated no more than two units would be needed. An assessment of inventory and their operational status will be done before final budgets are approved and contract signed.

More information on proposed activities can be found in the ODOT active research projects webpage at the link above.

ACCOMPLISHMENTS

Information on accomplishments may be viewed by selecting ODOT active research projects webpage at the link above.

RESPONSIBLE PARTIES

ODOT Research Section

ODOT Work Zone Traffic Engineer

Oregon State University: Dr. John Gambatese as principal investigator. Agreement for $166,000 ending Jan 2023. Approximately $0 expended through May 2021.

COST INFORMATION

SPR 839	**FY'21**	**FY'22**	**FY'23**	**FY'24**	**TOTAL**
STAGE 2 BUDGET	$71,000	$74,000	$34,000	$-	$179,000
WORK PLAN BUDGET	$68,806	$74,443	$22,751		
SPENT TO DATE	$16,391				
REVISED BUDGET	**$42,000**	**$96,000**	**$57,000**		**$195,000**

FY'21 expenditure values are estimated as of May 2021 based on billings to date and forecast of fourth quarter invoice. FY'22 through FY'23 expenditure values are estimated based on forecasted project work.

840 SAFEST PLACEMENT FOR CROSSWALKS AT INTERSECTIONS

OVERVIEW

ODOT's ADA settlement agreement requires that two curb ramps will be provided at each street corner for pedestrian use. At many locations, providing two curb ramps will require crosswalks to be set back a significant distance from the apex of the intersection corner. Concerns have been raised that setback crossings may be less safe because drivers expect to see pedestrians waiting to cross the intersection at the corner. However, the assumption that this is less safe is not based on empirical evidence.

As ODOT prepares to reconstruct thousands of curb ramps over the next 13 years as part of the ADA settlement agreement, research is needed to help understand how curb radii and crosswalk placement interact to produce the desired interactions between right and left-turning drivers and pedestrians at intersections.

OBJECTIVES

This research will identify the relation, if any, between pedestrian safety and the lateral offset of crosswalks and document those findings in a clear manner. The influence of intersection design factors (traffic controls, markings, curb radius, sight distance…) will be addressed.

More detailed information regarding the project and its objectives can be found at the link below: https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES

Consultant Payments; Staff Time; Literature Review; Methodology Review; Survey Development, Data Acquisition (In-Field); Data Acquisition (By Survey); Data Acquisition (Subject testing in Driving Simulator);Data Analysis; TAC Presentations, Pilot Site Selection and Installation, Final Report; Research Note, and Travel;

More information on proposed activities can be found in the ODOT active research projects webpage at the link above.

ACCOMPLISHMENTS

Information on accomplishments may be viewed by selecting ODOT active research projects webpage at the link above.

RESPONSIBLE PARTIES

ODOT Research Section

ODOT Statewide Project Delivery Branch

Oregon State University (Agreement for $120,000 ending November, 2022. Approximately $0 expended through May, 2021.)

Portland State University (Agreement for $90,000 ending November, 2022. Approximately $22,852 expended through May, 2021.)

COST INFORMATION

SPR 840	FY'21	FY'22	FY'23	FY'24	TOTAL
STAGE 2 BUDGET	$65,500	$90,000	$66,500		$222,000
WORK PLAN BUDGET	$107,000	$100,000	$15,000		$222,000
SPENT TO DATE	$7,755	$0	$0		$7,755
REVISED BUDGET	**$105,000**	**$94,000**	**$26,000**		**$225,000**

FY'21 expenditure values are estimated as of May 2021 based on billings to date and forecast of fourth quarter invoice. FY'22 through FY'23 expenditure values are estimated based on forecasted project work.

841 UNDERSTANDING PEDESTRIAN CRASH INJURY AND SOCIAL EQUITY DISPARITIES IN OREGON

OVERVIEW

Pedestrian traffic crash injuries in Oregon have increased significantly since the early 2000s. During the five year period between 2002 and 2006 there were on average 610 pedestrians injured while in the years 2012 to 2017 that figure has grown to 914, and increase of 50 percent. Fatal injuries have grown quickly too, rising from an annual average of 48 pedestrian deaths in the earlier period to an annual average of 65 per year, an increase of 36 percent. Pedestrian fatal injuries now represent 16 percent of all fatal injuries, up from 10 percent. These pedestrian injuries are occurring at a disproportionate rate in lower-income communities and communities with more people of color, both in Oregon and nationally. Possible contributors to these disparate outcomes include higher population densities, rates of walking, and lower auto ownership, along with higher speeds, fewer sidewalks or safe crossings opportunities, and poor lighting, among other factors. This research will investigate the underlying infrastructure and behavioral conditions in Oregon that are leading to these disparate outcomes.

OBJECTIVES

The primary research objectives for this project are as follows:

- Understand the difference in pedestrian injury disparities across the state and measure the impact that socio demographics, traffic characteristics, infrastructure, and the built environment have on explaining these disparities in order to inform mitigation strategies for infrastructure and program interventions.
- Measure how these disparities have changed over time.
- Develop standardized outputs for use in existing crash screening methods used in ODOT safety and active transportation programs.
- Inform updates of the Oregon Transportation Safety Action plan (TSAP), Oregon Transportation Plan, and Oregon Highway Plan.

More detailed information regarding the project and its objectives can be found at the link below:
https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES

Consultant payments; staff time; literature review; data management, data acquisition (by procurement and/or field observations); data analysis; technical advisory meetings, presentations, report writing, interim report publication, and final report editing and publication.

More information on proposed activities can be found in the ODOT active research projects webpage at the link above.

ACCOMPLISHMENTS

Information on accomplishments may be viewed by selecting ODOT active research projects webpage at the link above.

RESPONSIBLE PARTIES

ODOT Research Section, Mr. Josh Roll, as Principal Investigator

Portland State University Nathan McNeil as Co-Principle Investigator (Agreement for $79,684.00 ending August, 2023. Approximately $20,411 expended through May, 2021.)

COST INFORMATION

SPR 841	FY'20	FY'21	FY'22	**FY'23**	**TOTAL**
STAGE 2 BUDGET	$2,253	$156,862	$6,038		$165,153
WORK PLAN BUDGET	$2,253	$156,862	$6,038		$165,153
SPENT TO DATE	$2,253	$106,904			$109,157
REVISED BUDGET	**$2,250**	**$106,904**	**$7,313**	**$50,783**	**$167,250**

FY'20 values are actual. FY'21 expenditure values are estimated as of May 2021 based on billings to date and forecast of fourth quarter invoice. FY'22 through FY'23 expenditure values are estimated based on forecasted project work.

On May 19, 2020, the Oregon DOT received authorization under 23 CFR 420.115(a) to use a portion of previously authorized SPR funds to start this project early.

842 CONSTRUCTING HIGH-DENSITY LONGITUDINAL JOINTS TO IMPROVE PAVEMENT LONGEVITY

OVERVIEW

When hot-mix asphalt (HMA) is placed next to the previously constructed lane (cold mat) during construction, a longitudinal joint occurs between the newly constructed lane and the old one. Due to the particles in the HMA bouncing back from the stiff-cold mat under heavy compactor loads during compaction, proper compaction around the joint generally cannot be achieved and density of the longitudinal joint is generally lower than the constructed lane. For this reason, fatigue cracking generally occurs around the longitudinal joints before the pavement structure reaches its design life. Centerline rumble strips (CLRS) constructed on longitudinal joints with lower densities are also more likely to crack in a shorter period of time. Cracking from a longitudinal joint generally propagates to the rest of the mat and results in localized failures around the pavement section. High permeability of longitudinal joints (due to high air void content) can also result in subgrade saturation, which can eventually cause structural failures on the roads.

In this study, a detailed longitudinal joint construction specification will be developed. This research will also produce information and guidelines for ODOT to implement in asphalt pavement construction to improve longitudinal joint performance. Recommendations to improve longitudinal joint performance will also be provided. Pilot sections with the developed specification will be constructed to determine the impact of developed strategies on longitudinal joint density and performance.

OBJECTIVES

This research has three major objectives: i) determine the factors that control the longitudinal joint density; ii) develop a test method for more accurate quality control testing of the longitudinal joints; and iii) develop a specification for longitudinal joint construction based on the findings of the research project.

More detailed information regarding the project and its objectives can be found at the link below: https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES

Consultant Payments; Staff Time; Literature Review; Equipment Purchase; Data Acquisition (In-Field); Data Analysis for Multiple Sites; TAC Presentations, Final Report; and Travel.

More information on proposed activities can be found in the ODOT active research projects webpage at the link above.

ACCOMPLISHMENTS

Information on accomplishments may be viewed by selecting ODOT active research projects webpage at the link above.

RESPONSIBLE PARTIES

ODOT Research Section

ODOT Construction Section, Pavement Services

Oregon State University: Dr. Erdem Coleri as principal investigator. (Agreement for $225,000 ending December 2022. Approximately $0 expended through May 2021.)

COST INFORMATION

SPR 842	**FY'21**	**FY'22**	**FY'23**	**FY'24**	**TOTAL**
STAGE 2 BUDGET	$100,400	$112,400	$56,200		$269,000
WORK PLAN BUDGET	$108,480	$112,470	$4,050		$225,000
SPENT TO DATE	$4,508				$4,508
REVISED BUDGET	**$100,400**	**$110,400**	**$35,200**		**$246,000**

FY'21 expenditure values are estimated as of May 2021 based on billings to date and forecast of fourth quarter invoice. FY'22 through FY'23 expenditure values are estimated based on forecasted project work.

