Fiscal 2014 – 2015
BIENNIAL WORK PROGRAM
STATE PLANNING AND RESEARCH

PART II – RESEARCH

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Transportation Development Division

In cooperation with the

Federal Highway Administration

▪ OREGON DEPARTMENT OF TRANSPORTATION ▪

BIENNIAL WORK PROGRAM

FOR

STATE PLANNING AND RESEARCH PART II (RESEARCH)

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July 1, 2013 to June 30, 2015

BIENNIAL WORK PROGRAM FOR STATE RESEARCH

PART II – RESEARCH

Project SPR-PL-STP-PR14 (001)

July 1, 2013 to June 30, 2015

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BIENNIAL WORK PROGRAM

FOR STATE PLANNING AND RESEARCH (SPR)

PART II – RESEARCH

July 1, 2013 to June 30, 2015

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. In recognition of this fact, the Federal Highway Administration (FHWA) actively encourages the state highway agencies to conduct research and provides financial support through the State Planning and Research (SPR) program.

Primary objectives of the Research Section of the Planning Section of the Transportation Development Division of 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; and
- promote the implementation of research findings.

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:

- Solicit transportation users for research needs.
- 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 for Research Advisory Committee consideration.
- Select principal investigators and Technical Advisory Committee members for each project.
- Conduct literature research as required.
- 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 the Department of Transportation.
- 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 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 with 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. 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.

The implementation of research varies with the nature of the project. The projects, if not conducted by the operating sections that have need for the findings, typically at least involves them in the project management and work product review process. In these cases, implementation takes place as the project progresses. 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, and a semi-annual research 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.

Also, the Research Section may participate in the coordination and reporting of Demonstration Projects conducted in cooperation with FHWA, AASHTO and TRB. However, no such projects were active in FY’13 or scheduled for FY’14.

OTHER RESEARCH SECTION ACTIVITIES

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

A. Support for the National Cooperative Highway Research Program (NCHRP) utilized 5.5% of the SPR allocation. The annual support for FY 2013 is $524,223. The estimated level of direct support for FY 2014 is expected to be close to the FY'13 amount. Oregon funds NCHRP "off the top" of SP&R, meaning that 75% comes from Part 1 and 25% comes from Part 2.

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.

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 annual fee for FY 2013 is $109,002. FY 2014 through FY 2016 will be $103,552 Funds for FY'13 are being obligated through TPF 5(261), which included a 2.5% surcharge to compensate TRB for accepting the fee on a reimbursement basis. As with NCHRP, Oregon's TRB subscription is shared 75-25 between Part 1 and Part 2.

C. Transportation Pooled Fund Projects. Oregon was a co-sponsor of eight SPR Transportation Pooled Fund projects for FY 2013 and will participate in funding at least three in FY 2014. Oregon initiated and is leading TPF-5(259) "Tools for Evaluation of Gusset Plate Connections in Steel Truss Bridges." In addition to TRB and NCHRP support, $175,000 is targeted to Pooled Fund projects in FY'13 and FY'14. In addition, Oregon is soliciting other states for contributions to at least one more pooled fund project, tentatively titled *Validation of Tsunami Design Guidelines for Coastal Bridges*.

Table 1 Cooperative Research

Study No.	Title	FY'13	FY'14	FY'15
TPF-5(209)	Support for the Transportation Curriculum Coordination Council	$15,000	$0	$0
TPF-5(237)	Transportation Library Connectivity and Development	$ 15,000	$15,000	$ 15,000
TPF-5(241)	Western States Rural Transportation Consortium	$2,500	$2,500	$0
TPF-5(254)	Bulb-T Beam as Alternate ABC Side-By-Side Box Beam	$ 20,000	$0	$0
TPF-5(259)	Tools for Evaluation of Gusset Plate Connections in Steel Truss Bridges	$30,000	$50,000	$0
TPF-5(264)	Passive Force-Displacement Relationships for Skewed Abutments	$15,000	$0	$0
TPF-5(271)	Reorganization of Section 5, Concrete Structures, of AASHTO LFRD	$5,000	$0	$0
TPF-5(272)	Evaluation of Lateral Pile Resistance Near MSE Walls …	$15,000	$0	$0
1332	Validation of Tsunami Design Guidelines for Coastal Bridges	$20,000	$20,000	$20,000
	Unidentified Projects		$137,500	$140,000
	Subtotal for Pooled Fund Projects	**$137,500**	**$175,000**	**$175,000**
SHR-2(013)	SHRP 2 Transfer	$95,313	$0	$0
TPF 5(261)	TRB Subscription FY'13[1]	$27,932		
NA	TRB Subscription[1] FY'14 and FY'15		$25,888	$25,888
TPF-5(413)	2013 NCHRP Assessment[1]	$131,055		
TPF-5(41X)	2014 NCHRP Assessment[1]		$131,055	
TPF-5(41X)	2015 NCHRP Assessment[1]			$131,055
	Total	**$391,787**	**$398,943**	**$331,943**

[1]Beginning in FY'06 ODOT Research and ODOT Planning agreed to share the cost of the NCHRP and TRB assessments. Amounts reported represent 25% of the ODOT assessments which tapped SPR Part 2 (Research) funds. The balance was covered with SPR Planning funds. For fiscal 13 the transfer for SHRP-2 implementation was also shared by Planning and Research.

D. 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. T2 is one of 49 such centers across the country (one in nearly every state and Puerto Rico) that are part of FHWA's Local Technical Assistance Program (LTAP). Present T2 annual funding is at $345,000 through December 2013.

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.
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 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.

E. 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 (Part II) program of research described herein. As the opportunity arises, this additional budget allows for some use of SPR Part 1 funding. Otherwise, Oregon Highway Funds will be utilized.

F. A State-funded Indirect Account Approximately $650,000 for the 2013-2015 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.

CORE RESEARCH PROGRAM FUNDING SUMMARY

Ta	Project Title	FY'14	FY'15	Total
301	SPR Project Development	$200,000	$200,000	
302	SPR Implementation	$50,000	$50,000	
	Unidentified Projects	$0	$620,000	
304	Research Discretionary Fund	$127,000	$250,000	
	Continuing Projects			
719	Climate Change Impact on Coastal River Estuaries in Oregon	$21,632	$22,000	$289,670
728	Shrinkage Limits and Testing Protocols for High Performance Concrete	$1,500	$0	$251,635
729	Criteria for Selection/Application of Advanced Traffic Signal Systems	$1,000	$0	$182,108
730	Copper removal from storm water runoff using fish bone meal	$154,242	$0	$375,648
731	Underwater Noise Generation and Propagation from Pile Driving	$1,500	$0	$254,340
732	Comparison of Pelletized Lime with other Anti-stripping Additives	$23,503	$0	$189,212
734	Premature Asphalt Concrete Pavement Cracking	$78,937	$0	$160,117
736	Corrosion Monitoring System for Reinforced Concrete Structures	$13,000	$0	$237,719
740	Impacts of Potential Seismic Landslides on Lifeline Corridors	$23,678	$0	$234,867
741	Seismic Retrofit Measures considering Subduction Earthquakes	$118,553	$68,000	$287,815
742	Mitigating Effects of Chloride Deicer Exposure on Concrete	$17,000	$0	$286,266
745	Residential Location Choices for Transportation Decision Making	$58,389	$0	$174,507
747	Operational Guidance for Bicycle-Specific Traffic Signals	$2,000	$0	$78,515
750	Strengthening Methods for Deficient Flexural Steel Anchorages in Bridge Girders	$125,000	23,000	373,000
752	GTFS Data as a Basis for Optimization of Large Scale Transit Networks	$32,730	$0	90,775
753	Transportation Performance Measures for Statewide Outcomes-Based Management	$38,920	$0	199,420
754	Pedestrian and Bicycle-Specific Data Collection Methods in Oregon	$81,009	$0	146,000
755	Performance Based Selection of RAP-RAS in Asphalt Mixtures	$87,430	$0	160,000
756	Improved Safety Performance Functions for Signalized Intersections	$105,000	$49,500	$164,500
757	Bluetooth Data Collection System for Planning and Arterial Management	$112,508	$0	225,016
758	Width of Filter Strips for Natural Dispersion of Stormwater in Western Oregon	$144,778	$118,007	$303,084
759	Capturing Multimodal Comparisons in Freight Project Prioritization	$91,866	$0	$158,000
	New Projects			
760	Multimodal Performance Measures: Developing a Transportation Cost Index	$50,000	$100,000	$150,000
761	Evaluation of weather Based Variable Speed Limit Systems	$45,500	$89,000	$180,000
762	High Strength Steel Reinforcement for Bridges	$61,750	$121,500	$245,000
763	Mechanistic Design Data	$44,250	$86,500	$175,000
764	Road Map for Connected Vehicle/Cooperative Systems	$45,750	$89,500	$151,000
765	High Strength Steel bars and Casing on Response to Drilled Shafts	$57,500	$110,000	$335,000
766	Effective Measures to Restrict Turning Movements	**$72,500**	$72,500	$145,000
767	Design Treatments for Right Turns at Intersections with Bicycle Traffic	$51,000	$101,000	$161,500
768	Crowdsourcing as a data collection method for Bicycle Performance Measures	$74,740	$112,110	$186,500
769	Safe and Effective Speed Reductions for Freeway Work Zones Phase 2	$52,500	$52,460	$104,960
770	Impact of Cascadia Earthquake on Seismic Evaluation Criteria of Bridges	$50,500	$99,000	$200,000
771	Risk Factors Associated with High Potential for Serious Crashes	$53,833	$106,167	$160,000
	TOTAL	$2,370,998	$2,540,244	$7,016,174
	FEDERAL	$1,896,798	$2,032,195	
	STATE	$474,200	$508,049	

Table 3 Research Projects Ending In FY'13

#	TITLE	FY'11 and Prior	FY'12	FY'13	TOTAL
	Completed Projects				
665	Access Management Best Practices Manual	$ 58,063	$0	$ 1,350	$ 59,413
710	Analysis and Design of Pipe Ramming Installations	$215,898	$ 98,484	$ 39,539	$353,921
711	Internal Curing of Concrete Bridge Decks	$223,049	$ 12,303	$ 5,016	$240,368
713	Asphalt Binder Grade Selection for HMAC with Recycled Asphalt	$226,505	$ 38,547	$ 5,655	$270,707
718	Mechanistic Design Guide Calibration for Pavement Rehabilitation	$ 93,115	$106,313	$ 5,485	$204,913
720	Quantifying Safety Performance of Driveways on State Highways	$101,936	$ 24,652	$ 653	$127,241
733	Safety Performance Measures for Roundabout Applications in Oregon	$ 2,040	$ 86,185	$ 1,958	$140,183
735	Measuring the Performance of Transit Relative to Livability	$ 22,861	$ 70,321	$ 27,113	$120,295
738	Determining Outsourcing Feasibility and Standard Pricing Methodologies				
739	Characterizing Oregon's Supply Chains	$ 14,322	$ 55,353	$ 43,209	$112,884
744	Profiler repeatability and accuracy using the IRI model	$ 0	$ 66,615	$ 6,837	$103,452
746	Use, Test & Evaluation of a Mobile Work Zone Barrier System	$ 0	$ 87,921	$ 77,459	$165,380
751	Implementing Safe Effective Speed Reductions for Freeway Work	$ 0	$40,856[1]	$ 66,336	$107,192
	Terminated Projects				
743	Variable Speed Limit System for Wet and Extreme Weather	$ 0	$ 70,947	$ 3,664	$ 74,610
	Total	**$957,789**	**$1,1**	**$**	**$2,0**

1. Results from this project were needed for a report to the 2013 legislative session. Due to the short deadline it was started early using FY'12 funds from the Research Discretionary fund (SPR 304).

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. 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

There has been a notable increase in project development expenses starting in 2004, and which is expected to continue at these higher levels for the foreseeable future. The cause of this increase has two components. The smaller of the two components is the creation of two additional expert task groups, bringing the total from six to eight. The second, more important component is simply development of more projects. Prior to 2004 six or seven projects were typically initiated each year. Since 2004, the average has been 12, and with supplemental funding from OTREC and other University Transportation Centers, those levels are generally expected to continue into the future, but for FY'14 our intention is to select between 10 and 12 new projects.

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 Oregon Division of FHWA.

COST INFORMATION

SPR 301	FY'08	FY'09	FY'10	FY'11	FY'12	FY'13	FY'14	FY'15
BUDGET	$170,000	$170,000	$200,000	$200,000	$200,000	$200,000	$200,000	$200,000
SPENT TO DATE	$203,833	$318,986	$186.783	$237,606	$224,500	$226,500	$0	$0
REVISED BUDGET	**$203,833**	**$318,986**	**$186.783**	**$237,606**	$224,500	**$226,500**	**N/A**	**N/A**

FY'13 expenditures are estimated.

302 IMPLEMENTATION

OVERVIEW AND OBJECTIVES

When a project ends and the report is published the project budget is no longer available for continuing activities related to dissemination and implementation 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 System (TRIS) 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.

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.

Events

In 2012 ODOT Research was a major sponsor of the Northwest Transportation Conference, which was held at the CH2M Hill Alumni Center at Oregon State University, February 7-9. The event typically involves about 100 speakers in 21 sessions over three days.

The Northwest Transportation Conference is also planned for April 2014. ODOT Research will continue to play a major role in delivery of that event.

The ODOT Research Section supports the conference in the following ways.

- Participated on the conference steering committee.
- Section staff prepared and circulated a request for abstracts, and review the abstracts received for inclusion in the conference program.
- Section staff organized several sessions and recruited speakers for those sessions.
- Research Section funds were made available to cover the fees charged or expenses incurred by major speakers.
- Section staff prepared online and printed conference materials including pre conference announcements, the conference registration brochure, a booklet of major speaker bios, preliminary and final conference programs, conference evaluation forms and assorted posters.
- The section sponsored and staffed vendor display at the conference, for the Research Program and the Oregon Technology Transfer Center.
- Section staff chaired sessions and presented research papers.

Summary Publications.

"Research Notes" (2-4 page research project summaries) provide ODOT and local public works agency offices with information on the latest research findings. An internet website for Research includes information on available reports and current project status. For FY'12 as part of the agency's "right-sizing" initiative, the semi-annual Research Newsletter was discontinued and Research Notes were somewhat curtailed commensurate with a reduction in staff.

Projects.

Thirteen major projects are expected to be completed in FY'13. 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. For projects ending in FY'12 a summary of the project objectives, outcome and implementation accomplished or expected, is presented below.

665: Access Management Best Practices Manual. The transportation industry has been aware for several years that there are substantial safety and operational benefits when a transportation system is constructed or retrofitted with strategic access management designs such as shared driveways, raised medians, or driveway restrictions near intersections. It was important to develop a best practices document for the state of Oregon that includes decision-support tools that will help quantify the anticipated results and determine the costs and benefits of these choices to both the transportation agency as well as to the community.

The product of this research was the *Oregon Access Management Best Practices Manual.* This document will be used by engineers, decision makers, and educators to help the transportation community better understand the appropriate application of access management strategies and how to quantify the benefits of various access management options. For example, research determined that 'a change from 10 to 20 driveways per mile would result in a 41% increase in

accidents'. This kind of information will help representatives of transportation agencies explain the principles and benefits of access management to elected officials, local agency partners, and private developers. Quantifying the impacts access management has on system management will help develop credibility for the use of these access management techniques.

Oregon will use the *Access Management Best Practices Manual* in a variety of training classes. The research will be presented at regional, statewide and national land use and transportation conferences, such as the TRB Access Management Bi-annual conference, the annual Oregon Planning Institute, ACEC conferences and the Project Delivery Leadership Academy. The Manual will be made available throughout the Department and to consultants from the Access Management Program's website. It will also be submitted for inclusion as a resource on the TRB website.

The Manual will be an educational tool to help governing jurisdictions communicate and market the principles and benefits of access management. It will help establish consistent statewide understanding, expectations, and application of access management techniques.

710: Analysis and Design of Pipe Ramming Installations. Prior to this research Oregon Department of Transportation planners and designers have been at the mercy of consultants and contractors regarding where and how pipe ramming could be used as a cost-effective, trenchless method for installing, or replacing, culverts under highways. ODOT has used pipe ramming in the past, but the lack of technical information regarding the feasibility, specification, and design of pipe ramming installations has limited confidence in the method and deterred its use.

This research project produced information and methods for predicting vertical ground movements, ground vibrations, dynamic stresses in the pipe, the static soil resistance to ramming, and the drivability of a pipe based on site conditions.

In the short-term ODOT staff in the regions that are planning and designing future culvert projects can immediately use the information from the final report to better inform the selection, specification, and use of pipe ramming as a method.

In the intermediate to long-term the results of the research project will be incorporated into the documents, procedures, and manuals used by the Region Tech Centers to design and specify pipe ramming installations.

The result of implementing this research will be greater use of pipe ramming in circumstances where it is appropriate. In those cases where it is used, the benefits will be reduced disruption of travel on the roadway, fewer changes and delays during pipe ramming projects, and reduced costs through better design and properly specified bid solicitations.

711: Internal Curing of Concrete Bridge Decks. Current ODOT standard specifications for curing high-performance bridge deck concrete requires wet curing be initiated within 20 minutes of the final pass of the finishing machine and not greater than 20 feet from the back of the pavement machine. This wet cure is specified for 14 days with longer curing possible if cooler ambient temperatures are encountered during the initial 14-day period. This long wet cure reduces evaporation that causes concrete shrinkage and cracking, and it provides water to the bulk concrete to participate in the chemical reactions that develop the properties of the concrete. While this curing period reduces bridge deck cracking, the time requirement represents a burden on constructability and project scheduling. Previous research has shown that replacing some of the conventional fine aggregate with lightweight fine aggregate (LWFA) saturated with water can provide internal curing to mitigate cracking and provide water for the chemical reactions.

The objective of this research project was to reduce the 14-day wet curing requirement for bridge decks by incorporating saturated LWFA into the concrete for internal curing. Best on the degree of cracking, the results showed that LWFA did not perform as well as shrinkage reducing admixtures (SRAs) when external curing time was reduced. The best performance was a SRA combined with LWFA. However, another key finding of the research was that ODOT's typical bridge deck mixes have a high potential for cracking. Consequently, any benefit from internal curing or SRAs in reducing curing time may be minor compared to the propensity for the concrete to crack. It is not anticipated that internal curing will be used to reduce wet curing time until ODOT is confident that its conventional mixes are less likely to crack, which is the focus of SPR 728.

713: Asphalt Binder Grade Selection for HMAC with Recycled Asphalt Products. This study investigated several characteristics of laboratory-fabricated and plant-produced hot-mix asphalt mixtures containing various proportions of Recycled Asphalt Pavement (RAP) and Recycled Asphalt Shingles (RAS) with the principal objectives of developing a procedure for selecting the virgin binder grade used in such mixtures as well as a procedure for determining ignition oven calibration factors for mixtures containing these materials. Other objectives included developing recommendations for procedures to effectively and efficiently recover asphalt binder from RAS, batch and mix reclaimed materials with virgin materials, and for quality control and quality assurance testing.

The results of this research project has allowed ODOT to move forward with the inclusion of RAS in pavement projects, recently making the specification permissive allowing RAS in any pavement. The research has also informed ODOT pavement engineering on the proportions of recycled material that is acceptable with current design practices.

Other positive developments associated with this research include the refinement of test procedures for extraction of oil from RAS material while confirming the current use of ignition ovens with currently specified calibration factors. The research provided recommendations for the use of blending charts for asphalt mixes with higher percentage recycled materials and has laid the ground work for a follow-on project which is exploring very high percentage RAP and RAS mixes.

718: Mechanistic Design Guide Calibration for Pavement Rehabilitation. This report was published in February 2013. It represents one of the steps in transitioning from the empirically-based pavement design to a mechanistic-empirical procedure that combines the strengths of advanced analytical modeling and observed field performance. The original pavement performance prediction models were calibrated primarily using design inputs and performance data from the LTPP database. However, these models warrant local validation and calibration because of potential differences between national and local conditions.

This sampled forty-four pavement sections throughout Oregon. Sections were categorized into overperforming or underperforming, and also by region. A detailed comparison of predictive and measured distresses was made using MEPDG software Darwin M-E (Version 1.1). It was found that the nationally calibrated predictive distresses did not accurately reflect measured distresses when comparing local measurements. Nationally calibrated models over predicted total rutting compared to the measured total rutting and most of the rutting predicted by Darwin M-E occurred in the subgrade. For alligator (bottom-up) and thermal cracking, the nationally calibrated models underestimated the amount of cracking considerably as compared to in-field measurements. Variability was also found between predicted and measured values for

longitudinal (top-down) cracking. The performance (punch-out) model was also assessed for continuously reinforced concrete pavement (CRCP) using Darwin M-E's default coefficients.

Four distress prediction models (rutting, alligator, longitudinal, and thermal cracking) of the HMA overlays were calibrated for Oregon conditions. The locally calibrated models for rutting, alligator, and longitudinal cracking provided better predictions with lower bias and smaller standard error than the nationally (default) calibrated models. However, there was a high degree of variability between the predicted and measured distresses, especially for longitudinal and transverse cracking, even after the calibration. The report suggested a significant lack-of-fit modeling error for the occurrence of longitudinal cracks. The report recommended Darwin M-E calibrated models for rutting and alligator cracking to be implemented, however, additional sample sites need to be established and included in the future calibration efforts to improve the accuracy of the prediction models. ODOT's Pavements unit plans to continue to collect data and improve design models. The current pavement models for areas with underperforming rutting and alligator cracking will be used to provide an improved pavement design.

720: Quantifying Safety Performance of Driveways on State Highways. Access management allows for the safe and efficient operation of highways and roadways. In doing so, access management provides for designs, placement and operation that limit the conflicts, potential crashes and unnecessary stopping, slowing and confusion for the driver as they travel the roadway system.

ODOT access management rules and procedures incorporate crash risk considerations in development review and highway approach permit decisions, but the available research that quantifies the crash potential at driveways is limited. The need for fundamental knowledge improvement is driven by a Department of Justice (DOJ) opinion that ODOT must have consistent proactive process to manage safety risks associated with unpermitted highway approaches.

This research quantifies the safety performance of driveways located adjacent to principal arterial state highways with urban or rural designations in the State of Oregon and provides the Oregon Department of Transportation (ODOT) with safety performance functions (SPFs) to evaluate the safety impacts of various access management and driveway-related configurations. ODOT is currently in the process of validating the models provided by this research. When validated, the SPFs will be incorporated into the online resources that are currently used by the region access management engineers during the highway approach permit process.

The research results will help the Department make decisions that have greater consistency and are better informed, while maintaining an appropriate balance between crash risk and economic vitality during administration of ODOT's Access Management Program. It will provide appropriate support for the decisions made regarding specific cases. These actions will increase the Department ability to communicate with the public and elected officials about trade-offs and benefits of managing highway access.

733: Safety Performance Measures for Roundabout Applications in Oregon. In recent years the construction of roundabouts as alternatives to signalized or STOP-controlled intersections has increased in Oregon and in the United States. Conceptually, a roundabout makes sense as it reduces delay (resulting in capacity improvements) and minimizes the number of potential conflicts between users in the traffic stream. Public acceptance of roundabouts, however, has been mixed and determination of the actual, quantifiable safety benefits of roundabouts in Oregon and the Pacific Northwest will enable the Oregon Department of

Transportation (ODOT) and other regional transportation agencies to make informed decisions about the potential construction of these unique intersections.

Published literature suggests that the conversion of signalized intersections to roundabouts reduces total crashes by approximately 35-percent and reduces injury crashes by around 65-percent. However, different sources report a wide range of safety expectations ranging from 1-percent to 80-percent reduction in total crashes. Crash reduction reports for converting a STOP-controlled intersection to a roundabout also have high variability. The reason for these vastly different estimates is confusing and merited validation for Oregon roundabouts to provide reliable, dependable information about safety of all users as one component of the project design process.

The primary goal of this research was to provide ODOT with safety performance functions (SPFs) to evaluate the safety performance of single-lane, four-leg roundabouts. These safety metrics generally conform to the statistical models and methodologies similar to those outlined in the *Highway Safety Manual* (HSM) published in 2010 by the American Association of State Highway and Transportation Officials (AASHTO).

735: Measuring the Performance of Transit Relative to Livability. This project sought to understand the relationship between urban form, transit service characteristics, and ridership measured at the stop level. Most previous work in this area has looked at these issues separately, by either linking system performance (e.g. on-time performance, cost, etc.) to ridership or exploring the connection between urban form (e.g. density) and transit use. This project sought to synthesize these disparate approaches. While transit service characteristics (e.g. frequency, travel time, etc.) are important to help individuals reach their desired destinations, most transit users are pedestrians at the beginning and end of any transit trip. Therefore, focusing on the walkable zone around each transit stop was also important.

There were three methodological approaches to this project: (1) the development of spatial indicators using geographic information systems (GIS); (2) regression analysis linking those indicators to ridership at the stop level; and (3) evaluation of micro-scale urban design factors. Three metropolitan regions in Oregon were included, representing a range of sizes and characteristics: TriMet (Portland), Lane Transit District (LTD) and the Rogue Valley Transit Authority (RVTD).

As a result of this work, the project identified three key policy areas where both transit agencies and local or regional governments could bring about a more transit-supportive urban form. The regression analysis emphasized that service frequency is clearly important and when holding all else equal in terms of urban form, transit ridership increases when transit service increases. The study also found that clustering density and destinations at transit stops is important and that connectivity is important as measured both by GIS analysis of existing networks and urban form analysis of connectivity barriers.

Another key component of this research was to identify livability indicators that ODOT, transit agencies, and communities in Oregon can use to assess and evaluate their performance. The three key transit livability indicators that project recommended were the quality of transit service (represented by service frequency), the ability to get to transit stops on foot, and the presence of destinations to reach from each transit stop. These indicators will help inform performance based planning.

The project also produced a spreadsheet tool which will be used by ODOT and local agencies to examine how changing different variables such as demographics impact transit ridership for Oregon and can assist in planning efforts and investment decisions.

738: Determining Outsourcing Feasibility and Standard Pricing Methodologies. Research project SPR 738 "Determining Outsourcing Feasibility and Standard Pricing Methodologies" was published in April 2013. The report examined ODOT's practices for in-house pricing versus outsourcing costs, resulting from a 2006 Secretary of State audit and Oregon House Bill 2867 (2010). The focus of the audit and house bill was to have a comparative cost analysis for personal services contracts, including Architectural, Engineering and Land Surveying (A&E) contracts, and consultant cost estimates.

The research includes analysis of two databases: local agency projects and OTIA III bridge projects. Comparisons were made between in-house consultant hours estimated between various sized local agency and higher-cost bridge projects. Actual hours charged were not obtained. Both databases and analysis were provided to ODOT's Procurement Office to aid in negotiations and in estimating hours for future projects. However, during the course of the research, it was determined that the legislation did not intend to cover engineering and related services, but did apply to the next largest group of personal service contracts: Information Technology (IT) contracts. In some cases, IT personal service contracts are written as fixed-fee or time and materials contracts, which reduce ODOT's contracting risk.