843 US HIGHWAY 101 COASTAL HAZARD VULNERABILITY AND RISK ASSESSMENT FOR MITIGATION PRIORITIZATION

OVERVIEW

US 101 is a vital economic and emergency lifeline that connects coastal communities and provides access to numerous coastal destinations for Oregonians and tourists. Though sections of this highway are highly susceptible to coastal hazards such as erosion, wave action, storm surge, and rising sea levels, structural mitigation of these susceptible areas is challenging due to the extensive regulatory exceptions process required by the Department of Land Conservation and Development (DCLD) through Statewide Planning Goal 18 (which prohibits shoreline armoring of highway infrastructure). The need to revisit Goal 18 for maintaining and protecting public infrastructure has been recognized, with ODOT recently participating in a DLCD led Shoreline Armoring Focus Group. This Group identified that research providing a comprehensive and prioritized coastal highway vulnerability and risk assessment is key to informing upcoming DLCD Goal 18 policy updates. To proactively position ODOT to effectively manage risk and support Goal 18 updates, development of a coastal highway hazard prioritization matrix that includes vulnerability, risk assessment, mitigation options, and management strategies for planning and project development is critical.

OBJECTIVES

A comprehensive coastal hazard vulnerability and risk assessment for US 101 does not exist. The goal of this research is to develop a hazard prioritization matrix for at-risk public infrastructure along US101 that can both directly support DLCD Goal 18 policy changes as well as inform STIP project development.

More detailed information regarding the project and its objectives can be found at the link below:
https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES

Funds will be used to pay for the following: staff time, consultants and professional services, travel expenses, computational needs, and other services and supplies. Funds will be used to pay for Technical Equipment required to conduct the research.

These activities will result in: a focused literature review; review of existing data, including agency outreach; development of an erosion model; development of a hazard assessment model; development of an economic model; a recommended prioritization list, and compilation of recommendations in a final report.

More information on proposed activities can be found in the ODOT active research projects webpage at the link above.

ACCOMPLISHMENTS

Information on accomplishments may be viewed by selecting ODOT active research projects webpage at the link above.

RESPONSIBLE PARTIES

ODOT Research Section

ODOT Geo/Environmental Section

ODOT Climate Change Section

ODOT Regions 3 and 4

Oregon State University: Dr. Michael J. Olsen as principal investigator. (Agreement for $289,500 ending April 30, 2023. For the OSU Contract approximately $30,585 expended through May of 2021).

COST INFORMATION

SPR 843	**FY'21**	**FY'22**	**FY'23**	**TOTAL**
STAGE 2 BUDGET	$120,600	$120,600	$60,300	$301,500
WORK PLAN BUDGET	$105,436	$170,498	$33,566	$309,500
SPENT TO DATE	$35,324			$35,324
REVISED BUDGET	**$111,085**	**$144,000**	**$62,000**	**$317,085**

FY'21 expenditure values are estimated as of May 2021 based on billings to date and forecast of fourth quarter invoice. FY'22 through FY'23 expenditure values are estimated based on forecasted project work.

844 EVALUATION OF CURB RAMP COMPLIANCE

OVERVIEW

ODOT agreed to a settlement in late 2016 to inventory and remediate all curb ramps identified in the 2017 inventory, which consists of approximately 25,000 ramps. Although ODOT has made progress toward their goals, ODOT has had to re-construct several curb ramps after initial construction. ODOT acknowledges other factors that can contribute to non-compliance since very precise slope and size measurements are conducted without an "industry standard" of tolerance.

From observations in the field, there is much difficulty in obtaining reproducible QA/QC measurements in the exact same place, orientation, etc. over time. This research will not assess the accuracy of existing measures; rather it will comprehensively evaluate the compliance assessment process for curb ramps to generate best practices for success in increased precision and compliance.

The American Disabilities Act (ADA) guidelines for ramps also require that slopes not vary along a ramp run or turning space. In the absence of accepted construction tolerances, public agencies are forced to reject curb ramps when any measurement reading is greater than the allowed maximum slopes or where the slope readings themselves are inconsistent without acknowledging the inherent lack of precision with tools, variability of constructed surfaces, or understanding the error ranges of the measurement device. ODOT needs an improved understanding of the magnitude of local variations in flatness on sloped, planar concrete surfaces in standard industry construction practices to designate and apply an achievable tolerance to measurements of constructed curb ramps. These aspects were detailed as further research in US Access Board's publication.

ADA compliance is critical to ODOT's mission to provide a safe and reliable multimodal transportation system by allowing equal access to infrastructure, particularly for those with disabilities.

OBJECTIVES

This research enables ODOT to reliably and systematically evaluate the methods and tools used in the inspection process to achieve successful ADA compliance by:

- Investigating alternative technologies used for ADA compliance assessments such as laser scanning.
- Developing a database of existing and newly-constructed curb ramps, acquiring measurements over time using several tools and methods to determine their precision and repeatability,
- Identifying ideal combination(s) of tools and methods to achieve higher precision and reproducibility but still maintain efficiency and cost-effectiveness.
- Help ODOT identify an appropriate overall flatness index measure, when localized outlier variations from existing measurements indicate non-compliance (i.e., outside of existing specified slope limits), and

- Establishing the expected variance for (1) instruments used measure the ramps, (2) flatness of the concrete material itself, and (3) movement or settlement of a ramp to determine an industry tolerance for concrete sloped planar surfaces.

More detailed information regarding the project and its objectives can be found at the link below: https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES

Consultant Payments; Staff Time; Literature Review; Calibration setup; Site scanning; Method/Pilot Testing; Data Acquisition (In-Field); Data Analysis for Multiple Sites; Database creation and delivery; TAC Presentations, Final Report; Research Note; and Travel.

More information on proposed activities can be found in the ODOT active research projects webpage at the link above.

ACCOMPLISHMENTS

Information on accomplishments may be viewed by selecting ODOT active research projects webpage at the link above.

RESPONSIBLE PARTIES

ODOT Research Section

ODOT ADA Program

RESPONSIBLE PARTIES

ODOT Research Section

ODOT ADA Program

Oregon State University: Dr. Michael Olsen as principal investigator. Agreement for $270,000 ending Dec 2023. Approximately $25,065 expended through May 2021.

COST INFORMATION

SPR 844	FY'21	FY'22	FY'23	FY'24	TOTAL
STAGE 2 BUDGET	$84,600	$56,400	$56,400	$84,600	**$282,000**
WORK PLAN BUDGET	$85,000	$110,000	$65,000	$35,000	**$295,000**
SPENT TO DATE	$36,240				
REVISED BUDGET	**$87,000**	**$109,000**	**$75,000**	**$35,000**	**$306,000**

FY'21 expenditure values are estimated as of May 2021 based on billings to date and forecast of fourth quarter invoice. FY'22 through FY'24 expenditure values are estimated based on forecasted project work.

845 OPTIMIZING MAINTENANCE PRIORITIES FOR DRIVING SAFETY

OVERVIEW

ODOT's Maintenance Districts are responsible for maintaining and operating Oregon's State Highway System. The Maintenance and Operations Branch has developed "Desired Conditions of Maintenance Features on State Highways" (DCMFSH). Each year the Districts evaluate segments of highways based on how the highway segments compare to the level of service guidance shown in the DCMFSH.

Evaluating how the safety performance of specific highway segments relates to how well the highway segments meet the level of service guidance for specific elements within the DCMFSH would allow maintenance decision makers to most effectively prioritize the use of limited maintenance funds.

OBJECTIVES

Researchers will incorporate guidance on safety effectiveness and project prioritization from the AASHTO Highway Safety Manual (HSM) as appropriate to examine crash records for varied sections of Oregon highways and compare those records to the conditions proscribed by the DCMFSH. Specific maintenance functions may then be prioritized with regard to their impact on road safety.

Researchers will also identify characteristics of highway sections that modify the priority of maintenance functions, such as traffic speed, congestion, grade, number of intersections, number of horizontal curves, weather conditions, etc.

More detailed information regarding the project and its objectives can be found at the link below: https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES

Funds will be used to pay for the following: staff time, consultants and professional services, travel expenses, computational needs, and other services and supplies. Funds will be used to pay for Technical Equipment required to conduct the research.

These activities will result in: Literature Review; Select highway sections for study and obtain crash records; Review the consistency of the DCMFSH data across districts and regions; Match crash sites to DCMFSH data and determine the conditions at the time and place of crashes; Reconcile DCMFSH conditions with HSM recommendations for safety improvement; Evaluate Benefit/Costs of changing the level of service in the Desired Conditions; Prepare final report and Research Note.

More information on proposed activities can be found in the ODOT active research projects webpage at the link above.

ACCOMPLISHMENTS

Information on accomplishments may be viewed by selecting ODOT active research projects webpage at the link above.

RESPONSIBLE PARTIES

ODOT Research Section

ODOT Maintenance and Operations Branch

Texas Transportation Institute (Agreement under development)

COST INFORMATION

SPR 845	**FY'21**	**FY'22**	**FY'23**	**FY'24**	**TOTAL**
STAGE 2 BUDGET	$79,000	$118,000	$0		$197,000
WORK PLAN BUDGET					$197,000
SPENT TO DATE	$9,316	$0	$0		$9,316
REVISED BUDGET	**$10,000**	**$97,500**	**$97,500**	**$-**	**$205,000**

FY'21 expenditure values are estimated as of May 2021 based on billings to date and forecast of fourth quarter invoice. FY'22 through FY'23 expenditure values are estimated based on forecasted project work.