Although most of the analysis focused on engineering contracts, it produced ratios for total contract amounts versus outsourced amounts for categories of employees (e.g. engineer, administration, etc.), but did not address quality of work or performance. These ratios will be used by OPO and the Major Projects Branch to evaluate new bids for "reasonable" hours given the size of contract and complexity of work. Outliers should be easily identified with the developed ratios and allow for further negotiation and discussion with the vendors.

739: Characterizing Oregon's Supply Chains. The common approach to freight truck modeling has been to mimic passenger travel modeling methods which does not adequately reflect freight travel behavior. Little is known about the transportation activity of individual supply chains (such as long-haul agricultural versus local bakery goods deliveries) and the extent to which transportation activity varies across these supply chains.

Understanding the relationships between freight transportation and characteristics such as commodity, shipment size, origin and destination, and time sensitivity is necessary in order to properly evaluate the impacts of transportation investments and policies on the state's transportation and economic activity.

Truck trips are influenced not only by the road network, time of day, and day of the week but also by such factors as the physical qualities of the commodities being carried (perishable, hazardous, bulk, etc.), the value of the shipments, and the availability of intermodal facilities.

In an effort to classify freight companies into grouping with differentiated travel movements a survey was designed and developed for licensed motor carriers in Oregon. The survey consisted of 33 questions. Respondents were asked details about their fleets, locations served, times of travel, types of deliveries and commodities.

An analysis of the data revealed clusters of company types that can be distinguished by determining characteristics such as their role in a supply chain, facilities operated, commodity type, and vehicle types. An assessment these relationships are also presented that can be integrated into the state models.

The results found that the survey conducted in this study, combined with the data comparisons, support recommendations for changes that can be made to the current Commercial Transport (CT) module of Oregon's SWIM2. There are three ways the analysis can affect the CT module:

1. The new data may be used to update current inputs to the model.
2. Results may be integrated into the model as new input parameters.
3. An entirely new framework may be developed for future model generations.

In conclusion, the survey and subsequent analysis has resulted in clear and actionable recommendations for how to update and/or modify the SWIM2 model to better capture supply chain and freight transportation correlations. When these modifications are implemented, the model will be better able to capture shipper behavior, and therefore be more effective in supporting policy analysis.

744: Profiler Repeatability and Accuracy using the IRI Model. The specifications for pavement roughness are being transitioned by Oregon DOT from PI based measurements to IRI. This research was conducted on the accuracy and repeatability of the inclinometer profiler. It is intended that the inclinometer profiler will be used to establish the reference profile with which inertial profilers will be calibrated against. In previous tests the instruments were unable to meet accuracy requirements established by AASHTO. Additional data was collected from inclinometer, inertial profiler, rod and level, and 3D laser scanning tests to further evaluate the accuracy and repeatability of the instruments. The goal of the study was to establish a certification test site, determine the repeatability and accuracy of the inclinometer, and develop procedures and guidelines for inclinometer based certification.

This research project has aided in the inclinometer being fully implemented. Multiple changes to the Highway Construction Section, Manual of Field Test Procedures (MFTP), have been incorporated. These changes include test threshold settings, equipment recalibration requirements and refinement of repeatability score requirements. Also, while this research project accomplished the necessary inspection of a certification site, the research pointed out the need to review the current certification site to improve accuracy. This review is currently underway informed by detailed site mapping provide from this project. Other, future modifications to the certification process are in progress and will be incorporated in subsequent additions of the MFTP including the potential for an operator certification process.

746: Use, Test & Evaluation of a Mobile Work Zone Barrier System. This report was published in April 2013. The need for this research stemmed from highway maintenance activities performed while the public travels by at relatively high speeds in very close proximity to the workers. Work zone traffic control efforts include safety measures for the workers, but have limitations with deployment and mobility of the equipment due to short durations. Generally, short durations are considered one crew shift or less. A recent advancement in work zone safety is a mobile barrier system that consists of a motorized tractor/trailer combination, and can provide up to 100 feet of positive-protection in an isolated work area. The research evaluated one mobile barrier product in six different work zone environments, leading to a determination of its benefits and limitations detailed within the research report.

ODOT continues to use the product, predominately by the Clackamas Bridge crew for various maintenance jobs. Contractors have requested ODOT to detail specifications for future projects where they are also able to use this type of barrier for construction projects. ODOT is currently drafting specifications to use this type of mobile barrier product for a large bridge repair contract on OR99 in Newberg. This will serve as a pilot project for future bids. The bid (with mobile barrier specifications) is planned to be released in the summer of 2013, with work starting in 2014.

751: Implementing Safe Effective Speed Reductions for Freeway Work Zones. This project was published in April 2013. Interstate preservation projects are commonly conducted at night and often require working in close proximity to ongoing traffic. The project implemented several treatments (traffic control devices) during two highway paving projects and measured traffic speeds to quantify associated speed reductions. These consisted of: PCMS signs, radar speed display, police officer presence, tubular markers, and drums on both sides of travel lane.

Data regarding their impact on vehicle speed, construction productivity, cost, and motorist and worker safety were evaluated. Oregon's State Police (OSP) presence was found to be the strongest factor to reduce traffic speeds; however, due to limited resources to deploy officers, ODOT wanted the next best performing treatment(s). The research findings suggest using a combination of temporary reduced speed limit signs, radar speed monitoring display, and PCMS signs on both trailers and rollers. However, further research is needed to better quantify the speed reductions.

ODOT will recommend the aforementioned combination treatment for high risk areas in conjunction with or where OSP's presence is limited or not available. A continuation study has been approved for funding to focus on select treatments and quantify traffic speed reductions. The continuation study will start in July 2013.

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 major 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 scanned for implementable findings and brief reports presenting suggested implementation procedures will be circulated to potential users.

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.

COST INFORMATION

SPR 302	FY'08	FY'09	FY'10	FY'11	FY'12	FY'13	FY'14	FY'15
BUDGET	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000
SPENT TO DATE	$37,500	$51,336	$52,933	$44,045	$53,500	$51,900	$0	$0
REVISED BUDGET	**$37,500**	**$51,336**	**$52,933**	**$44,045**	$53,500	**$51,900**	**N/A**	**N/A**

FY'13 expenditures are estimated.

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 Research 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 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.

RELATIONSHIP OF OBJECTIVES TO OVERALL PROGRAM

This fund provides a means of evaluating innovative products or non-standard methods and materials on an experimental basis, similar to, but more broadly applicable than, the Experimental Features Program. It also provides the flexibility to respond quickly to other Research needs that emerge through the fiscal year, and to commit to small (up to $25,000 in a year) projects without specific approval from the Research Advisory Committee.

ACCOMPLISHMENTS

Seven projects and activities were active and one was completed in FY'13. New projects and activities for the FY'14 Small Projects Discretionary Fund have yet to be identified. A summary of completed and continuing projects is provided below.

"Activities" occur continuously, or cyclically. Examples are information requests and NCHRP support. The balance of funds is spent on projects of finite duration that are either in progress or completed. A number of those involve evaluation of an innovative material or method. The initial construction and/or installation has been completed and documented, and the project has entered a monitoring phase.

Activities.

- **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 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 (Status is *ongoing*).

Projects.

- **Digital Image Rectification of Gusset Plate Connection in Steel Truss Bridges Phase 2.** Additional work in the area of digital image rectification is being undertaken in partnership with FHWA and several other states under TPF-5(259) Tools for Evaluation of Gusset Plate Connections in Steel Truss Bridges. An account is being established within the discretionary fund to cover staff time for project coordination (status is *continuing*).
- **Carbon Anode Paint Phase 2.** This project is an exposure test under operating conditions for a water-based carbon paint that can be used for impressed current cathodic protection (ICCP). Previous laboratory work and literature indicates the carbon paint should be an adequate replacement for zinc anodes in ICCP systems, but ODOT wanted an additional exposure test before allowing the paint to be used on a cathodic protection project. By allowing this alternative anode material, ODOT may realize cost savings in future ICCP applications (status is *continuing*).
- **LED Illumination.** ODOT is field testing LED "bulbs" in luminaires. The Research Section has been invited to participate in that field test, and to document the results (status is *continuing*.)

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'08	FY'09	FY'10	FY'11	FY'12	FY'13	FY'14	FY'15
ORIGINAL BUDGET	$100,000	$100,000	$100,000	$100,000	$100,000	$100,000	$127,000	$250,000
SPENT TO DATE	$118,014	$96,121	$61,764	$42,215	$104,500	$31,000	N/A	N/A
REVISED BUDGET	**$118,014**	**$96,121**	**$61,764**	**$42,215**	**$104,500**	**$31,000**	**$250,000**	**$250,000**

FY'13 expenditures are estimated.

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:

http://www.oregon.gov/ODOT/TD/TP_RES/ActiveProjectsIV.shtml#SPR_719

PROPOSED ACTIVITIES

The main focus is to monitor the hydrology of the estuary around the highway, including flow and stage at a number of locations influenced by and influencing the highway and related structures. Additional parameters such as water temperature and salinity will also be monitored at those sites. Elevation profiles will be taken in and around the highway and monitoring sites to track changes due to settlement, aggradation, degradation, channel migration and avulsion, which are also intertwined with the hydrology. The water table will also be monitored at some locations.

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

ACCOMPLISHMENTS

(See Quarterly Reports at the link above.)

RESPONSIBLE PARTIES

ODOT Research Section

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**	**FY15-19**	**TOTAL**
STAGE 2 BUDGET	$65,778	$24,358	$24,358	$24,358	$34,358	$131,790	**$305,000**
WORK PLAN BUDGET	$37,000	$28,000	$48,360	$18,727	$79,102	$105,051	**$316,240**
SPENT TO DATE	$16,344	$49,824	$21,088	**$20,000**	N/A	N/A	**$86,186**
REVISED BUDGET	**$16,344**	**$49,824**	**$21,088**	**$20,000**	**$21,632**	**$161,852**	**$289,670**

FY'13 expenditures are estimated.

728 SHRINKAGE LIMITS AND TESTING PROTOCOLS FOR ODOT HIGH PERFORMANCE CONCRETE

OVERVIEW

ODOT has observed varying degrees of cracking in concrete structures. Cracking at early ages (especially within the first year after placement) results in additional costs and a significant maintenance burden to ODOT. These added costs could be avoided through improved testing techniques, improved material specifications, and improved construction requirements related to reducing cracking risks in such structures.

The most significant challenge to overcoming cracking risk is to reduce the shrinkage, and ultimately the stresses generated as a result of such shrinkage, in concrete mixtures. Without a commonly agreed upon testing method and subsequent shrinkage threshold limits, it is essentially impossible for ODOT, under current guidelines, to specify and receive crack-free concrete with a high degree of confidence.

OBJECTIVES

The research goals are to 1) provide shrinkage threshold limits for ODOT Materials Specifications and 2) provide a robust test procedure (or set of procedures) so that materials suppliers can easily determine compliance with specified threshold limits.

More detailed information regarding the project and its objectives can be found at the link below:

http://www.oregon.gov/ODOT/TD/TP_RES/ActiveProjectsIV.shtml#SPR_728

PROPOSED ACTIVITIES

Task #1: Literature Review.

Task #2: Evaluation Plan.

Task #3: Laboratory Evaluation.

Task #4: Testing Method Determination

Task #5: Reporting and Implementation.

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

ACCOMPLISHMENTS

(See Quarterly Reports at the link above.)

RESPONSIBLE PARTIES

ODOT Research Section

ODOT Bridge Section

Oregon State University (Agreement for $229,089 fully expended through June 2013.)

COST INFORMATION

SPR 728	**FY'11**	**FY'12**	**FY'13**	**FY'14**	**TOTAL**
STAGE 2 BUDGET	$ 62,500	$120,000	$62,500	$ 0	**$245,000**
WORK PLAN BUDGET	$ 69,602	$110,000	$ 48,000	$ 0	$227,602
SPENT TO DATE	$ 73,645	$132,321	$43,669	N/A	**$249.635**
REVISED BUDGET	**$ 73,645**	**$132,321**	**$ 43,669**	**$1,500**	**$251,135**

FY'13 expenditures are estimated.

729 CRITERIA FOR THE SELECTION AND APPLICATION OF ADVANCED TRAFFIC SIGNAL SYSTEMS

OVERVIEW

Recently ODOT and major Oregon cities have begun upgrading traffic controllers at signalized intersections. Model 2070 controllers are now required on new construction and are being installed at some locations such as high-volume actuated-coordinated arterial signal systems where the additional functionality of the controller offers the option of traffic responsive and adaptive traffic signal systems. These systems lead to improved traffic flow, reduced congestion and delay, and increased safety through reduced rear end crashes.

The investment in Model 2070 controllers, vehicle detection enhancements, software, and trained staff to support an upgraded system is significant. The challenge facing ODOT and local agencies is a lack of criteria and guidance in matching signal systems to roadway conditions. Guidance is needed to help determine the most cost effective traffic signal system solution(s), particularly as ITS solutions are stressed as alternative treatments to traditional capacity enhancement projects.

OBJECTIVES

- To develop criteria for the selection and application of advanced traffic signal systems.
- To incorporate the requirements and guidance in ODOT specifications, guidelines, manuals, and training programs.
- To develop measures to evaluate effectiveness of advanced traffic signal systems.
- To develop a training program for staff involved in the implementation and maintenance of advanced traffic signal systems.

More detailed information regarding the project and its objectives can be found at the link below:

http://www.oregon.gov/ODOT/TD/TP_RES/ActiveProjectsIV.shtml#SPR_729

PROPOSED ACTIVITIES

Successful completion of the proposed research will include the following tasks:

Task #1: Literature Review and Agency Survey.

Task #2: Develop Decision Matrix.

Task #3: Testing.

Task #4: Revise ODOT specifications and guidelines.

Task #5: Develop a training program.

Task #6: Prepare draft and final reports.