846 LAST MILE DELIVERY: IMPACT OF MORE DELIVERY VEHICLES ON SAFETY AND CONGESTION

OVERVIEW

The Federal Motor Carrier Safety Administration (FMCSA) defines a Commercial Motor Vehicle (CMV) under 49 CFR 390.5 as "any self-propelled or towed motor vehicle used on a highway in interstate commerce to transport passenger or property when the vehicle has a gross vehicle weight or gross combination weight of 10,000 pounds or greater". However, Commercial Driver License (CDL) requirements set by the FMSCA under 49 CFR 383.5 only require operators of motor vehicles greater than 26,000 pounds to obtain a CDL.

The rise in medium-duty truck VMT over the last ten years potentially indicates there is an increasing number of truck drivers operating without a CDL. Shifting reliance on medium trucks for a growing freight sector may be increasing safety impacts from non-CDL drivers, who are not subject to DOT drug and alcohol testing requirements, or to DOT and OSHA training that includes defensive driving, accident reporting, hazardous materials management, vehicle inspections and maintenance.

OBJECTIVES

The primary goal of this initiative is to provide the agency with a comprehensive understanding of increased medium-duty truck operation, identification of potential areas of risk, forecast of future operational growth and monetization of the costs associated with these changes. To meet this goal, the research methodology must meet the following objectives:

- Estimate of the number of medium-duty trucks operating in Oregon, including general categorization by industry and/or commodities/services utilizing the trucks, general trip characteristics and logistic patterns, and regional patterns by population density;
- Evaluate safety data to compare and contrast crash rates, incidents and other relevant safety data involving medium trucks compared to heavy trucks requiring CDL drivers in order to determine whether there is a statistical difference between the two populations after controlling for other factors;
- Develop a gap analysis to determine if ODOT is meeting FMCSA safety standards around medium-duty truck operations currently and into the future five and ten years out;
- Recommend a monitoring methodology for ODOT to implement in order to track medium-duty truck safety and performance into the future,

More detailed information regarding the project and its objectives can be found at the link below: https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES

Consultant Payments; Staff Time; TAC Presentations, Final Report; and Travel.

Researchers will: Conduct a literature review, Determine data sources for medium trucks, safety, fuel taxes paid, counts by location; Create methodology to analyze the data selected; and Present results to ODOT and publish report, including data used and code for analysis.

More information on proposed activities can be found in the ODOT active research projects webpage at the link above.

ACCOMPLISHMENTS

Information on accomplishments may be viewed by selecting ODOT active research projects webpage at the link above.

RESPONSIBLE PARTIES

ODOT Research Section

ODOT Commerce and Compliance

ODOT Economic Analysis Unit

ODOT DMV Unit

Oregon State University: Dr. Salvador Hernandez as principal investigator. (Agreement for $149,620 ending June 30, 2023. For the OSU Contract approximately $25,622.76 expended through May of 2021).

Portland State University Dr. Avinash Unnikrishnan as principal investigator. (Agreement for $85,380.00 ending June 30, 2023. For the OSU Contract approximately $0 expended through May of 2021).

COST INFORMATION

SPR 846	**FY'21**	**FY'22**	**FY'23**	**FY'24**	**TOTAL**
STAGE 2 BUDGET	$47,000	$150,000	$50,000		$247,000
WORK PLAN BUDGET	$47,000	$150,000	$50,000		**$247,000**
SPENT TO DATE	$36,636				**$36,636**
REVISED BUDGET	**$48,847**	**$147,153**	**$59,000**		**$255,000**

FY'21 expenditure values are estimated as of May 2021 based on billings to date and forecast of fourth quarter invoice. FY'22 through FY'23 expenditure values are estimated based on forecasted project work.

847 ALTERNATIVE BRIDGE DECK OVERLAYS HIGH EARLY STRENGTH CONCRETE BRIDGE DECK OVERLAYS

OVERVIEW

ODOT's bridge inventory is continuing to age, and with that, ODOT needs to be proactive in its approach to bridge maintenance. With increasing traffic volumes and public/political involvement, bridge projects have been put into tighter and tighter constraints. ODOT cannot afford to construct diversion structures for every structural overlay project, and traffic volumes have gotten to the point where daytime lane closures have become nearly impossible except for the most remote areas.

As bridge decks continue to wear, there will be a need to replace the existing structural overlays. There is also a need to strengthen some bridges due to higher demands, which can include increasing deck thickness through a structural overlay. As salt is introduced at higher and higher rates, PPC overlays will not be feasible because they will not address the salt issue, leaving structural overlays as the only option. High Early Strength Concrete (HESC) overlays have the have the potential to be placed in a single overnight lane or bridge closure, with wet cure times as low as three hours

OBJECTIVES

The objective of this research project is to identify the obstacles of impediments to successful and reliable use of HESC for structural bridge deck overlays on Oregon bridges and to develop the standards, specifications, processes, and practices necessary to using them on ODOT bridges.

More detailed information regarding the project and its objectives can be found at the link below: https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES

Consultant Payments; Staff Time; Literature Review; Pilot Testing; Data Acquisition (In-Field);Data Analysis for Multiple Sites; TAC Presentations, Final Report; and Travel;

These activities will result in:

- Literature review
- Research methodology
- Laboratory testing of overlay mixes
- Field evaluation of overlay
- Proposed standards, specifications, and processes
- Final Report.

More information on proposed activities can be found in the Project Work Plan at the link above.

ACCOMPLISHMENTS

Accomplishments may be viewed by selecting Quarterly Reports at the link above.

RESPONSIBLE PARTIES

ODOT Research Section

ODOT Bridge Section

ODOT Construction and Maintenance Section

Oregon State University: Dr. Jason Ideker as principal investigator. (Agreement for $319,000 ending July 31, 2023. Approximately $20,460 expended through May 2021.)

COST INFORMATION

SPR 847	**FY'21**	**FY'22**	**FY'23**	**FY'24**	**TOTAL**
STAGE 2 BUDGET	$101,700	$67,800	$67,800	$101,700	$339,000
WORK PLAN BUDGET	$168,000	$144,000	$27,000		$339,000
SPENT TO DATE	$29,916	$0	$0		$29,916
REVISED BUDGET	**$95,000**	**$179,000**	**$63,456**	**$1,000**	**$338,456**

FY'21 expenditure values are estimated as of May 2021 based on billings to date and forecast of fourth quarter invoice. FY'22 through FY'23 expenditure values are estimated based on forecasted project work.

848 TRUCKING PLATOONING IMPACT ON BRIDGE LOADING – POLICY AND REGULATORY IMPLICATIONS

OVERVIEW

Truck platooning, an autonomous vehicle technology where multiple heavy trucks operate at close spacing (headspacing), has been authorized for use in Oregon under HB 4059 Section 40 without requiring permitting or notification to the agency. This allows groups of trucks traveling very close to each other, increasing the weight stress on bridges, with potential to exceed stress levels the current bridge formula accounts for, which would reduce the lifespan of a bridge. In order to preserve the life of existing bridges and ensure structural safety of bridges on highways where truck platooning is expected, it is important to gain an understanding of the potential impact of truck platooning on existing bridge inventory.

Current and ongoing research from other states focuses more on how to design new bridges, rather than estimate impacts on extant bridges. Given the aging condition of Oregon bridges, there is a concern from bridge engineers in ODOT that the agency will be reacting to wear and tear of new truck configurations and platooning software. In order to preserve and maintain Oregon's vast investment in bridges, it is prudent to take a proactive approach by understanding potential issues and implement the results of this research to craft policies and plans that can be used to have conversations with fleet owners, regulators, and others to avoid damaging bridges and increasing the costs associated with our infrastructure.

OBJECTIVES

The goal of this research is to determine what combination of truck configurations (axle weight and spacing) and platooning headspace may exceed acceptable levels of stress for bridges carrying heavy loads. Results from the modeling will be used to create a set of policy and regulatory recommendations that could be used to update load ratings on Oregon's bridges.

More detailed information regarding the project and its objectives can be found at the link below: https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES

Consultant Payments; Staff Time; TAC Presentations, Final Report; and Travel.

Researchers will: Conduct a literature review; Determine what configurations of trucks and bridges will be modeled; Model the effects of platoons; and Present and write up results, include assumptions and code used in models

More information on proposed activities can be found in the ODOT active research projects webpage at the link above.

ACCOMPLISHMENTS

Information on accomplishments may be viewed by selecting ODOT active research projects webpage at the link above.

RESPONSIBLE PARTIES

ODOT Research Section

ODOT Bridge Section

ODOT Commerce and Compliance Division

Oregon State University: Michael Scott as principal investigator. (Agreement for $129,000 ending June 30, 2023. For the OSU Contract approximately $0 expended through May of 2021).

Portland State University Dr. Avinash Unnikrishnan as principal investigator. (Agreement for $81,000 ending June 30, 2023. For the OSU Contract approximately $0 expended through May of 2021).