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

ACCOMPLISHMENTS

(See Quarterly Reports at the link above.)

RESPONSIBLE PARTIES

ODOT Research Section

ODOT Traffic/Roadway Section

ODOT ITS Unit

University of Washington (Phase 1 agreement for $154,000 fully expended through March 2013.)

COST INFORMATION

SPR 729	**FY'11**	**FY'12**	**FY'13**	**FY'14**	**TOTAL**
STAGE 2 BUDGET	$54,000	$108,000	$0	$0	**$162,000**
WORK PLAN BUDGET	$65,000	$98,000	$0	$0	**$163,000**
SPENT TO DATE	$30,151	$94,088	$56,869	N/A	**$181,108**
REVISED BUDGET	**$30,151**	**$94,088**	**$56,869**	**$1,000**	**$182,108**
UTC Commitment (TransNow)	**$43,333**	**$52,667**			**$96,000**

FY'13 expenditures are estimated.

730 ASSESSMENT OF COPPER REMOVAL FROM HIGHWAY STORM WATER RUNOFF USING FISH BONE MEAL

OVERVIEW

Copper, which is harmful to salmon, is sometimes present in highway stormwater runoff. The ODOT BMPs with the most robust performance are bioslopes and bioswales, especially with regard to metals removal. Design and implementation of these types of BMPs has become an increasingly large and costly part of transportation projects.

Even the current best available technologies are not capable of removing copper to the levels which regulators currently consider "no effect". Some research suggests that even slight increases in copper concentrations may cause harmful behavioral and sensory effects in salmon.

Phosphate based minerals have been used in a number of instances for remediation of water contaminated with heavy metals. Based on preliminary research in Region 1, the addition of fish bone meal to bioslope media mix may reduce dissolved copper to background levels. Even if extremely low copper levels are shown to be overly conservative, the improved efficiency of the fish bone meal will likely have benefits in the form of reduced size and cost and increased longevity of bioslopes.

OBJECTIVES

The overarching goal of this project is to identify an efficient and cost effective means of remediating copper in highway stormwater runoff. Specific research questions include:

More detailed information regarding the project and its objectives can be found at the link below:

http://www.oregon.gov/ODOT/TD/TP_RES/ActiveProjectsV.shtml#SPR_730

PROPOSED ACTIVITIES

Task #1: Literature Review.

Task #2: Bench Scale Testing.

Task #3: Field Testing.

Task #4: Data Analysis and Reporting.

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

ACCOMPLISHMENTS

(See Quarterly Reports at the link above.)

RESPONSIBLE PARTIES

ODOT Research Section

ODOT Geo-Environmental Section

Oregon State University (Agreement for $360,294 with approximately $220,706 expended through June 2013.)

COST INFORMATION

SPR 730	**FY'11**	**FY'12**	**FY'13**	**FY'14**	**TOTAL**
STAGE 2 BUDGET	$1,000	$132,333	$132,333	$132,334	**$398,000**
WORK PLAN BUDGET	$39,000	$144,000	$144,000	$ 50,794	**$377,794**
SPENT TO DATE	$28,719	$ 89,773	$102,214	N/A	**$220,706**
REVISED BUDGET	**$ 28,719**	**$ 89,773**	**$102,214**	**$154,242**	**$375,648**

FY'13 expenditures are estimated.

731 UNDERWATER NOISE GENERATION AND PROPAGATION RESULTING FROM PILE DRIVING

OVERVIEW

There is growing concern about pile driving noise levels associated with the construction of bridges and other in-water structures. It has been demonstrated that noise generated from pile driving with an impact hammer can be harmful to ESA protected aquatic species. Construction activities in Oregon are subject to compliance with established noise level criteria (cited as sound pressure levels of 206 dB peak and 187 dB accumulated sound exposure). ODOT's first efforts at mitigating underwater pile driving noise have been costly and problematic.

Most hydroacoustic research completed to date has been done in deep water habitat with large diameter pile. Typically, ODOT projects are completed in shallow environments with smaller diameter pile. To comply with current criteria, ODOT needs to develop hydroacoustic monitoring protocol and predictive models so projects can develop appropriate sound attenuation strategies based on site specific conditions in order to design attenuation appropriate for the project. Ultimately this will save projects time and money and demonstrate good environmental stewardship.

OBJECTIVES

The research project will include: 1) identifying sound generation mechanisms from pile driving and how sound propagates into the surrounding underwater environment, 2) develop an acoustic monitoring procedure and predictive model that will help assure compliance and 3) provide validation and verification of predictive models.

In summary, the goal of the research project is to develop predictive modeling capability that could be used to estimate expected sound levels due to various pile driving activities at specific locations. With that information, site specific recommendations can be made regarding attenuation strategies, taking into account the sound generation and propagation effects. This would allow highway projects to implement the appropriate level of hydroacoustic attenuation, assure regulatory compliance and achieve better cost efficiencies. Bridge construction activities and associated monitoring that is occurring in Oregon provides a unique opportunity to engage the scientific community with the goal of improving our understanding and management of human generated underwater acoustic noise.

More detailed information regarding the project and its objectives can be found at the link below:

http://www.oregon.gov/ODOT/TD/TP_RES/ActiveProjectsV.shtml#SPR_731

PROPOSED ACTIVITIES

Task #1: Literature survey.

Task #2: Determine pile driving sound generation mechanisms.

Task #3: Model sound propagation.

Task #4: Identify Future Needs.

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

ACCOMPLISHMENTS

(See Quarterly Reports at the link above.)

RESPONSIBLE PARTIES

ODOT Research Section

ODOT Geo-Environmental Section

Portland State University (Agreement for $232,000 fully expended through April 2013.)

COST INFORMATION

SPR 731	**FY'11**	**FY'12**	**FY'13**	**FY'14**	**TOTAL**
STAGE 2 BUDGET	$35,000	$118,000	$87,000		**$240,000**
WORK PLAN BUDGET	$128,000	$133,500	$15,500		**$277,000**
SPENT TO DATE	$98,416	$95,047	$59,377	N/A	**$193,463**
REVISED BUDGET	**$98,416**	**$95,047**	**$59,377**	**$1,500**	**$254,340**

FY'13 expenditures are estimated.

732 COMPARISON OF PELLETIZED LIME WITH OTHER ANTI-STRIPPING ADDITIVES

OVERVIEW

Moisture damage significantly reduces the structural integrity and useful life of hot mixed asphalt concrete (HMAC) pavements. While various alternatives exist, laboratory and field studies concluded that lime is a superior product in eliminating moisture sensitivity problems in asphalt pavements.

The principal disadvantages of using lime powder in the production of HMAC mixtures include the added expense associated with mixing, difficulty in containing lime dust, and potential safety and health threats to workers. Use of pelletized lime, rather than lime powder, could minimize health risks to workers as well as other fugitive dust issues. It can be added through the RAP collar or into the liquid asphalt, thus avoiding the additional costs associated with mixing dry, powdered lime and damp aggregate in a pug-mill.

OBJECTIVES

The goal of the research is to determine if pelletized lime is a viable alternative to polymeric aggregate treatments and liquid anti-stripping additives for improving the resistance of dense-graded HMAC to moisture-induced damage. The principal objective will be to determine the relative effectiveness of pelletized lime, polymeric aggregate treatments, and liquid anti-stripping additives with regard to reducing the moisture sensitivity of dense-graded HMAC. Both lab-mixed and plant-mixed materials will be evaluated. A second objective will be to compare unit production costs of mixtures with and without these additives.

More detailed information regarding the project and its objectives can be found at the link below:

http://www.oregon.gov/ODOT/TD/TP_RES/ActiveProjectsV.shtml#SPR_732

PROPOSED ACTIVITIES

Task #1: Experiment Plan.

Task #2: Laboratory Study.

Task #3: Field Study.

Task #4: Analysis of Results.

Task #5: Production Costs.

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

ACCOMPLISHMENTS

(See Quarterly Reports at the link above.)

RESPONSIBLE PARTIES

ODOT Research Section

ODOT Pavement Services Unit

Oregon State University (Agreement for $177,739 with approximately $157,000 expended through June 2013.)

COST INFORMATION

SPR 732	**FY'11**	**FY'12**	**FY'13**	**FY'14**	**TOTAL**
STAGE 2 BUDGET	$38,000	$112,000	$28,000	$0	**$178,000**
WORK PLAN BUDGET	$22,238	$117,406	$47,075	$0	**$187,739**
SPENT TO DATE	$8,987	$105,722	$51,000	N/A	**$165,709**
REVISED BUDGET	**$8,987**	**$105,722**	**$ 51,000**	**$ 23,503**	**$189,212**

FY'13 expenditures are estimated.

734 PREMATURE ASPHALT CONCRETE PAVEMENT CRACKING

OVERVIEW

Recently ODOT has constructed pavements that have experienced premature cracking within three years of construction. Early cracking allows moisture to penetrate the pavement structure reducing the section's design life and significantly increasing the life cycle cost. Also within the last several years, design and material changes occurred that may or may not have contributed to the pavement distress.

National investigations into cracking have identified areas where the cracking is top down versus bottom up. While both are serious, bottom up cracking typically indicates the pavement structure was underdesigned indicating a need to change structural design practices. Top down cracking, however, may indicate that the material selection process can be fine-tuned.

The literature has identified several possible causes for early distresses. For top down cracking, high surface horizontal tensile stress, age hardening and low stiffness upper layer caused by high surface temperatures have been identified as possible causes. Also for thicker pavements, greater than 6.5 inches, top down cracking can be the dominant form of cracking. For Oregon however, it is unknown which mechanism(s) have contributed to the early cracking distress.

OBJECTIVES

The objectives of the research are to determine the causes of early cracking on the state highway system. The results of the study will be used to modify our pavement design process including modifications to the Pavement Design Guide and Mix Design Guidelines.

More detailed information regarding the project and its objectives can be found at the link below:

http://www.oregon.gov/ODOT/TD/TP_RES/ActiveProjectsV.shtml#SPR_734

PROPOSED ACTIVITIES

Task #1: Literature Review and State Survey.

Task #2: Identification of pavements exhibiting early cracking.

Task #3: Field work and laboratory evaluation.

Task #4: Analysis and documentation.

Task #5: Implementation.

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

ACCOMPLISHMENTS

(See Quarterly Reports at the link above.)

RESPONSIBLE PARTIES

ODOT Research Section

ODOT Pavement Services Unit

Iowa State University (Agreement for $140,000 with approximately $55,000 expended through June 2013.)

COST INFORMATION

SPR 734	**FY'11**	**FY'12**	**FY'13**	**FY'14**	**TOTAL**
STAGE 2 BUDGET	$21,500	$85,500	$21,000	$0	**$128,000**
WORK PLAN BUDGET	$103,823	$44,177	$0	$0	**$148,000**
SPENT TO DATE	$1,154	$44,901	$35,125	$0	**$81,180**
REVISED BUDGET	**$1,154**	**$44,901**	**$35,125**	**$78,937**	**$160,117**

FY'13 expenditures are estimated.

736 A CORROSION MONITORING SYSTEM FOR EXISTING REINFORCED CONCRETE STRUCTURES

OVERVIEW

Reinforcement corrosion is a leading cause of premature failure of reinforced concrete and a major concern for concrete structural durability. Concern is greatest in coastal and northern states where these structures are exposed to marine environments or deicing salts respectively, such as in the State of Oregon.

ODOT conducts labor-intensive corrosion surveys to identify structures that are expected to require future corrosion mitigation. Because of the time and cost required to conduct these surveys, the corrosion information for coastal bridges is not as complete as desired. A method of obtaining frequent corrosion data would provide better condition assessment at much lower cost. In addition, a system that measures real-time corrosion behavior could potentially be used with impressed current cathodic protection (ICCP) to adjust the protective current in a way that maximizes anode life. Unfortunately, available corrosion sensors are not adequate because of operational and data interpretation deficiencies.

OBJECTIVES

The goal of this research is to provide a reliable, cost-effective corrosion monitoring system for existing ODOT reinforced concrete structures.

More detailed information regarding the project and its objectives can be found at the link below:

http://www.oregon.gov/ODOT/TD/TP_RES/ActiveProjectsV.shtml#SPR_736

PROPOSED ACTIVITIES

Task #1: Optimize an Integrated Corrosion Sensor.

Task #2: Build Data Communication and Collection System.

Task #3: Develop Methodology for Corrosion Diagnosis and Prognosis.

Task #4: Test Pilot-Scale System.

Task #5: Final Report.

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

ACCOMPLISHMENTS

(See Quarterly Reports at the link above.)

RESPONSIBLE PARTIES

ODOT Research Section

OODT Bridge Section

Montana State University (Agreement for $215,000 expiring 09/30/2013 with approximately $197,000 expended through FY'13.)

COST INFORMATION

SPR 736	**FY'11**	**FY'12**	**FY'13**	**FY'14**	**TOTAL**
STAGE 2 BUDGET	$60,000	$90,000	$75,000		**$225,000**
WORK PLAN BUDGET	$41,500	$113,956	$92,044		**$**
SPENT TO DATE	$9,770	$120,928	$94,020	N/A	**$224,718**
REVISED BUDGET	**$9,770**	**$120,928**	**$94,020**	**$13,000**	**$237,718**
UTC Commitment (WTI)	$20,000	$40,000	$11,000		**$71,000**
UTC Commitment (AUTC)	$50,000	$50,000	$45,000		**$145,000**

FY'13 expenditures are estimated.

740 IMPACTS OF POTENTIAL SEISMIC LANDSLIDES ON LIFELINE CORRIDORS

OVERVIEW

Coastal communities depend on Highway 101 and the state highways crossing the Coast Range to connect them with the rest of the State of Oregon. Landslides have the potential to isolate these communities. The Cascade Range is likewise home to weak soils, steep slopes, abundant groundwater, and substantial rainfall that can combine to produce landslides.