COST INFORMATION

SPR 848	**FY'21**	**FY'22**	**FY'23**	**FY'24**	**TOTAL**
STAGE 2 BUDGET	$48,800	$108,800	$64,400		$222,000
WORK PLAN BUDGET	$48,800	$108,800	$64,400		**$222,000**
SPENT TO DATE	$11,445				$11,445
REVISED BUDGET	**$48,000**	**$108,600**	**$74,400**		**$231,000**

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849 IMPROVED SYSTEMATIC ANALYSIS TO PREDICT ROADWAY SAFETY PERFORMANCE

OVERVIEW

ODOT is tasked with providing a safe, efficient transportation system. Improving roadway safety continues to be at the forefront of all stages of project development, including planning, alternatives analysis, design, construction, and operations. However a lack of clear guidance on data driven safety analysis in project development (planning, project analysis/design/delivery, work zone etc.) results in greater costs to Oregon and missed opportunities.

Performance Based Practical Design (PBPD) modifies the traditional highway design process by taking a "design up" approach where transportation decision makers build up improvements from existing conditions to meet both project and system objectives. Developing a comprehensive PBPD project prioritization framework from a safety performance perspective based on crash and roadway data would allow the agency to focus safety improvements at locations where the improvement will be the most cost-effective.

OBJECTIVES

The proposed research is focused on providing data driven safety analytical support in the project delivery lifecycle process. Data driven safety analysis during the design phase can evaluate multiple design options and compare the safety and cost of each solution from a safety perspective. The research will identify data needs, tools, methods, policies, potential software solutions and required structural changes needed to implement a data driven safety approach for the project delivery process. The implementable product of the research will be a decision matrix supporting a restructure of ODOT's project development process to incorporate and prioritize safety.

More detailed information regarding the project and its objectives can be found at the link below: https://www.oregon.gov/odot/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES

Consultant Payments; Staff Time; Literature Review; ODOT practice and data-source review; Data Acquisition; Data Analysis; TAC Presentations, Final Report; and Travel.

More information on proposed activities can be found in the ODOT active research projects webpage at the link above.

ACCOMPLISHMENTS

Information on accomplishments may be viewed by selecting ODOT active research projects webpage at the link above.

RESPONSIBLE PARTIES

ODOT Research Section

ODOT Project Development Section

ODOT Roadway and Traffic Section

Oregon State University: Dr. Haizhong Wang as principal investigator. (Agreement for $137,000 ending June 2023. Approximately $0 expended through May 2021.)

COST INFORMATION

SPR 849	**FY'21**	**FY'22**	**FY'23**	**FY'24**	**TOTAL**
STAGE 2 BUDGET	$56,000	$82,600	$53,400		$192,000
WORK PLAN BUDGET	$42,000	$70,000	$25,000		
SPENT TO DATE	$10,006				$10,006
REVISED BUDGET	**$57,800**	**$80,600**	**$61,400**		**$199,800**

FY'21 expenditure values are estimated as of May 2021 based on billings to date and forecast of fourth quarter invoice. FY'22 through FY'23 expenditure values are estimated based on forecasted project work.

850 AUTOMATING LIDAR DATA TO DEVELOP AND MANAGE ACTIVE TRANSPORTATION ASSET INVENTORIES

Pedestrian crosswalks, bike lanes, and medians are important traffic devices for safety in a multi-modal highway network for drivers, pedestrians, and bicyclists. Currently, there is no comprehensive statewide map of the locations and types (e.g., midblock crossing) of these assets; however, such a map would be very useful for planning, maintenance, systematic safety studies, and many types of network analyses that are important to ODOT and its partner agencies at the local level. Site visits and surveys to capture this information are time-consuming and costly for the vast road network across the state that ODOT and its partners maintain. Fortunately, ODOT Geometronics collects 3D mobile lidar data on a two-year cycle, providing rich geometric and radiometric information of the entire road network. However, current workflows to process these mobile lidar data require manual extraction of these assets as Microstation or GIS objects from the mobile lidar data with specialized software. More efficient approaches to extract this information are necessary in order to create a statewide inventory of certain roadway assets needed by transportation engineers. Such approaches will enable ODOT to obtain additional returns on investment (ROI) in the mobile lidar system currently used for several applications with minimal cost.

OBJECTIVES

This research explores the capabilities of both mobile lidar data and aerial photogrammetric data and develops automated algorithms and efficient workflows to extract pedestrian crosswalks, bike lanes, and medians with important attributes such that they can be used in asset management, transportation safety, and maintenance applications. Specifically, the primary objectives of this research are to:

1) Investigate state-of-the-art machine learning and object detection algorithms for extraction of transportation assets from mobile lidar and photogrammetric data.

2) Develop procedures for extracting pedestrian crosswalks, bike lanes, and medians from Oregon DOT's mobile lidar data.

3) Produce a GIS geodatabase for several pilot corridors identifying the locations of bike lanes, crosswalks, and medians to support decision making and integrate data analysis results into Oregon DOT's overall workflows. These corridors will be selected from urban and rural regions with varying levels of complexity.

4) Evaluate benefits (e.g., time or cost savings, inventory completeness, and improved accuracy) associated with the developed approaches compared with current processes.

More detailed information regarding the project and its objectives can be found at the link below:
https://www.oregon.gov/ODOT/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES

Consultant Payments; Staff Time; Literature Review; Pilot Testing; Equipment Purchase; Data Acquisition (In-Field); Data Analysis for Multiple Sites; TAC Presentations, Final Report; and Travel;

This project is under development. Once it begins, more information on proposed activities can be found in the Project Work Plan at the link above.

ACCOMPLISHMENTS

This project is under development in May of 2021.Once it begins, accomplishments may be viewed by selecting Quarterly Reports at the link above.

RESPONSIBLE PARTIES

Michael J. Olsen, College of Engineering Dean's Professor
Jaehoon Jung, Assistant Professor, Senior Research, CCE
Erzhuo Che, Assistant Professor, Senior Research, CCE
Yelda Turkan, Assistant Professor, CCE
Chris Parrish, Associate Professor, CCE

COST INFORMATION

SPR 850	**FY'22**	**FY'23**	**FY'24**	**FY'25**	**TOTAL**
STAGE 2 BUDGET	$79,568	$116,550	$68,882		$265,000
WORK PLAN BUDGET					
SPENT TO DATE					
REVISED BUDGET					

Budget values are estimated based on forecasted project work.

851 EVALUATION OF ELECTRONIC ENFORCEMENT OF MOTOR CARRIER COMPLIANCE AND SAFETY

OVERVIEW

Currently weigh stations are not open at all hours, leaving a large portion of the week when safety data is not collected. In addition, enforcement staff FTE has declined from 103.5 in 2010 to 86 currently. Electronic enforcement of commercial vehicles would enable ODOT to collect data and monitor truck movement when scales are closed, thereby increasing enforcement of safety requirements without adding additional FTE.

The agency's mission explicitly highlights safety and reliability as top priorities for Oregon's transportation system. Expanding enforcement of commercial freight movement outside business hours would assist the Commerce and Compliance Division (CCD) in improving motor carrier safety compliance, as well as other areas of non-compliance. Electronic enforcement has the potential to assist other agency initiatives such as tolling and infrastructure preservation as well. Other states around the nation are exploring electronic enforcement of commercial freight vehicles for many of the stated reasons. This provides the perfect opportunity to collect lessons learned and best practices from states who are leading this initiative.

OBJECTIVES

This research will be used to identify if electronic enforcement operations will improve the state's safety and compliance rates enough to offset any monetary investment requirements. In order to determine whether the return on investment for electronic enforcement makes good business sense to ODOT, the following objectives must be met:

- Determine the current state of electronic enforcement in the United States and what challenges exist for implementation by ODOT.
- Develop an understanding of how Motor Carriers and the public perceive electronic enforcement.
- Identify the safety improvements and other benefits seen in states currently using electronic enforcement.
- Learn what worked well and what didn't from states currently utilizing electronic enforcement.
- List out what technology would benefit Oregon the most and where it should be located to maximize the investment.

More detailed information regarding the project and its objectives can be found at the link below: https://www.oregon.gov/ODOT/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES

Consultant Payments; Staff Time; Literature Review; Pilot Testing; Equipment Purchase; Data Acquisition (In-Field); Data Analysis for Multiple Sites; TAC Presentations, Final Report; and Travel;

This project is under development. Once it begins, more information on proposed activities can be found in the Project Work Plan at the link above.

ACCOMPLISHMENTS

This project is under development in May of 2021.Once it begins, accomplishments may be viewed by selecting Quarterly Reports at the link above.

RESPONSIBLE PARTIES

ODOT Research Section

Commerce and Compliance Division

ODOT ITS

Oregon State University

COST INFORMATION

SPR 851	**FY'22**	**FY'23**	**FY'24**	**FY'25**	**TOTAL**
STAGE 2 BUDGET	$59,000	$80,000	$67,000		$206,000
WORK PLAN BUDGET					
SPENT TO DATE					
REVISED BUDGET					

Budget values are estimated based on forecasted project work.