The eventual certainty of one or more large earthquakes adds to the considerable existing hazard described above. Seismic events may trigger landslides on slopes that are normally stable or reactivate dormant, pre-existing landslides. The geographic scope of these seismically-induced landslides will be particularly broad when the next Cascadia Subduction Zone earthquake occurs. The disruption of state highway system by landslides will inhibit the response to the damage and disruption. The human and economic costs of earthquakes are multiplied by delayed response.

The vulnerability of the various state highway routes must be objectively determined; in order to prioritize mitigation investments and to ensure that lifeline corridors remain operational after a disaster.

OBJECTIVES

The objective of this research is to use geospatial data such as LIDAR, land-cover, and geologic materials to map potential seismically-induced landslides. These regional maps will be assembled based on probabilistic analyses. They can then be used for site to site comparisons of the hazard and risk at key locations. This information would be developed using GIS technology to enable easy integration with other information to designate lifeline corridors and prioritize the restoration of the state highway system following a disaster.

More detailed information regarding the project and its objectives can be found at the link below:

http://www.oregon.gov/ODOT/TD/TP_RES/ActiveProjectsV.shtml#SPR_740

PROPOSED ACTIVITIES

Task #1: Integrate multiple data layers, including but not limited to LIDAR, DEM, geology, land-cover, USGS ground acceleration predictions, and hydrology into a GIS database.

Task #2: This geospatial data will then be used to perform probabilistic slope stability analyses to detect locations most likely to fail from seismic activity along transportation corridors.

Task #3: Model select historical landslides, where possible, to determine the role of geologic material, interbedding, slope inclination, and dip angle on back-calculated strength parameters.

Task #4: Using the above data and developed methodology, the team will produce a probabilistic seismic-induced landslide map for the zone between Oregon’s coast and the I-5 corridor.

Task #5: Make preliminary recommendations regarding potential mitigation techniques at key sites to promote continued operation of lifeline corridors immediately, or soon, after an earthquake event.

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

ACCOMPLISHMENTS

(See Quarterly Reports at the link above.)

RESPONSIBLE PARTIES

ODOT Research Section

ODOT Geo-Environmental Section

Oregon State University (Agreement with Oregon State University for $239,831 expiring in August 2013 with approximately $157,000 expended through June 2013.)

COST INFORMATION

SPR 740	**FY'11[1]**	**FY'12**	**FY'13**	**FY'14**	**FY'15**	**TOTAL**
STAGE 2 BUDGET	$0	$ 75,000	$125,000	$65,000	$0	**$265,000**
WORK PLAN BUDGET	$17,692	$146,426	$118,575	$0	$0	**$265,000**
SPENT TO DATE	$17,692	$113,189	$98,000	N/A		**$228,881**
REVISED BUDGET	**$17,692**	**$113,189**	**$98,000**	**$23,678**		**$252,559**

FY'13 expenditures are estimated.

1. *This project was given an early start in FY'11 using a different expenditure account.*

741 BRIDGE SEISMIC RETROFIT MEASURES CONSIDERING SUBDUCTION EARTHQUAKES

OVERVIEW

The majority of Oregon's bridges was built prior to the current understanding of the regional seismic risk and did not incorporate design details to withstand a significant earthquake. A seismic hazard assessment model for Oregon highway routes has shown serious vulnerability to the transportation network. Seismic retrofits in the state have been limited to Phase 1 retrofits that provide restrainers for keeping the superstructure in place on the bents. Such retrofit measures are effective for their intended purpose, but shift the displacement demands onto the supporting substructure. Effective retrofit measures for the substructure have been developed based on research for California bridges and seismic events. However, bridges in Oregon were built differently from those in California, and Oregon is likely to experience a subduction earthquake whereas earthquakes in California are crustal earthquakes.

The M8.8 subduction earthquake in Chile in 2010 highlighted the differences between a subduction earthquake and a crustal earthquake. The duration of a subduction earthquake is longer. Subduction earthquakes may entail significant aftershocks for months. Finally, the frequency content of the shaking that affects the response of structures can span a wider range than crustal earthquakes.

The effectiveness of conventional retrofit measures applied to Oregon bridges is uncertain due to the differences in bridge construction, the underlying assumptions for retrofit design and Oregon's situation. Similarly, fragility, which relates the probability of damage to shaking intensity, is also uncertain. Current research at PSU is investigating the seismic performance of a representative column and of a single retrofit measure for a crustal earthquake. Results for additional retrofit designs exposed to subduction earthquakes are needed in order to achieve accurate output from transportation network models and to have reliable retrofit designs.

OBJECTIVES

The goal of the research is for ODOT to have validated effective seismic retrofit measures that consider the uniqueness of Oregon bridges and the effects of subduction earthquakes.

More detailed information regarding the project and its objectives can be found at the link below:

http://www.oregon.gov/ODOT/TD/TP_RES/ActiveProjectsV.shtml#SPR_741

PROPOSED ACTIVITIES

Task #1: Analyze records from subduction earthquakes.

Task #2: Identify seismic retrofit for bridge bent.

Task #3: Validate the effectiveness of the retrofit measures.

Task #4: Calibrate numerical model of bridge bent retrofit.

Task #5: Develop seismic fragility functions.

Task #6: Final Report and Design Recommendations.

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

ACCOMPLISHMENTS

(See Quarterly Reports at the link above.)

RESPONSIBLE PARTIES

ODOT Research Section

ODOT Bridge Engineering Section

Portland State University (Agreement for $268,000 expiring in September 2014 with approximately $88,000 expended through June 2013.)

COST INFORMATION

SPR 741	**FY'12**	**FY'13**	**FY'14**	**FY'15**	**TOTAL**
STAGE 2 BUDGET	$61,000	$121,500	$100,500		**$283,000**
WORK PLAN BUDGET	$47,287	$145,142	$90,571		**$283,000**
SPENT TO DATE	$11,262	$90,000	N/A		**$101,262**
REVISED BUDGET	**$11,262**	**$90,000**	**$118,553**	**$68,000**	**$287,815**

FY'13 expenditures are estimated.

742 UNDERSTANDING AND MITIGATING EFFECTS OF CHLORIDE DEICER EXPOSURE ON CONCRETE

OVERVIEW

The corrosive effect of chloride on embedded steel reinforcement is well known; however, it is unclear whether deicers based on chloride salts deteriorate concrete. Laboratory studies using concentrated solutions to accelerate testing have demonstrated that magnesium chloride has the potential to damage concrete. However, field cores extracted from sites in Colorado, Idaho, Iowa, Montana, and South Dakota did not exhibit damage conclusively attributable to deicers. Consequently, ODOT does not know the damaging effects that chloride deicers may impact on Oregon's concrete infrastructure over time. Without an idea of the potential damage, there is no widely accepted strategy for protecting existing structures.

The exposure to deicing chemicals at a specific site may depend not only on application frequency but also on other factors. Deicer may be applied directly to a bridge deck or roadway, but other nearby concrete elements such as rails, barriers, and columns may be vulnerable due to splash. Consequently, not all bridges or concrete components are expected to have the same likelihood of damage. However, there is no known practical means to measure deicer exposure in order to focus on those bridges or components potentially at highest risk.

OBJECTIVES

The goal of this project is to minimize the long-term impacts of magnesium chloride deicers on ODOT concrete bridges.

More detailed information regarding the project and its objectives can be found at the link below:

http://www.oregon.gov/ODOT/TD/TP_RES/ActiveProjectsV.shtml#SPR_742

PROPOSED ACTIVITIES

Task #1: ODOT Deicer Application Map.

Task #2: Field Sampling.

Task #3: Exposure Measurement Method.

Task #4: Laboratory Testing of Field Cores.

Task #5: Identification and Laboratory Testing of Mitigation Methods.

Task #6: Damage State Tool.

Task #7: Final Report.

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

ACCOMPLISHMENTS

(See Quarterly Reports at the link above.)

RESPONSIBLE PARTIES

ODOT Research Section

ODOT Construction Section

Western Transportation Institute (Agreement for $248,000 ending in March 2014, 2014 with approximately $88,000 expended through June 2013.

COST INFORMATION

SPR 742	**FY'12**	**FY'13**	**FY'14**	**FY'15**	**TOTAL**
STAGE 2 BUDGET	$72,000	$105,000	$71,000		**$248,000**
WORK PLAN BUDGET	$138,778	$120.222	$14,000		**$273,000**
SPENT TO DATE	$90,615	$178,651	N/A		**$269,266**
REVISED BUDGET	**$90,615**	**$178,651**	**$17,000**		**$286,266**
UTC Contribution (AUTC)	**$86,500**	**$68,500**	**$0**		**$155,000**

FY'13 expenditures are estimated.

745 UNDERSTANDING RESIDENTIAL LOCATION CHOICES FOR TRANSPORTATION DECISION MAKING

OVERVIEW

Growing populations and the need for urban expansion inevitably generates transportation congestion and greenhouse gas emissions (GHG). In order to evaluate the future of Oregon's landscape in relation to its growing population, a better understanding of evolving land use patterns and travel behavior is required. Further, recent legislation has focused on methods for reducing GHG emissions from the transportation sector, and setting reduction targets for Oregon's metropolitan areas.

The bills anticipate that metropolitan areas will need to do detailed analysis of transportation and land use alternatives to meet set targets. Additionally, ODOT is currently charged with developing a statewide strategy for GHG reduction and analyzing policy alternatives. Both analyses require information on residential location choice.

The research results would serve a vital role of helping metropolitan areas and the rest of the state better understand current location choices as well as related travel decisions, and be able to potentially predict future choices. In addition it will provide information valuable to identifying specific actions and policies that are most effective for a specific community given their demographics and built environment.

OBJECTIVES

The project will make use of existing Oregon Household Activity Survey (OHAS) and archived spatial environmental data about transportation and land use and collect new primary data on housing decisions of households in Oregon with the intent of contributing to existing and new policy analysis tools. These tools include but are not limited to: GreenSTEP (a sketch-level greenhouse gas estimation tool), LUSDR (a land use model that simulates location decisions of household and firms), SWIM2 (the Oregon Statewide Integrated Model that includes economic, land use and transportation modules), and other analysis tools with a statewide or urban scope.

More detailed information regarding the project and its objectives can be found at the link below:

http://www.oregon.gov/ODOT/TD/TP_RES/ActiveProjectsV.shtml#SPR_745

PROPOSED ACTIVITIES

Task #1: Literature review.

Task #2: Data assembly.

Task #3: Analysis of revealed preference data.

Task #4: Develop and conduct stated preference survey.

Task #5: Analysis of stated preference survey data.

Task #6: Applicability assessment.

Task #7: Final Report.

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

ACCOMPLISHMENTS

(See Quarterly Reports at the link above.)

RESPONSIBLE PARTIES

ODOT Research Section

ODOT Planning Section

Portland State University (Agreement for $164,999 ending July 2013 with approximately $116,000 expended through June 2013.)

COST INFORMATION

SPR 745	**FY'12**	**FY'13**	**FY'14**	**FY'15**	**TOTAL**
STAGE 2 BUDGET	$45,000	$7,500	$42,500		**$175,000**
WORK PLAN BUDGET	$51,968	$102,516	$21,515		**$175,999**
SPENT TO DATE	$ 24,618	$ 91,500	N/A		**$116,118**
REVISED BUDGET	**$ 24,618**	**$ 91,500**	**$ 58,389**	**$0**	**$ 174,507**

FY'13 expenditures are estimated.

747 OPERATIONAL GUIDANCE FOR BICYCLE-SPECIFIC TRAFFIC SIGNALS

OVERVIEW

As a policy objective, increasing bicycling as a transportation mode has a number of desirable outcomes ranging from reduced greenhouse gases to improved public health. Recent estimates from the 2005-2009 American Community Survey indicate that of the 1.7 million workers in Oregon, 2% commute by bicycle to work, though the rates are much higher in specific cities. The literature suggests that infrastructure improvements will encourage more cycling. In many urban areas, bicycle-specific signal control is receiving more attention, especially as bicycle volumes increase.

The MUTCD permits controlling bicycles with traffic signals, but not bicycle-specific signals, and includes no specific guidance about placement, design, warrants, or the use of special indications. However, a proposal is being considered for inclusion of more guidance in the next MUTCD revision. The Traffic/Roadway Section has produced "Section VI. Special Applications" as addendum #2 in ODOT's *Traffic Signal Policy and Guidelines* with information related to bicycle signal phases. However, ODOT and local agency traffic engineers desire additional guidance that is based on a thorough review of the literature and analysis of observational data.

The City of Portland has several bicycle signals in place and more are planned. Other Oregon communities are considering installations of bicycle-specific signals. ODOT is currently planning two bicycle-specific traffic signals. As more Oregon cities promote and expand the usage of signalized traffic control specific for bicycles, there is a need for research that will lead to the development of comprehensive engineering guidelines.

OBJECTIVES

This research will produce a synthesis of current practice and collect important observational data that will inform critical engineering design and operational guidance.

More detailed information regarding the project and its objectives can be found at the link below:

http://www.oregon.gov/ODOT/TD/TP_RES/ActiveProjectsV.shtml#SPR_747

PROPOSED ACTIVITIES

Task #1: Literature Review.

Task #2: Synthesis of Practice.

Task #3: Host Focus Group to Prioritize Design and Operations Issues.

Task #4: Field-based Observation of Bicyclist Performance Characteristics for Signal Operations

Task #5: Develop Evaluation Plan for Experimental Bicycle Signals.

Task #6: Final Report.

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

ACCOMPLISHMENTS

See Quarterly Reports at the link above.

RESPONSIBLE PARTIES

ODOT Research Section

ODOT Traffic Services

Portland State University (Agreement for $66,562 ending and fully expended by June 2013.)