852 IMPLEMENTATION OF BALANCED MIX DESIGN METHODS IN OREGON TO MEET LONG-TERM PERFORMANCE GOALS

OVERVIEW

In Oregon, asphalt cracking is the major distress mode, necessitating costly rehabilitation and maintenance at intervals of less than half of the intended design lives in some cases. 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 increased use of recycled asphalt materials with high binder replacement rates results in a significant reduction in ductility of the asphalt mixtures used in construction, which causes a significant reduction in the fatigue life of the pavement in many cases. Results of rutting (permanent deformation on highways) performance tests conducted in the ODOT SPR801 project showed that Oregon mixes are highly deformation resistant and it is possible to significantly increase cracking resistance by increasing the asphalt binder content and/or incorporating warm-mix additives to improve ductility. According to the 2020 ODOT Pavement Condition Report, current ODOT pavement program is underfunded, which is expected to result in a decline in pavement conditions in Oregon within the next 4 years. An estimated $220 million a year funding level is needed to repair pavements that are in poor condition, while providing timely preventive preservation and maintenance on roads in fair-or-better condition. However, pavement program funding levels after 2021 are planned to be around $107 million (expected 21-24 annual STIP funding) per year according to the report (almost half of the needed funding level). For this reason, implementing innovative strategies for asphalt mixture design is critical to improving long-term pavement performance in Oregon.

OBJECTIVES

The major objective of this research project is to implement the BMD process by developing the following products:

- detailed guidelines and specifications for ODOT to implement BMD procedures in Oregon;
- software packages to automatically perform balanced asphalt mix design without requiring any complicated and detailed analysis;
- a comprehensive ODOT asphalt materials database to be used for future performance evaluation and monitoring; and
- a detailed BMD training process with related documentation and training videos.

More detailed information regarding the project and its objectives can be found at the link below:
https://www.oregon.gov/ODOT/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES

Consultant Payments; Staff Time; Literature Review; Pilot Testing; Equipment Purchase; Data Acquisition (In-Field); Data Analysis for Multiple Sites; TAC Presentations, Final Report; and Travel;

This project is under development. Once it begins, more information on proposed activities can be found in the Project Work Plan at the link above.

ACCOMPLISHMENTS

This project is under development in May of 2021.Once it begins, accomplishments may be viewed by selecting Quarterly Reports at the link above.

RESPONSIBLE PARTIES

ODOT Research Section

COST INFORMATION

SPR 852	FY'22	FY'23	FY'24	FY'25	TOTAL
STAGE 2 BUDGET	$94,000	$77,000	$77,000	$86,000	$334,000
WORK PLAN BUDGET					
SPENT TO DATE					
REVISED BUDGET					

Budget values are estimated based on forecasted project work.

853 PREDICTING NEAR REAL-TIME POST-FIRE LANDSLIDE DEBRIS FLOWS ALONG ODOT CORRIDORS

OVERVIEW

Debris flows are hazardous landslides that can travel for miles, carry boulders and trees, and rapidly move up to 40 mph with the density of concrete. As a result, debris flows pose significant safety risks to ODOT infrastructure and motorists. Climate change projections for Oregon include both increased high-intensity precipitation events as well as amplified wildfire potential throughout the state. These changing climate conditions are predicted to increase the occurrence and potentially the severity of debris flows, as debris flows are activated by rainfall events and exacerbated by burned hillslope conditions. Winter events have already resulted in multiple debris flows in Regions 1 and 2 with significant and devastating impacts to our travelling public. Unfortunately, available predictive assessment tools for debris flows are not tailored for conditions relevant to Oregon, are too coarse for quantitative risk analysis and prioritization, and are not informed by active monitoring. Development of predictive tools that can be proactively informed by ground surface movement and weather monitoring is critical for mitigating the economic and safety impacts of debris flows and pivotal for ODOT's mission to effectively address climate equity concerns across our state.

OBJECTIVES

The main objective of this research is to develop tools that can be used to actively assess and address the potential for debris flows along ODOT corridors in near-real time. This research will utilize landslide susceptibility modeling and ground surface monitoring research from SPR807, SPR808, as well as ODOT's 2019 Surface Monitoring STIC grant project which successfully developed a field validated surface monitoring station prototype for active landslides.

More detailed information regarding the project and its objectives can be found at the link below:
https://www.oregon.gov/ODOT/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES

Funds will be used to pay for staff time; consultants and professional services; computational needs; travel expenses; and other services and supplies. Funds will be used to pay for Technical Equipment required to conduct the research.

This project is under development. Once it begins, more information on proposed activities can be found in the Project Work Plan at the link above.

ACCOMPLISHMENTS

This project is under development in May of 2021.Once it begins, accomplishments may be viewed by selecting Quarterly Reports at the link above.

RESPONSIBLE PARTIES

ODOT Research Section

ODOT Geo Section

ODOT Regions 1, 2, and 3

Oregon State University (OSU): Dr. Ben A. Leshchinsky as principal investigator, Dr. Michael J. Olsen (OSU), Dr. Kevin Bladon (OSU), Josh Roering (University of Oregon), and Francis Rengers (United States Geological Survey, USGS) as Associate Investigators.

COST INFORMATION

SPR 853	**FY'22**	**FY'23**	**FY'24**	**FY'25**	**TOTAL**
STAGE 2 BUDGET	$102,000	$153,000	$134,000	$51,000	$440,000
WORK PLAN BUDGET					
SPENT TO DATE					
REVISED BUDGET					

Budget values are estimated based on forecasted project work.

854 VALIDATION OF THE NEW SPEED ZONING METHOD FOR URBAN ARTERIALS AND HIGH-SPEED ROADWAYS IN TERMS OF SPEED COMPLIANCE AND SAFETY OUTCOMES

OVERVIEW

Operating speeds of vehicles has long been a concern for Oregon cities. Previous research has shown that vehicles traveling above posted speeds are overrepresented in crashes and for vulnerable users the survivability of a crash is dependent on the speed of the collision. Setting appropriate speeds that motorists will respect and will reduce variations in speeds is important for reducing crashes and crash severity between motor vehicles. Achieving lower operating speeds that improve the survivability of vulnerable users on our roads is also important for decreasing pedestrian and other active user crashes. From 2009 to 2018 pedestrian fatalities increased 53% after decreasing for three decades. The proportion of all traffic fatalities that were pedestrian increased from 12% to 17%. High speed roadways and urban arterials are major risk factors.

ODOT has implemented a new method of speed setting in urban areas. Prior to that ODOT has worked with the City of Portland to pilot a new urban speed zoning method. Both efforts aim at improving safety in urban areas, particularly for active transportation users. NCHRP 17-76 is on the cusp of releasing a new study that provides guidance on making decisions about speed zoning and factors that influence operating speed. NCHRP Synthesis 535 analyzed known strategies and measures to improve pedestrian safety. The synthesis found that there was a need for greater clarity about the speed setting process and greater collaboration between state and local agencies on state roads through urban areas.

It is necessary to evaluate the new ODOT methodology to determine if the process improves safety and determine if drivers are inclined to lower operating speeds when lower speeds are posted.

OBJECTIVES

The evaluation of the current ODOT methodology will focus on higher speed roadways such as arterials and roadways with a record of high severity injuries. This will require investigating ways agencies have found to balance between local safety needs and mobility of vehicles on urban arterials and high-speed roadways and consider the pros and cons of different procedures and criteria to set reasonable and safe speed zones.

Specific research objectives include: (a) Identify any other cities or states across the nation that may be using innovative methods for setting speeds; (b) Determine if drivers are inclined to lower operating speeds when lower speeds are posted; (c) Evaluate the current ODOT methodology to determine if the process improves safety; and (d) Identify improvements to the process or missing factors in the method.

More detailed information regarding the project and its objectives can be found at the link below:
https://www.oregon.gov/ODOT/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES

Consultant Payments; Staff Time; Literature Review; Data Acquisition (In-Field); Data Analysis for Multiple Sites; TAC Presentations, Final Report; and Travel;

This project is under development. Once it begins, more information on proposed activities can be found in the Project Work Plan at the link above.

ACCOMPLISHMENTS

This project is under development in May of 2021.Once it begins, accomplishments may be viewed by selecting Quarterly Reports at the link above.

RESPONSIBLE PARTIES

ODOT Research Section

ODOT Traffic and Roadway Section

COST INFORMATION

SPR 854	**FY'22**	**FY'23**	**FY'24**	**FY'25**	**TOTAL**
STAGE 2 BUDGET	$70,000	$120,070	$46,430	$-	$236,500
WORK PLAN BUDGET					
SPENT TO DATE					
REVISED BUDGET					

Budget values are estimated based on forecasted project work.

855 REMOVING RESIDUAL LANE MARKINGS TO REDUCE DRIVER CONFUSION

OVERVIEW

When lane markings need to be reconfigured but available budgets will not allow for roadway resurfacing and installation of new lane markings, old lane markings can be removed and new markings can be applied to the existing roadway surface. This process leaves what are sometimes referred to as ghost lines. Ghost lines can provide faulty delineation information to road users, leading road users to position their vehicles they do not belong in the cross section of the roadway. This failure mechanism negatively impacts for both roadway operations and safety.

OBJECTIVES

The overarching goal of the research is to quantitatively determine which of several pavement marking removal strategies result in the highest level of driver comprehension and compliance with longitudinal pavement markings (e.g. lane lines). This project will help decision makers and engineers at ODOT tasked with pavement marking removals select the most effective approach within available project budgets. Solving this transportation issue will improve driver safety and anticipate incorporating the finding into ODOT policy and procedures which will provide a safer and more reliable multimodal transportation system that connects people and helps Oregon's communities and economy thrive.

More detailed information regarding the project and its objectives can be found at the link below:
https://www.oregon.gov/ODOT/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES

Consultant Payments; Staff Time; Literature Review; Pilot Testing; Equipment Purchase; Data Acquisition (In-Field); Data Analysis for Multiple Sites; TAC Presentations, Final Report; and Travel;

This project is under development. Once it begins, more information on proposed activities can be found in the Project Work Plan at the link above.

ACCOMPLISHMENTS

This project is under development in May of 2021.Once it begins, accomplishments may be viewed by selecting Quarterly Reports at the link above.

RESPONSIBLE PARTIES

ODOT Research Section
Oregon State University (Agreement under development)
Portland State University (Agreement under development)

COST INFORMATION

SPR 855	FY'22	FY'23	FY'24	FY'25	TOTAL
STAGE 2 BUDGET	$88,000	$103,500	$41,500	$-	$233,000
WORK PLAN BUDGET					
SPENT TO DATE					
REVISED BUDGET					

Budget values are estimated based on forecasted project work.

856 AUTOMATED METHODS FOR CORRECTING OREGON DOTS REAL-TIME GNSS NETWORK FOR SURVEY AND POST-DISASTER RECOVERY

OVERVIEW

Surveying is required for nearly all ODOT construction, maintenance, and emergency repair projects. To support these efforts ODOT has heavily invested in developing and maintaining the Oregon Real-Time Global Navigation Satellite Systems (GNSS) Network (ORGN), which consists of 110 continuously operating reference control stations across Oregon and has become the elite real-time network on the west coast. ODOT sponsored research has recently demonstrated that tailored use of ORGN will enable transition from time-consuming traditional survey methods, providing substantial cost savings for ODOT. However, for this needed update to dependably work for our practitioners, ORGN coordinates must be consistently dependable.

For ODOT's ORGN to be dependable, ORGN reference station spatial locations must be correct. Though these reference stations are ground stabilized, soil foundations settle with time and Oregon's active plate tectonic movements are shifting the bedrock itself—slowly resulting in average spatial location errors of 2-3 cm per year. Current procedures calls for the exclusion of stations if they have positional errors greater than 2 cm in the horizontal and 3 cm in vertical; but there is currently no procedure in place to actively monitor the positional errors of the network stations or autonomously generate new coordinates for the stations. Updating positions is currently a time consuming, manual process and this compromises the effectiveness of ORGN.

To ensure long-term robustness of ODOT's ORGN system, research is needed that can automatically detect and correct reference station locations once ground movement is realized. The value of this research effort extends to ODOT's pre-disaster monitoring and post-disaster recovery efforts such as after a Cascadia Subduction Zone (CSZ) event where a rapid automated methodology for identifying movement will provide a valuable triage tool. Notably, the CSZ event will likely cause drastic shifts in a large number of ORGN station positions. The automated methodology for reprocessing GNSS coordinates proposed in this research will enable rapid correction to support surveying for reconstruction and repair post-disaster. Without the proposed near-real-time network adjustments, it will take ODOT additional weeks to get the ORGN fully operational after the CSZ event occurs.

OBJECTIVES

The main objective of this research is to develop a near-real time methodology for automatically flagging and correcting ORGN reference stations that are misaligned with the satellite based National Spatial Reference System (NSRS). This methodology and associated tools will be invaluable for 1) ensuring cost-effective routine ODOT project surveying, 2) enabling ODOT to effectively monitor ground movement in disaster prone areas including landslides and earthquake events, and 3) situating ODOT for timely and efficient post-disaster response.
More detailed information regarding the project and its objectives can be found at the link below:
https://www.oregon.gov/ODOT/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES

Consultant Payments; Staff Time; Literature Review; Pilot Testing; Equipment Purchase; Data Acquisition (In-Field); Data Analysis for Multiple Sites; TAC Presentations, Final Report; and Travel;

This project is under development. Once it begins, more information on proposed activities can be found in the Project Work Plan at the link above.

ACCOMPLISHMENTS

This project is under development in May of 2021.Once it begins, accomplishments may be viewed by selecting Quarterly Reports at the link above.

RESPONSIBLE PARTIES

ODOT Research Section

COST INFORMATION

SPR 856	**FY'22**	**FY'23**	**FY'24**	**FY'25**	**TOTAL**
STAGE 2 BUDGET	$57,000	$67,000	$80,500	$88,500	$293,000
WORK PLAN BUDGET					
SPENT TO DATE					
REVISED BUDGET					

Budget values are estimated based on forecasted project work.

857 ACTIVE TRANSPORTATION COUNTS FROM EXISTING ON-STREET SIGNAL AND DETECTION INFRASTRUCTURE

OVERVIEW

ODOT's mission is to provide a safe and reliable multimodal transportation system that connects people and helps Oregon's communities and economy thrive. Currently there is no systemic accounting of pedestrian traffic across the transportation network. Without measured pedestrian traffic understanding systemic crash safety is difficult and analysts must rely on imperfect proxies such land use density, race, income, and transit usage. Having measures of nonmotorized travel activity is a key input to systemic crash analysis and project prioritization. Additionally, ODOT is on course to determine a new key performance measure for reporting to the Oregon Transportation Commission (OTC) for pedestrian travel which will require pedestrian traffic counts. While significant efforts have been undertaken in the last decade to establish active transportation counting programs, due to cost and resource considerations, the proliferation of permanent counters has been limited and this trend is likely to continue. Significant opportunity exists to use existing traffic signal infrastructure to count pedestrians using pedestrian push button actuation systems as permanent traffic counters. Permanent counters are critical for assessing temporal patterns and for developing factors which can be applied to short duration counts to estimate active transportation flows on the network. Existing permanent traffic counters tend to be situated on trails and therefore are not able to provide information on the amount of walking activity that takes place on the statewide street network and on sidewalks and crosswalks. These counters also require significant investment in installation and maintenance of specialized equipment that is often proprietary.

OBJECTIVES

The primary research objectives for this project are as follows:

- Explore the feasibility of collecting pedestrian from existing on-street infrastructure (such as pedestrian pushbuttons) at a large scale.
- Develop adjustment factors to convert pedestrian data collected from existing on-street infrastructure to actual pedestrian counts.
- Determine the transferability of the methods developed to convert infrastructure data to estimated pedestrian counts and the efforts needed to apply these methods statewide.
- Develop a workflow to integrate pedestrian traffic counts from existing infrastructure into ODOT's enterprise traffic data system.

More detailed information regarding the project and its objectives can be found at the link below:
https://www.oregon.gov/ODOT/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES

Consultant Payments; Staff Time; Literature Review; Pilot Testing; Equipment Purchase; Data Acquisition (In-Field); Data Analysis for Multiple Sites; TAC Presentations, Final Report; and Travel;

This project is under development. Once it begins, more information on proposed activities can be found in the Project Work Plan at the link above.

ACCOMPLISHMENTS

This project is under development in May of 2021.Once it begins, accomplishments may be viewed by selecting Quarterly Reports at the link above.

RESPONSIBLE PARTIES

ODOT Research Section Sirisha Kothuri, Ph.D., Senior Research Associate
Portland State University, Patrick A. Singleton, Ph.D., Assistant Professor (Contract Pending)

COST INFORMATION

SPR 857	**FY'22**	**FY'23**	**FY'24**	**FY'25**	**TOTAL**
STAGE 2 BUDGET	$50,500	$88,500	$17,000	$-	$156,000
WORK PLAN BUDGET					
SPENT TO DATE					
REVISED BUDGET					

Budget values are estimated based on forecasted project work.

858 DEVELOPMENT OF PROCEDURES AND TECHNOLOGIES FOR CHIP SEAL CONSTRUCTION QUALITY CONTROL IN OREGON

OVERVIEW

General reduction in pavement program funding levels over the past decade and the possible consequent increase in pavement distresses created a need for low cost yet effective alternative ways to rehabilitate, preserve and maintain roadway network in Oregon (ODOT, 2018). In a limited budget scenario, the use of lower-cost pavement preservation options, such as chip seals, allows transportation agencies to pave more lane miles and improve overall pavement condition and user comfort more in the state. However, performance of chip seals highly depends on construction practices and material quality. For this reason, life of a chip seal can range from 3 to 15 years (Romero, 2005). Binder and aggregate application rate and uniformity, aggregate-binder adhesion, binder quality, aggregate properties, applied asphalt binder temperature, and aggregate embedment were accepted to be the major factors controlling chip seal performance. In general, decisions on these factors during construction are made by experience, judgment, and convenience. Thus, premature chip seal failures due to the lack of quality control (for material production and construction stages) on some roadway sections are inevitable. By establishing better construction quality control and using higher quality materials, longevity of chip seals should be improved.

OBJECTIVES

In past research a chip seal design method was developed for ODOT. Although the developed design method is expected to improve the long-term performance of chip seals in Oregon, ensuring the proper construction of the chip seals by following the new design method is crucial to be able to achieve major improvements in long-term performance. For this reason, technologies and field test methods for chip-seal construction quality control need to be developed and implemented. To address this need, this research would have six major objectives:

- determine the major factors that control chip seal performance;
- develop an imaging system to measure “ground truth” aggregate embedment achieved after construction and compare measured embedment to embedment estimates from simple volumetric tests (such as Constant diameter method);
- develop a field and laboratory test to measure aggregate-binder adhesion;
- using the developed experiments for adhesion and dynamic shear rheometer (DSR) testing, determine the effectiveness of several different binder and aggregate types for chip sealing and develop a comprehensive list of ideal chip seal materials;
- using the wireless OreTackRate system developed in SPR818 (2020), develop a field quality control process for emulsion/binder and aggregate application rate and uniformity; and
- implement all tests and methods for chip seal construction quality control.