COST INFORMATION

SPR 747	**FY'12**	**FY'13**	**FY'14**	**FY'15**	**TOTAL**
STAGE 2 BUDGET	$40,000	$79,000			**$119,000**
WORK PLAN BUDGET	$38,281	$38,281			**$76,562**
SPENT TO DATE	$ 14,228	$ 62,287	N/A		$ 76,515
REVISED BUDGET	**$ 14,228**	**$ 62,287**	**$ 2,000**	**$0**	**$ 78,515**
UTC Contribution (OTREC)	$50,000	$14,062			$64,062

FY'13 expenditures are estimated.

750 STRENGTHENING METHODS FOR DEFICIENT FLEXURAL STEEL ANCHORAGES IN BRIDGE GIRDERS

OVERVIEW

Many of Oregon's reinforced concrete deck girder(RCDG) bridges built in the 1950's have significant diagonal shear cracks. Because flexural steel anchorages in RCDG bridges have limited reserve capacity and no proven flexural strengthening methods have been validated, otherwise serviceable bridges cannot be effectively rehabilitated and may need to be replaced or posted.

Carbon fiber reinforced polymer (CFRP) strips adhered to the concrete surface is the most expedient method for flexural strengthening, but strengthening for flexure near a crack is problematic because the crack tends to cause the strips to peel away when loaded. Near-surface mounted carbon fiber reinforced polymer (NSM-CFRP) may be an effective strengthening system even near cracks. However this technique has not been proven specifically for strengthening the steel reinforcement anchorages; therefore, design methods are lacking. In addition, because the retrofitted strengthening elements will be oriented across existing shear stirrups, the cut groove with fiber strip approach used for shear strengthening may need to be modified to avoid cutting the stirrups.

OBJECTIVES

The objective of the research is to provide proven options for strengthening the flexural anchorage on cracked reinforced concrete girders.

More detailed information regarding the project and its objectives can be found at the link below:

http://www.oregon.gov/ODOT/TD/TP_RES/ActiveProjects.shtml#SPR_750

PROPOSED ACTIVITIES

Task #1: Literature Review and Materials Options Study.

Task #2: Laboratory Tests of Anchorages Retrofits.

Task #3: Analysis and Design of Anchorage Retrofits.

Task #4: Reporting.

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

ACCOMPLISHMENTS.

(See Quarterly Reports at the link above.)

RESPONSIBLE PARTIES

ODOT Research Section

ODOT Bridge Engineering Section

Oregon State University (Agreement for $360,000 ending December 2014, with $215,000 expended by June 2013.)

COST INFORMATION

SPR 750	**FY'13**	**FY'14**	**FY'15**	**FY'16**	**TOTAL**
STAGE 2 BUDGET	$139,000	$183,000	$ 48,000		**$370,000**
WORK PLAN BUDGET	$240,000	$125,000	$5,000		**$370,000**
SPENT TO DATE	$225,000	N/A			**$225,000**
REVISED BUDGET	**$225,000**	**$125,000**	**$23,000**	**$0**	**$373,000**

FY'13 expenditures are estimated.

752 PROOF OF CONCEPT; GTFS DATA AS A BASIS FOR OPTIMIZATION OF LARGE SCALE TRANSIT NETWORKS

OVERVIEW

Most transit agencies use General Transit Feed Specification (GTFS) as a common format for describing characteristics of their transit network such as schedules, stop times, stop locations, trips and routes. ODOT lacks a tool to use the GTFS data to analyze the performance of the larger state or regional transit network.

OBJECTIVES

The project will develop a prototype computer-based open sourced tool that uses existing GTFS data. This data can be used to analyze existing state-wide and region-wide transit networks within Oregon.

More detailed information regarding the project and its objectives can be found at the link below:

http://www.oregon.gov/ODOT/TD/TP_RES/ActiveProjects.shtml#SPR_752

PROPOSED ACTIVITIES

Task #1: Perform a literature search on transit network analysis tools.

Task #2: Identify reports to be generated by the TNA software tool.

Task #3: Design, develop and implement the TNA software tool(s).

Task #4: Select a subset of GTFS data from Oregon transit agencies.

Task #5: Testing and Validation of the TNA software tool.

Task #6: Develop documentation of the different components of the TNA software tool.

Task #7: Prepare final report.

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

ACCOMPLISHMENTS

(See Quarterly Reports at the link above.)

RESPONSIBLE PARTIES

ODOT Research Section

ODOT Public Transit Division

Oregon State University (Agreement for $83,275 ending December 2013, with approximately $45,000 expended by June 2013.)

COST INFORMATION

SPR 752	**FY'13**	**FY'14**	**FY'15**	**FY'16**	**TOTAL**
STAGE 2 BUDGET	$40,000	$50,000			$90,000
WORK PLAN BUDGET	$ 49,500	$ 41,275	$ 0	$ 0	$ 90,775
SPENT TO DATE	$58,045	N/A			$58,045
REVISED BUDGET	$49,500	$32,730	$0	$0	$90,775

FY'13 expenditures are estimated.

753 TRANSPORTATION PERFORMANCE MEASURES FOR STATEWIDE OUTCOMES-BASED MANAGEMENT

OVERVIEW

Many of the performance measures that ODOT analyzes and reports on are used by individual units or sections but have the potential for broader applications, and others may be useful in tracking progress but do not provide the right type of information necessary to help make decisions. As a whole, these measures do not currently function together to draw a clear picture of how the transportation system is functioning.

This research project will build on existing efforts within the agency (e.g. alternative mobility measures research, safety performance measures, and Least Cost Planning / Mosaic) to identify decision making performance measures, outcome based performance measures, and consideration of other strategic planning measures, seeking to identify those indicators most informative, measurable, and consistent.

OBJECTIVES

This project will recommend a set of statewide transportation performance measures, as well as improved/enhanced data collection, analysis, and reporting methods that help to get the most benefit out of existing measures and that make possible the new measures which are better aligned with FHWA and State outcome areas and provide better support to decision making.

More detailed information regarding the project and its objectives can be found at the link below:

http://www.oregon.gov/ODOT/TD/TP_RES/ActiveProjects.shtml#SPR_753

PROPOSED ACTIVITIES

Task #1: Synthesis of Goals Areas.

Task #2: Performance Measure Inventory and Assessment.

Task #3: Literature Review and External Interviews.

Task #4: Preliminary Performance Measures.

Task #5: Data Assessment.

Task #6: Final Report.

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

ACCOMPLISHMENTS

(See Quarterly Reports at the link above.)

RESPONSIBLE PARTIES

ODOT Research Section

ODOT Planning Section

Cambridge Systematics (Agreement for $188,420 ending in March 2014 with approximately $125,000 expended through June 2013.)

COST INFORMATION

SPR 753	**FY'13**	**FY'14**	**FY'15**	**FY'16**	**TOTAL**
STAGE 2 BUDGET	$64,000	$96,000			**$160,000**
WORK PLAN BUDGET	$100,210	$ 98,710	$0	$0	$198,920
SPENT TO DATE	$160,500	N/A			**$160,500**
REVISED BUDGET	**$160,500**	**$ 38,920**	**$ 0**	**$ 0**	**$199,420**

FY'13 expenditures are estimated.

754 DESIGN AND IMPLEMENTATION OF PEDESTRIAN AND BICYCLE-SPECIFIC DATA COLLECTION METHODS IN OREGON

OVERVIEW

There is extensive experience, equipment, and procedures to collect and analyze continuous and short duration motorized vehicle count data. These data have many valuable uses for the transportation agencies support safety, forecasting, and performance monitoring activities. This is not the case for non-motorized travel.

There is a need for pedestrian and bicycle count data to properly design improvements on sidewalks, crosswalk, cycle tracks, bike boxes, and signalized traffic crossings (green time allocation, pedestrian and bicycle-specific signals, dedicated signal phases). In addition, non-motorized volume data are needed to evaluate the performance of new investments, as input for new safety analysis tools used in the AASHTO *Highway Safety Manual*, to inform health assessments, and to assess multimodal transportation trends.

OBJECTIVES

This proposal focuses on research and evaluation of pedestrian and bicycle available collection methods, data retrieval and storage, and data analysis. The outcome of this research will be a plan for long-term implementation and data collection guidance. The implementation plan will identify a minimum level of hardware placement to start the program and how to invest in data collection over time as resources become available.

More detailed information regarding the project and its objectives can be found at the link below:

http://www.oregon.gov/ODOT/TD/TP_RES/ActiveProjects.shtml#SPR_754

PROPOSED ACTIVITIES

Task #1: Identification of Best Data Collection Programs.

Task #2: Review of Data Collection Technologies.

Task #3: Synthesis of Practice and Issues Regarding Spatial/Temporal Sampling and Factoring.

Task #4: Identify Oregon Data Collection Practices, Data Gaps, and Data Needs.

Task #5: Develop Implementation Guidance for Pedestrian and Bicycle Count Data Collection.

Task #6: Project Report.

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

ACCOMPLISHMENTS

(See Quarterly Reports at the link above.)

RESPONSIBLE PARTIES

ODOT Research Section

ODOT Traffic and Roadway Design Section

ODOT active Transportation Section

ODOT Transportation Safety Division

Portland State University (agreement for $137,000 ending March 2014 with approximately $38,000 expended through June 2013).

COST INFORMATION

SPR 754	**FY'13**	**FY'14**	**FY'15**	**FY'16**	**TOTAL**
STAGE 2 BUDGET	$62,000	$83,000			**$145,000**
WORK PLAN BUDGET	$73,000	$73,000	$ -	$ -	**$146,000**
SPENT TO DATE	$43,194	N/A			**$43,194**
REVISED BUDGET	**$43,194**	**$81,009**	**$ -**	**$ -**	**$146,000**

FY'13 expenditures are estimated.

755 PERFORMANCE BASED SELECTION OF RAP-RAS IN ASPHALT MIXTURES

OVERVIEW

ODOT currently uses recycled asphalt materials (RAM), which are is typically recycled asphalt pavement (RAP) and recycled asphalt shingles (RAS), to help reduce the costs. The current limits on RAM are restricted based upon local and national experience. The intent of this study is to use performance based tests to evaluate mixtures with increased RAM content, resulting in minimizing the potential cost, and providing environmental and performance benefits.

ODOT currently allows the use of RAM in its HMAC without any adjustments to the virgin binder grade. The effect of the recycled asphalts on the final binder grading is unknown. This may lead to a HMAC product that is more susceptible to early fatigue or thermal cracking. This study will also explore approaches to evaluate the selection of appropriate binder grade.

OBJECTIVES

Guidelines will be developed for selecting RAM content by using binder and mix performance criteria. A study will be conducted to identify binder and mix properties related to cracking and permanent deformation. Acceptable properties will be established by an evaluation of a range of lab produced mixtures, with subsequent validation by trial projects and testing of plant produced mix. In the absence of a full suite of performance tests, blended binder properties targets could be the criteria, however the ultimate goal will be to establish minimum criteria for mix properties with particular focus on how to determine the impacts on age related, cold temperature and fatigue cracking. Also, appropriate triggers will be developed for virgin binder replacement percentages and/or base binder grade changes to accommodate the effects of the RAM and develop a RAM QC/QA testing program.

More detailed information regarding the project and its objectives can be found at the link below:

http://www.oregon.gov/ODOT/TD/TP_RES/ActiveProjects.shtml#SPR_755

PROPOSED ACTIVITIES

Task #1: Literature Review.

Task #2: Develop a Work Plan.

Task #3: Collect Field Data and Materials.

Task #4: Laboratory tests.

Task #5: Construct Test Sections.

Task #6: Evaluate Results.

Task #7: Report.

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

ACCOMPLISHMENTS

(See Quarterly Reports at the link above.)

RESPONSIBLE PARTIES

ODOT Research Section

ODOT Pavement Services Unit

Oregon State University (Agreement for $134,000 ending March 2014 with approximately $43,467 expended through June 2013.)

COST INFORMATION

SPR 755	**FY'13**	**FY'14**	**FY'15**	**FY'16**	**TOTAL**
STAGE 2 BUDGET	$64,000	$96,000			**$160,000**
WORK PLAN BUDGET	$ 85,053	$ 74,947	$0	$0	**$160,000**
SPENT TO DATE	$72,570	N/A			**$72,570**
REVISED BUDGET	**$72,570**	**$87,430**	**$0**	**$0**	**$160,000**

FY'13 expenditures are estimated.

756 IMPROVED SAFETY PERFORMANCE FUNCTIONS FOR SIGNALIZED INTERSECTIONS

OVERVIEW

The 1st edition of the AASHTO *Highway Safety Manual* (HSM) was published in 2010 and included predictive safety performance functions (SPFs) for rural two-lane, rural multi-lane, and urban and suburban arterials. Interestingly, the currently adopted SPFs and their associated predictive methods do not explicitly address intersection approach speed. The goal of this research effort is to develop signalized SPFs for a range of approach speeds so as to determine how the speed influences safety at these locations.

OBJECTIVES

The project will prepare a brief that will help ODOT and other Oregon agencies understand how to apply the Highway Safety Manual (HSM) Safety Performance Factors (SPFs) for signalized intersection locations. This effort may include the creation of a "smart" spreadsheet or similar if appropriate. The project team will make recommendations to ODOT about the use of these SPFs and how they compare to the current methods provided in the HSM.

More detailed information regarding the project and its objectives can be found at the link below:

http://www.oregon.gov/ODOT/TD/TP_RES/ActiveProjects.shtml#SPR_756

PROPOSED ACTIVITIES

Task #1: Complete a Literature Review.

Task #2: Develop a Data Collection Plan.

Task #3: Collect Data.

Task #4: Develop ADT Estimation Procedure.

Task #5: Develop SPFs or CMFs.

Task #6: Prepare User Guide.

Task #7: Prepare and Submit Final Project Report.

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

ACCOMPLISHMENTS

(See Quarterly Reports at the link above.)

RESPONSIBLE PARTIES

ODOT Research Section

ODOT Traffic and Roadway Design Section

Texas Transportation Institute. (Agreement for $83,000 ending September 2014 with approximately $14,000 expended through June 2013.)

Portland State University. (Agreement for $72,000 ending September 2014 with approximately $5,000 expended through June 2013.)

COST INFORMATION

SPR 756	**FY'13**	**FY'14**	**FY'15**	**FY'16**	**TOTAL**
STAGE 2 BUDGET	$60,000	$95,000		$0	**$155,000**
WORK PLAN BUDGET	**$ 30,000**	$105,000	$ 29,500	$0	**$164,500**
SPENT TO DATE	$10,000	N/A	N/A	$0	**$10,000**
REVISED BUDGET	**$10,000**	**$105,000**	**$49,500**	**$0**	**$164,500**

FY'13 expenditures are estimated.

757 BLUETOOTH DATA COLLECTION SYSTEM FOR PLANNING AND ARTERIAL MANAGEMENT

OVERVIEW

An OSU research team has completed research that, in conjunction with a software application in development, will allow ODOT's ITS Unit to monitor transportation system travel times and provide more complete and timely traveler information to the public at a low cost. The research proposed in this problem statement will build on this completed research and more fully explore how wireless technology can be used to support planning and traffic operations data collection and analysis needs.

OBJECTIVES

- Develop a portable system for wireless automatic collection of vehicle movement data.
- Use the system to complete Origin-Destination study data collection.
- Collect data for simulation models and assess how the results compare to standard practice.
- Apply the system to monitor intersection performance.
- Apply the system to monitor the performance of arterials and advanced traffic signal systems.

More detailed information regarding the project and its objectives can be found at the link below:

http://www.oregon.gov/ODOT/TD/TP_RES/ActiveProjects.shtml#SPR_757

PROPOSED ACTIVITIES

Task # 1: Portable Data Collection System Design.

Task # 2: Development and Testing of Prototype Portable Data Collection System.

Task # 3: Data Processing Software Application Development.

Task # 4: Conduct a Field Test of Vehicle Origin-Destination Data Collection.

Task # 5: Conduct Field Tests of Traffic Analysis Data Collection.

Task # 6: Conduct Field Tests of Intersection Performance Data Collection.

Task # 7: Assess the Accuracy of Point Detection and Conduct Tests to Evaluate the Ability to Identify Non-vehicle Traffic.

Task # 8: Prepare Final Report.

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

ACCOMPLISHMENTS

(See Quarterly Reports at the link above.)

RESPONSIBLE PARTIES

ODOT Research Section

ODOT Traffic and Roadway Design Section

ODOT Planning Section

Oregon State University (Agreement for $215,016 ending March 2014 with approximately $102,500 expended through June 2013.)

COST INFORMATION

SPR 757	**FY'13**	**FY'14**	**FY'15**	**FY'16**	**TOTAL**
STAGE 2 BUDGET	$ 90,000	$135,000			**$225,000**
WORK PLAN BUDGET	**$112,508**	$112,508	$ -	$ -	**$ 225,016**
SPENT TO DATE	$112,508	N/A			**$112,508**
REVISED BUDGET	**$112,508**	**$112,508**	**$ -**	**$ -**	**$ 225,016**
PacTrans	**$53,000**				**$53,000**

FY'13 expenditures are estimated.

758 APPROPRIATE WIDTH OF FILTER STRIPS FOR NATURAL DISPERSION OF STORMWATER IN WESTERN OREGON

OVERVIEW

Infiltration is being emphasized as an important technique for managing stormwater. Dispersion of highway runoff in roadside filter strips or separate dispersal areas is a cost effective stormwater management technique that provides both water quality and flow control benefits. Determining the width of the dispersion area needed to infiltrate the design storm is necessary to identify the amount of right-of-way needed and if additional BMPs are required. Research to establish an equation for sizing dispersion areas in western Oregon is needed.

OBJECTIVES

The objective of this research is to expand the data set and understanding of Washington's LID Design Equation" to the point that an equivalent design approach that is applicable to western Oregon can be developed.

More detailed information regarding the project and its objectives can be found at the link below:

http://www.oregon.gov/ODOT/TD/TP_RES/ActiveProjects.shtml#SPR_758

PROPOSED ACTIVITIES

Task #1: Literature and Project Review.

Task #2: Assess Available Data and Determine Knowledge Gaps; Design Study; Purchase Equipment.

Task #3: Perform and Analyze Instrumented Field Study.

Task #4: Assess runoff generation and infiltration capacity relationships.

Task #5: Develop Design Guidance.

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

ACCOMPLISHMENTS

(See Quarterly Reports at the link above.)

RESPONSIBLE PARTIES

ODOT Research Section

ODOT Geo-Environmental Section

Oregon State University

COST INFORMATION

SPR 758	**FY'13**	**FY'14**	**FY'15**	**FY'16**	**TOTAL**
STAGE 2 BUDGET	$57,000	$114,000	$114,000		**$285,000**
WORK PLAN BUDGET	$40,299	$144,788	$118,007		**$303,094**
SPENT TO DATE	$40,299	N/A	N/A		**$40,299**
REVISED BUDGET	**$40,299**	**$144,788**	**$118,007**		**$303,094**

FY'13 expenditures are estimated.

759 CAPTURING MULTIMODAL COMPARISONS IN FREIGHT PROJECT PRIORITIZATION

OVERVIEW

Existing tools used to compare multi-modal investments are not sufficient to measure their economic and environmental impact or accurately evaluate tradeoffs between modes. Previous studies resulted in identifying new and supplemental multimodal freight investment criteria, including the ConnectOregon program, but did not identify any methodologies for prioritizing multimodal investment projects using these criteria.

OBJECTIVES

Previous work has identified the need to evaluate the impact of a modal project on other modes, but failed to describe how existing tools (if any exist) would perform the calculations and any inconsistencies between modal calculations that might affect comparisons. This project will develop a methodology to make comparisons across modes for use in intermodal comparison purposes and it will clearly identify the analytical gaps, and where possible, make recommendations for feasible solutions.

More detailed information regarding the project and its objectives can be found at the link below:

http://www.oregon.gov/ODOT/TD/TP_RES/ActiveProjects.shtml#SPR_759

PROPOSED ACTIVITIES

Task #1: Identify the most commonly used methods in project evaluation at transportation agencies.

Task #2: Identify approaches recommended in the academic literature, but not necessarily used by transportation agencies.

Task #3: Review the literature on project evaluation for road, rail, and marine projects identified in Tasks 1 and 2 and identify up to 10 methods for further investigation.

Task #4: Establish the features of the methods that prevent accurate comparisons across modes.

Task #5: Evaluate the impact of the methodological differences on cost and, where possible, emissions in terms of generally under or over estimating values.

Task #6: Recommend approaches to fill the most significant methodological gaps identified in.

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

ACCOMPLISHMENTS

(See Quarterly Reports at the link above.)

RESPONSIBLE PARTIES

ODOT Research Section

ODOT Planning Section

Oregon State University (Agreement for $75,000 with approximately $30,000 expended through June 2013.)

University of Washington (Agreement for $75,000 with approximately $33,000 expended through June 2013.)

COST INFORMATION

SPR 759	**FY'13**	**FY'14**	**FY'15**	**FY'16**	**TOTAL**
STAGE 2 BUDGET	$45,000	$85,000			**$130,000**
WORK PLAN BUDGET	$86,505	$71,495			**$158,000**
SPENT TO DATE	$66,134	N/A	$-		**$66,134**
REVISED BUDGET	**$66,134**	**$91,866**	**$-**	**$-**	**$158,000**
UTC Funding	**$60,000**				**$60,000**

FY'13 expenditures are estimated.

760 MULTIMODAL PERFORMANCE MEASURES: DEVELOPING A TRANSPORTATION COST INDEX

OVERVIEW

Recent federal and state laws are placing increasing emphasis on using comprehensive transportation performance measures that include mobility, safety, economy, livability, equity, and environment to guide transportation decision making. Proof-of-concept research in SPR 375 developed a Transportation Cost Index (TCI) for use in comparing transportation performance outcomes for different modes in common terms. The TCI accomplishes this by building on the concept of the widely-used Consumer Price Index (CPI). As a result of the logic appeal of the TCI and the proof-of-concept research, this measure was adopted by the Accessibility Indicator Development Team (IDT) for the Oregon LCP project. The aim of this research project is to advance the TCI from the proof-of-concept stage to implementation in transportation performance measurement and decision-making at the state, MPO, and community levels.

OBJECTIVES

The goal of this research is to develop, evaluate, and operationalize the TCI for immediate implementation in state-wide application as a comprehensive multi-modal performance measure capable of combining modes, transportation infrastructure and services, and land use information. To reach this goal, this research aims to subject the TCI prototype developed at ODOT to a rigorous academic investigation, identify and evaluate data sources, operationalize and test TCI measure for validity in three locations of different scales in Oregon, and prepare it for adoption in state-wide applications.

More detailed information regarding the project and its objectives can be found at the link below:

http://www.oregon.gov/ODOT/TD/TP_RES/ActiveProjects.shtml#SPR_760

PROPOSED ACTIVITIES

This project is under development in June of 2013. 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 June of 2013. Once it begins, accomplishments may be viewed by selecting Quarterly Reports at the link above.

RESPONSIBLE PARTIES

ODOT Research Section

ODOT Planning Section

Portland State University (agreement in development)

COST INFORMATION

SPR 760	**FY'14**	**FY'15**	**FY'16**	**FY'17**	**TOTAL**
STAGE 2 BUDGET	$50,000	$100,000		$0	**$150,000**
WORK PLAN BUDGET					
SPENT TO DATE					
REVISED BUDGET					

761 EVALUATION OF WEATHER BASED VARIABLE SPEED LIMIT SYSTEMS

OVERVIEW

Increasingly, variable speed limit (VSL) and variable advisory speed (VAS) systems have been used around the world, and in the U.S., to provide traffic- and weather-responsive guidance for drivers in order to achieve the goals mentioned above. By sensing the traffic and/or weather conditions, advisory speed limits can be displayed that are suited to real-time conditions and can warn drivers about congestion and speed conditions ahead. While shown to be cost-effective, ATM and specifically VSL do require significant investments in hardware and software, data collection/management and maintenance. In an environment of limited resources clear criteria are needed to aid in deployment decisions.

Two VSL projects being deployed in Oregon, with five additional systems under various levels of development in the state. ODOT is currently constructing an ATM Project along **OR 217**, which is operating at or above capacity with closely spaced interchanges and crash rates and congestion higher than regional averages. The OR 217 ATM Project includes variable advisory speeds (based on measured flows and speeds), posting real time travel times, queue warning, and a weather responsive curve warning system spanning seven miles of highway.

The **US 26 and OR 35** Mt. Hood Safety and Traveler information project (67 miles) will install a VSL and variable message sign (VMS) system to improve safety along this corridor (a large percentage of crashes occur on snow and ice, linked to inexperienced and overconfident drivers traveling too fast for conditions). A Road Weather Information System (RWIS) will collect real-time winter weather information at along US 26 and OR 35 to allow precise conditions to be monitored. The completed weather-controlled VSL on both corridors will utilize traffic speed and volume detection, weather information, and road surface condition technology to determine appropriate speeds at which drivers should be traveling. These advisory or regulatory speeds will then be displayed on overhead or roadside VMS or dynamic message signs (DMS).

OBJECTIVES

The goal of this project is to evaluate the effectiveness of two new active traffic management (ATM) system projects featuring VSL and VAS components being installed on OR 217 (urban) and US 26/OR 35 (rural/mountain), to aid in optimizing the operation of these systems as well as laying the groundwork for future implementations of ATM and VSL systems across the state. The two systems in Region 1 are the first of potentially many more projects to be implemented.

More detailed information regarding the project and its objectives can be found at the link below:

http://www.oregon.gov/ODOT/TD/TP_RES/ActiveProjects.shtml#SPR_761

PROPOSED ACTIVITIES

Task #1: Initial Reconnaissance.

Task #2: Field and Corridor Reconnaissance.

Task #3: Select Study Corridors.

Task #4: Experimental Design.

Task #5: Pilot Study.

Task #6: Corridor Study.

Task #7: Evaluation and Recommendations.

Task #8: Final Report.

This project is under development in June of 2013. 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 June of 2013. Once it begins, accomplishments may be viewed by selecting Quarterly Reports at the link above.

RESPONSIBLE PARTIES

ODOT Research Section

ODOT Region 1 Traffic

ODOT ITS Unit

COST INFORMATION

SPR 761	**FY'14**	**FY'15**	**FY'16**	**FY'17**	**TOTAL**
STAGE 2 BUDGET	$ 45,500	$ 89,000	$ 45,500	$0	**$180,000**
WORK PLAN BUDGET					
SPENT TO DATE					
REVISED BUDGET					

762 HIGH STRENGTH STEEL REINFORCEMENT FOR BRIDGES

OVERVIEW

High strength steel reinforcement, specifically ASTM A706 Grade 80, is now permitted by the AASHTO LRFD Bridge Design Specifications for use in reinforced concrete bridge components in non-seismic regions. However, state DOTs only allow Grade 80 reinforcing steel in bridge structural elements that are not expected to undergo large strain reversals (low cycle fatigue) during an earthquake. AASHTO and DOTs have concerns with using Grade 80 reinforcement in elements designed for low cycle fatigue due to the lack of experimental data. In addition, using Grade 80 reinforcement is only practical if it is used in all components on a job site to prevent the risk of using Grade 60 where Grade 80 should be used (most reinforcement looks the same).