PROPOSED ACTIVITIES

More detailed information regarding the project and its objectives can be found at the link below: https://www.oregon.gov/ODOT/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES

Consultant Payments; Staff Time; Literature Review; Pilot Testing; Equipment Purchase; Data Acquisition (In-Field); Data Analysis for Multiple Sites; TAC Presentations, Final Report; and Travel;

This project is under development. Once it begins, more information on proposed activities can be found in the Project Work Plan at the link above.

ACCOMPLISHMENTS

This project is under development in May of 2021.Once it begins, accomplishments may be viewed by selecting Quarterly Reports at the link above.

RESPONSIBLE PARTIES

ODOT Research Section

COST INFORMATION

SPR 858	**FY'22**	**FY'23**	**FY'24**	**FY'25**	**TOTAL**
STAGE 2 BUDGET	$82,000	$115,000	$76,000	$-	$273,000
WORK PLAN BUDGET					
SPENT TO DATE					
REVISED BUDGET					

Budget values are estimated based on forecasted project work.

859 REAL-TIME CONTINUOUS BRIDGE SCOUR MONITORING FOR IMPROVED SAFETY AND COST SAVINGS

OVERVIEW

Bridge structures disrupt natural streamflow, which increases turbulence and flow velocities, potentially leading to dangerous scour conditions. Scour is the erosion of stabilizing materials around bridge foundations and is the leading cause of bridge failure in the United States—oftentimes resulting in catastrophic loss of property, life, or both. Climate change effects, including increased flooding and changes to flow regimes, are expected to exacerbate these scour events. The State of Oregon owns approximately 900 bridges that are scour critical. The FHWA requires ODOT to address bridge scour, and monitoring is an approved countermeasure used extensively by ODOT. However, current ODOT methods for monitoring bridge scour are time-consuming, labor intensive, not always accurate, very dangerous to perform during extreme storm events, and unrealistic to apply to 900 bridges. Development of a deployable remote real-time monitoring system could alleviate these issues as well as provide an early warning system for our Region and District personnel. To capitalize on the benefits of available real-time scour monitoring technologies, ODOT must develop methodologies and science-informed strategies for use and deployment.

OBJECTIVES

The main objective of this research is to enable the incorporation of continuous real-time scour monitoring into ODOT's general practice by developing standardized methods and a statewide deployment strategy. A secondary objective is to use the data obtained from this continuous scour monitoring to assess the design performance of ODOT's current scour equations, which may then lead to more cost-effective bridge design. This research effort builds on a 2-year multi-site real-time pilot monitoring investment by ODOT in collaboration with the USGS.

More detailed information regarding the project and its objectives can be found at the link below: https://www.oregon.gov/ODOT/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES

Funds will be used to pay for the following: staff time, consultants and professional services, travel expenses, computational needs, and other services and supplies. Funds will be used to pay for Technical Equipment required to conduct the research.

This project is under development. Once it begins, more information on proposed activities can be found in the Project Work Plan at the link above.

ACCOMPLISHMENTS

This project is under development in May of 2021.Once it begins, accomplishments may be viewed by selecting Quarterly Reports at the link above.

RESPONSIBLE PARTIES

ODOT Research Section

ODOT Bridge Section

ODOT Env/Hydro Section

ODOT Maintenance and Operations Branch

United States Geological Survey (USGS): Greg Lind as principal investigator, Marc Stewart as associate investigator. The USGS will likely be matching an additional $110,070 towards this project that is not reflected in the budget below.

Oregon State University: Christopher C. Higgins as associate investigator.

COST INFORMATION

SPR 859	**FY'22**	**FY'23**	**FY'24**	**FY'25**	**TOTAL**
STAGE 2 BUDGET	$78,000	$92,500	$111,000	$96,500	$378,000
WORK PLAN BUDGET					
SPENT TO DATE					
REVISED BUDGET					

Budget values are estimated based on forecasted project work.

860 PILOTING SMART WORK ZONE TECHNOLOGIES TO PROVIDE REAL-TIME LANE CLOSURE INFORMATION TO IMPROVE OREGON HIGHWAY SAFETY AND MOBILITY

OVERVIEW

Construction and maintenance work zones adversely affect the safety and mobility of the traveling public and expose construction workers to very hazardous conditions in the worksite. Currently in Oregon, navigation tools such as the ODOT TripCheck, cannot be consistently fed with high-fidelity real-time, accurate work zone lane closure information due to difficulty in collecting reliable data from active work zones. ODOT recently updated its real time data portal with a new data set based on the US DOT work zone data exchange standard that was developed to support automated vehicles, but we're lacking the detailed lane impact data needed to fully support this standard. Additionally, the ODOT Commerce and Compliance Division (CCD) is planning to implement a project of automated over-dimension permitting system, which is one of the Oregon Transportation Commission (OTC)'s strategic action plan items. To support that strategic initiative, the system will need accurate real-time information about lane closures on Oregon highways. Thus, all of the above problems require methods that can provide automated and real-time information relating to the lane closures and locations of work zones on Oregon's highways. This information is currently difficult to obtain due to the dynamic and temporary nature of work zones.

In view of this gap in knowledge and practice, this research project aims to pilot the use of systems that provide such real-time information, using existing smart work zone technologies which can provide real-time information about work zone status, with a particular focus on real-time lane closure information. The goal of this proposal is to pilot the use of selected smart work-zone technologies, such as the smart arrow board, to provide high-fidelity accurate work zone data to ODOT TripCheck, third party navigation tools, and to provide real-time work-zone lane closure data to the automated over-dimension permitting system project for ODOT. The project team will work with ODOT vendors (e.g.: Ver-mac) to implement their smart work zone technologies for piloting and field demonstration.

OBJECTIVES

The research goal of piloting the use of smart work zone technologies to obtain real-time work zone lane closure information will be obtained by pursuing the following specific objectives: (1) pilot the selected smart work zone technologies to create ODOT policies and standards, (2) to provide real-time, accurate work zone data to ODOT TripCheck and other navigation tools, (3) to provide high-fidelity real time work-zone lane closure data to the ODOT project of automated over-dimension permitting system, and (4) provide real time lane impacted data via ODOT's work zone data exchange compliant data feed.

More detailed information regarding the project and its objectives can be found at the link below:
https://www.oregon.gov/ODOT/Programs/Pages/Active-Research-Projects.aspx

PROPOSED ACTIVITIES

Consultant Payments; Staff Time; Literature Review; Pilot Testing; Data Acquisition (In-Field); Data Analysis for Multiple Sites; TAC Presentations, Final Report; and Travel;

This project is under development. Once it begins, more information on proposed activities can be found in the Project Work Plan at the link above.

ACCOMPLISHMENTS

This project is under development in May of 2021.Once it begins, accomplishments may be viewed by selecting Quarterly Reports at the link above.

RESPONSIBLE PARTIES

ODOT Research Section

ODOT Systems Operations and ITS Section

ODOT Traffic and Roadway Section

Oregon State University

COST INFORMATION

SPR 860	**FY'22**	**FY'23**	**FY'24**	**FY'25**	**TOTAL**
STAGE 2 BUDGET	$79,200	$90,200	$55,600	$-	$225,000
WORK PLAN BUDGET					
SPENT TO DATE					
REVISED BUDGET					

Budget values are estimated based on forecasted project work.

APPENDIX A - SPR SUBPART B PROGRAM COMPLIANCE

Regulatory Basis	SPR Subpart B Program compliance requirement	Compliance Mechanism
23 CFR 420.117 and 420.205	The Program must be implemented in compliance with its approved work program.	TEAMS accounting system Program Oversight by ODOT management
23 CFR 420.111, 23 CFR 420.115, 23 CFR 420.209	Annual approval of State DOT Research and Development Work Program.	FHWA Division Office Approval
23 CFR 420.115, 23 CFR 420.209	Documentation that describes the State DOT's management process and the procedures for selecting and implementing RD&T activities must be developed by the State DOT and submitted to the FHWA Division office for approval. Significant changes in the management process must be submitted by the State DOT to the FHWA for approval.	ODOT Research Procedures Manual Approval: March 2010
23 CFR 420.209	Periodic reviews of the State DOT's Management Process of the RD&T.	FHWA Division Office participation in the November 2020 Research Peer Exchange and other oversight of work program
23 CFR 420.207	The State DOT's RD&T work program must, as a minimum, consist of a description of RD&T activities to be accomplished during the program period, estimated costs for each eligible activity, and a description of any cooperative activities including the State DOT's participation in any transportation pooled fund studies and the NCHRP. The State DOT's work program should include a list of the major items with a cost estimate for each item. The work program should also include any study funded under a previous work program until final report has been completed for the study.	Work Program Contents
23 CFR 420.207	The State DOT's RD&T work program must include financial summaries showing the funding levels and share (Federal, State, and other	Work Program Contents

Regulatory Basis	SPR Subpart B Program compliance requirement	Compliance Mechanism
	sources) for RD&T activities for the program year.	
23 CFR 420.209 (a)(1)	The State must use an interactive process for identification and prioritization of RD&T activities for inclusion in an RD&T work program.	Annual project solicitation, expert task group and research advisory committee review.
23 CFR 420.209 (a)(2)	The State must use all FHWA planning and research funds set aside for RD&T activities… to the maximum extent possible.	Work Program Budget and Active project management
23 CFR 420.209 (a)(3)	The State must have procedures for tracking program activities, schedules, accomplishments, and fiscal commitments.	Budget tracking spreadsheet, TEAMS system and project quarterly reports.
23 CFR 420.209 (a)(4)	The State must use support and use of the TRIS database for program development, reporting of active RD&T activities, and input of the final report information.	ODOT Research Procedures Manual, and administrative staff Desk Manual
23 CFR 420.209 (a)(5)	The State must have procedures to determine the effectiveness of the State DOT's management process in implementing the RD&T program, to determine the utilization of the State DOT's RD&T outputs, and to facilitate peer exchanges of its RD&T Program on a periodic basis.	Program Performance Measures, RD&T implementation program, Research Annual Report contents
23 CFR 420.209 (a)(6)	The State must have procedures for documenting RD&T activities through the preparation of final reports. As a minimum, the documentation must include the data collected, analyses performed, conclusions, and recommendation. The State DOT must actively implement appropriate research findings and should document benefits.	Publication of research reports, Research Notes, and Annual Report
23 CFR 420.209 (a)(7)	The State must participate in peer exchanges of its RD&T management process and other State DOTs' programs on a periodic basis. Note:	November 2020, Oregon Research Peer Exchange.

Regulatory Basis	SPR Subpart B Program compliance requirement	Compliance Mechanism
	FHWA has guidance defining "period" as at least once every 5 years for a minimum of 2-3 days.	
23 CFR 420.209	The State DOT must include a certification that it is in full compliance with the requirements of this subpart in each RD&T work program. Note, the language to be used for this certification is specified in the regulation.	Work Program transmittal letter
23 CFR 420.117 (e)	Suitable reports that document the results of activities performed with FHWA planning and research funds must be prepared by the State DOT or subrecipient and submitted for approval by the FHWA Division Administrator prior to publication. The FHWA Division Administrator may waive this requirement for prior approval.	March 2015 Division Prior Approval Waiver Letter
23 CFR 420.117 (e)	The FHWA's approval of reports constitutes acceptance of such reports as evidence of work performed but does not imply endorsement of a report's findings or recommendations. Reports prepared for FHWA-funded work must include appropriate credit references and disclaimer statements.	March 2015 Division Prior Approval Waiver Letter, Report disclaimer
23 CFR 420.121(c)	The State DOT must administer the RD&T program consistent with their overall efforts to implement section 1001(b) of The Transportation Equity Act for the 21st Century and 49 CFR Subpart B6 regarding disadvantaged business enterprises.	ODOT procurement and contracting process.
23 CFR 420.121(h)	The nondiscrimination provisions of 23 CFR 200 etc. with respect to Title VI of the Civil Rights Act of 1964 and the Civil Rights Restoration Act of 1987 apply to all programs and activities of recipients, subrecipients, and contractors receiving FHWA research funds, whether or not those programs or activities are federally funded.	Annual Title VI reporting, Research Annual Report contents
23 CFR 420.121(j)	Procedures for the procurement of property and services with FHWA research funds must be in accordance with 49 CFR and/or other applicable regulations.	ODOT Research Procedures Manual , TEAMS accounting system,

Regulatory Basis	SPR Subpart B Program compliance requirement	Compliance Mechanism
		Program Oversight by ODOT management
23 CFR 420.113	(a) Costs are eligible for FHWA participation provided that the costs: 1) are for work performed for activities eligible under the Section of title 23 applicable to the class of funds, 2) are verifiable from the State DOT's or the subrecipient's records, 3) are necessary and reasonable for the proper and efficient to accomplish of project objectives and meet the other criteria for allowable costs in the applicable cost principles, 4) are included in the approved budget or amendments thereto, 5) were not incurred prior to FHWA authorization, and (B) indirect costs are allowable if supported by a cost allocation plan and indirect cost proposal prepared, submitted and approved as required.	ODOT Research Procedures Manual TEAMS accounting system Program Oversight by ODOT management
23 CFR 420.117 (b)	The State DOT must submit performance and expenditure reports, including a report from each subrecipient, that contain as a minimum: (i) Comparison of actual performance with established goals; (ii) Progress in meeting schedules; (iii) Status of expenditures in a format compatible with the work program, including a comparison of budgeted (approved) amounts and actual costs incurred; (iv) cost overruns or underfunds; (v) Approved work program revisions; and (vi) other pertinent supporting data.	Project Quarterly Reports Annual Work Program Research Annual Report contents

APPENDIX B – SPR 812 APPROPRIATION LETTERS

U.S. Department of Transportation
Federal Highway Administration

Memorandum

HEPE-0517-Z445-0001

Subject: **ACTION:** Authority to Obligate Funds

Date: June 14, 2017

In Reply Refer To:
HEPE-30

From: Emily Biondi, Director
Office of Project Development
and Environmental Review

To: Phillip Ditzler
Division Administrator
Salem, OR

Brian Bezio
Chief Financial Officer
Office of the Chief Financial Officer

This memorandum allocates $100,000 to the Oregon State Department of Transportation (ODOT) to conduct "Modeling Chloride Accumulation in Streams from Winter Road Salt Application for Federal Compliance" to be conducted by the Oregon Department of Transportation. This research is presented as a two-phase research proposal. The following objectives are for research Phase 1:

1. Evaluate and adjust ODOT's Winter Salt Pilot project data collection methods to provide data deemed most useful for accurate predictions of surface chloride transport using the SELDM model for development into a framework than can be applied for MgCl2 or NaCl application in any watershed.
2. Evaluate SELDM model results, including probability of exceeding water quality standards in a given year and the effect of using BMPs such as hydrograph extension to mitigate chloride. As SELDM provides mass-balance results, chloride soil seepage into groundwater as well as chloride creek levels will also be estimated.
3. Determine the preliminary degree of groundwater infiltration at Site 1 using previous and supplemental well/spring data. SELDM mass balance together with these physical results will determine whether further study is needed to include chloride groundwater contributions for modeling stream exceedances.

If the results from Phase 1 reveal that chloride is reaching groundwater systems at high concentrations, Phase 2 will be initiated. For Phase 2 the main objectives are to evaluate chloride direction, mass, and rate of movement in groundwater systems for inclusion as baseflow input for SELDM chloride stream exceedance prediction.

By copy of this memorandum, we are requesting that the Office of the Chief Financial Officer, FHWA Office of Budget FMIS Team make $100,000 available for obligation by the ODOT using FY 2016 funds. The funds are authorized under the FAST Act. The funds must be obligated through the Fiscal Management Information System using program code Z445 and paid through the State's current billing. The State's obligation limitation will be increased by the amount of this allocation. The Federal share of this project shall not exceed 80 percent. The State should obligate these funds by September 2, 2017. These funds are specifically allocated for this effort and may not be used for other purposes.

Susan Jones is the Office of Project Development and Environmental Reviews contact for this effort and can be reached at Susan.Jones@dot.gov or 202-493-2139. Local contacts are Emily Cline with the FHWA Oregon Division Office who can be reached at emily.cline@dot.gov or 503-316-2547 and Jon Lazaras, Research Coordinator, ODOT at Jon.M.Lazarus@odot.state.or.us or 503-986-2852. Please send a copy of the final statement of work and project agreement to Susan Jones (HEPE-30) and Deborah Johnson at DeborahR.Johnson@dot.gov (HEPH-40).

U.S. Department of Transportation
Federal Highway Administration

Memorandum

HEPE-0218-Z445-0002

Subject: **ACTION:** Authority to Obligate Funds (CFDA: 20.200)

Date:

From: Emily Biondi
Director, Office of Project Development and Environmental Review

In Reply Refer To: HEPE-30

To: Mr. Philip Ditzler
Division Administrator (HDA-OR)
Salem, OR

Mr. Brian Bezio
Chief Financial Officer (HCF-1)
Office of the Chief Financial Officer

This memorandum allocates $36,000 to the Oregon Department of Transportation (ODOT) to conduct continuing efforts for Additional Project Scope and Budget for ODOT SPR 812: "Assessing the Impact of the ODOT Winter Salt Pilot Project on Neighboring Streams and Groundwater". The additional three tasks are: 1) Additional Manual Samples, 2) Data Conversion, and 3) Installation of an Additional Auto Sampler.

By copy of this memorandum, we are requesting that the Office of the Chief Financial Officer, FMIS Team make $36,000 available for obligation by the ODOT using FY 2017, FAST Act, HRD funds for this research. The funds should be obligated through the Fiscal Management Information System using program code Z445 and paid through the State's current billing. The State's obligation limitation will be increased by the amount of this allocation. The Federal share of this project shall not exceed 80 percent. The State should obligate these funds by September 14, 2018. These funds are specifically allocated for this effort and may not be used for other purposes.

Susan Jones is the Office of Project Development and Environmental Review's contact for this effort and can be reached at Susan.Jones@dot.gov or 202-493-2139. Local contacts are Emily Cline with the FHWA Oregon Division Office who can be reached at Emily.Cline@dot.gov or 503-316-2547 and Jon Lazaras, Research Coordinator, ODOT at Jon.M.Lazarus@odot.state.or.us or 503-986-2852. Please send a copy of the final statement of work and project agreement to Susan Jones (HEPE-30) at susan.jones@dot.gov and Deborah Johnson (HEPH-40), deborahr.johnson@dot.gov.