OBJECTIVES

The objective of this research is to generate datasets of key mechanical properties for ASTM A706 Grade 80 reinforcing steel and modify design equations based on the datasets so that the high strength reinforcement can be used for structures in seismic regions.

More detailed information regarding the project and its objectives can be found at the link below:

http://www.oregon.gov/ODOT/TD/TP_RES/ActiveProjects.shtml#SPR_762

PROPOSED ACTIVITIES

Task #1: Literature review.

Task #2: Develop experimental design.

Task #3: Perform experimental testing program.

Task #4: Produce final report and disseminate findings.

This project is under development in June of 2013. 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 June of 2013. Once it begins, accomplishments may be viewed by selecting Quarterly Reports at the link above.

RESPONSIBLE PARTIES

ODOT Research Section

ODOT Bridge Section

Oregon State University (Agreement in development)

COST INFORMATION

SPR 762	**FY'14**	**FY'15**	**FY'16**	**FY'17**	**TOTAL**
STAGE 2 BUDGET	**$ 61,750**	$121,500	$ 61,750	$ 0	$ 245,000
WORK PLAN BUDGET					
SPENT TO DATE					
REVISED BUDGET					

763 MECHANISTIC DESIGN DATA

OVERVIEW

ODOT began implementation of Mechanistic design practices and principles starting in approximately 2003. At the time, implementation was as a secondary evaluation tool in asphalt concrete pavement design due to uncertainty in the design method precision, lack of ongoing calibration, and lack of data. Three pavement sites were instrumented across Oregon between 2004 and 2008 to gather data to help in moving the implementation of mechanistic design practices forward. Data from the sites was collected as part of a previous research project, but was not completely summarized or analyzed and a large part of the data is currently providing no useful benefit to ODOT. If these data are to be useful in ODOT's ongoing mechanistic pavement design calibration, the data from the instrumented sites needs to be reduced from its current "raw" format and evaluated.

OBJECTIVES

The objective of this research is to reduce and manipulate existing data and to the extent possible used it to calibrate and improve mechanistic design methods. Because the existing data have not yet been assessed, the researchers will assess the data and determine whether the existing data can be beneficial for improving design of pavements.

More detailed information regarding the project and its objectives can be found at the link below:

http://www.oregon.gov/ODOT/TD/TP_RES/ActiveProjects.shtml#SPR_763

PROPOSED ACTIVITIES

Task #1: Procure and assess data.

Task #2: Demonstrate a calculation process for at least one load application and the resulting strain.

Task #3: Evaluate the data, output the data to useable formats, and compare the results with other existing models used to predict strain in pavements.

Task #4: Provide a user-friendly computer program with user's guide for reducing future data.

Task #5: Prepare a Final Report

This project is under development in June of 2013. 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 June of 2013. Once it begins, accomplishments may be viewed by selecting Quarterly Reports at the link above.

RESPONSIBLE PARTIES

ODOT Research Section

ODOT Pavement Services

Oregon State University (agreement in development)

COST INFORMATION

SPR 763	**FY'14**	**FY'15**	**FY'16**	**FY'17**	**TOTAL**
STAGE 2 BUDGET	$ 44,250	$ 86,500	$ 44,250	$0	$175,000
WORK PLAN BUDGET					
SPENT TO DATE					
REVISED BUDGET					

764 ROAD MAP FOR CONNECTED VEHICLE/COOPERATIVE SYSTEMS

OVERVIEW

The U.S. DOT plans to fund future pilot deployments of mobility and environmental related applications in the coming years—likely including a set of regional pilots as well as smaller, more self-contained projects focused on priority applications. As connected vehicle research moves into deployment, state, local and transit agencies, metropolitan planning organizations and the private sector will start feeling the effects of vehicles and infrastructure with dedicated, short-range wireless communications connectivity at their cores. Along with other states and regions, ODOT can benefit from preliminary scoping, evaluation, and assessment of the impact of connected vehicles and infrastructure and a wide range of potential cooperative system applications.

OBJECTIVES

The goal of this project is to lay the groundwork for Oregon to be prepared to lead in the implementation of a connected vehicle/cooperative systems transportation portfolio, and/or to avoid being caught by surprise as developments in this area evolve quickly. The project will assess ODOT' s current internal mechanisms for addressing connected vehicle/cooperative systems, scan, review and assess technical maturity of potential connected vehicle/cooperative system applications, develop preliminary goals, link to prospective connected vehicle/cooperative systems applications, and refine/rank/prioritize those that fit with potential ODOT role in advancing/leading these initiatives. identify opportunities for linking ODOT's current programs with national and international connected vehicle/cooperative system research, testing and deployment initiative, and recommend a final shared vision and "road map" for Oregon's priority connected vehicle/cooperative system applications.

More detailed information regarding the project and its objectives can be found at the link below:

http://www.oregon.gov/ODOT/TD/TP_RES/ActiveProjects.shtml#SPR_764

PROPOSED ACTIVITIES

This project is under development in June of 2013. 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 June of 2013. Once it begins, accomplishments may be viewed by selecting Quarterly Reports at the link above.

RESPONSIBLE PARTIES

ODOT Research Section

ODOT Research Section

ODOT Planning Section

Portland State University (agreement in development)

COST INFORMATION

SPR 764	**FY'14**	**FY'15**	**FY'16**	**FY'17**	**TOTAL**
STAGE 2 BUDGET	$ 45,750	$ 89,500	$ 15,750	$0	$151,000
WORK PLAN BUDGET					
SPENT TO DATE					
REVISED BUDGET					

765 HIGH STRENGTH STEEL BARS AND CASING IN RESPONSE TO DRILLED SHAFTS

OVERVIEW

Drilled shafts provide significant geotechnical resistance for support of highway bridges, and are used throughout the State of Oregon to meet its structural foundation requirements. Due to changes in construction methods and poor near-surface soils, the use of permanent steel casing for drilled shaft installation has increased. However, geotechnical design models for axial and lateral resistance of drilled shafts are largely based on soil-concrete interfaces, not soil-steel interfaces associated with large diameter steel casing. Owing to the increased understanding of our regional seismic hazards, the amount of steel reinforcement used in drilled shaft construction has increased over the past several decades. This creates a new construction concern for engineers: the increased steel area results in a reduced clearance between adjacent reinforcement bars in the steel cage, such that concrete has an increased difficulty in penetrating the cage, increasing the likelihood for voids and defects within the shaft, which can lead to poor structural and geotechnical performance. The use of high-strength reinforcement steel can lead to increased clearance within the steel cage, mitigating concreting issues. The use of steel casing and the amount of steel area control the axial and lateral resistance of the shaft. Thus, existing approaches need to be evaluated for modern construction methods, and new approaches developed if necessary to ensure desired performance criteria are met.

OBJECTIVES

The objectives of this research are to study the impact of steel casing and high-strength steel reinforcement on the axial and lateral behavior of full-scale drilled shaft foundation elements and to evaluate the appropriateness of existing ODOT design procedures. If necessary, new procedures incorporating the effect of steel casing and high-strength steel reinforcement will be developed. If selected, the Association of Drilled Shaft Contractors (ADSC) and PacTrans will contribute effort and funding to help accomplish these objectives. This project will also evaluate shafts installed at the OSU geotechnical test site 17 years ago by a joint FHWA/ADSC research venture such that interesting side-by-side geotechnical and structural aging effects can be determined.

More detailed information regarding the project and its objectives can be found at the link below:

http://www.oregon.gov/ODOT/TD/TP_RES/ActiveProjects.shtml#SPR_765

PROPOSED ACTIVITIES

This project is under development in June of 2013. 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 June of 2013. Once it begins, accomplishments may be viewed by selecting Quarterly Reports at the link above.

RESPONSIBLE PARTIES

ODOT Research Section

ODOT Bridge Preservation Unit

Oregon State University (Agreement in development).

COST INFORMATION

SPR 765	**FY'14**	**FY'15**	**FY'16**	**FY'17**	**TOTAL**
STAGE 2 BUDGET	$ 57,500	$110,000	$110,000	$ 57,500	$ 335,000
WORK PLAN BUDGET					
SPENT TO DATE					
REVISED BUDGET					

766 EFFECTIVE MEASURES TO RESTRICT TURNING MOVEMENTS

OVERVIEW

In Oregon, a highway access right does not guarantee a full turn highway road approach. ODOT has occasionally imposed a non-traversable median for an approach when deemed necessary to restrict vehicle turn movements so as to ensure an approach operates safely under the circumstances. Recent focus on supporting economic development has raised awareness of the need for other effective ways to restrict vehicle turn movements with less impact on businesses and freight movement.

This proposed effort will research and develop design guidelines or standards/targets for effective measures to restrict vehicle turn movements at private approaches. The ODOT *Highway Design Manual*, Chapter 9.0, provides general design standards for private road approaches; however, it does not contain design guidelines or standards for measures intended to restrict vehicle turn movements at approaches. ODOT needs performance-based information and data on the efficacy of a range of measures used to restrict vehicle turn movements in order to make objective decisions that are based on quantifiable information and provide options to help facilitate turning movements at these approach locations.

OBJECTIVES

The objective of this research is to support recent changes to ORS 374.312(10)(c) to determine and provide guidance for effective measures to restrict vehicle turning movements. At the conclusion of this research, ODOT will have a recommended list of alternative approach treatments, other than just the use of a non-traversable median, for various prevailing traffic conditions and guidelines for their selection and application in Oregon.

More detailed information regarding the project and its objectives can be found at the link below:

http://www.oregon.gov/ODOT/TD/TP_RES/ActiveProjects.shtml#SPR_766

PROPOSED ACTIVITIES

This project is under development in June of 2013. 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 June of 2013. Once it begins, accomplishments may be viewed by selecting Quarterly Reports at the link above.

RESPONSIBLE PARTIES

ODOT Research Section

ODOT Access Management Unit

COST INFORMATION

SPR 766	**FY'14**	**FY'15**	**FY'16**	**FY'17**	**TOTAL**
STAGE 2 BUDGET	$ 72,500	$ 72,500	$0	$0	$145,000
WORK PLAN BUDGET					
SPENT TO DATE					
REVISED BUDGET					

767 DESIGN TREATMENTS FOR RIGHT TURNS AT INTERSECTIONS WITH BICYCLE TRAFFIC

OVERVIEW

Most bicycle-motor vehicle crashes occur at intersections in urban areas—with crashes involving right-turning vehicles and through bicycles ("the right-hook") being the most common. In Oregon, data from 2007-2010 indicate that of 3,163 bicycle-vehicle crashes 66% occur at intersections and 35% of those can be typed as involving a right-turning vehicle and through cyclist. While drivers must legally yield the right-of-way to cyclists in bicycle lanes, drivers often fail to see cyclists or misjudge the gap of the approaching cyclist. In addition, cyclists do not always position themselves to be readily seen or approach at high rates of speed. These factors contribute to the occurrence of right-hook crashes.

A variety of passive and active traffic control measures and geometric designs have been implemented. Treatments include pavement markings, static signs, bicycle-activated signs, green bike lanes, contrasting pavement colors, tactile treatments, raised bike lanes, buffer space, shared right-turn lanes, and cycle tracks. The intent of these design treatments is to improve the awareness of the conflict point for both cyclists and drivers and ultimately improve safety. The relative effect that each of these designs has on the failure modes is not readily known.

OBJECTIVES

The overall goal of the proposed research is to quantify the safety performance of alternative traffic control strategies to mitigate right-turning vehicle-bicycle crashes at intersections in Oregon. The performance will be quantified with objective data gathered from OSU's driving & bicycling simulator validated through field observation.

More detailed information regarding the project and its objectives can be found at the link below:

http://www.oregon.gov/ODOT/TD/TP_RES/ActiveProjects.shtml#SPR_767

PROPOSED ACTIVITIES

This project is under development in June of 2013. 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 June of 2013. Once it begins, accomplishments may be viewed by selecting Quarterly Reports at the link above.

RESPONSIBLE PARTIES

ODOT Research Section

ODOT Active Transportation Section

Portland State University (Agreement in development)

Oregon State University (Agreement in development)

COST INFORMATION

SPR 767	**FY'14**	**FY'15**	**FY'16**	**FY'17**	**TOTAL**
STAGE 2 BUDGET	$ 51,000	$101,000	$ 9,500	$0	$161,500
WORK PLAN BUDGET					
SPENT TO DATE					
REVISED BUDGET					

768 CROWDSOURCING AS A DATA COLLECTION METHOD FOR BICYCLE PERFORMANCE MEASURES

OVERVIEW

Currently, ODOT does not have a system to collect bicycle and network usage information or a method to locate areas with low connectivity or poor user experience. Given the inaccuracy, user burden, and cost of traditional surveys (e.g. Oregon Household Activity Survey) along with the rapid penetration of smartphones; there is great potential associated with the development of smartphone applications to complement/reduce the cost of traditional data collection tools.

OBJECTIVES

This research will take advantage of recent smartphone technological advances and crowdsourcing to gather bicycle route data and identify deficient segments/facilities. The key objective is to design a cost-effective data collection method to feed ODOT's growing active transportation performance measures and investment prioritization needs.

More detailed information regarding the project and its objectives can be found at the link below:

http://www.oregon.gov/ODOT/TD/TP_RES/ActiveProjects.shtml#SPR_768

PROPOSED ACTIVITIES

This project is under development in June of 2013. 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 June of 2013. Once it begins, accomplishments may be viewed by selecting Quarterly Reports at the link above.

RESPONSIBLE PARTIES

ODOT Research Section

ODOT Active Transportation Section

ODOT Planning Section

Portland State University (agreement in development).

COST INFORMATION

SPR 768	**FY'14**	**FY'15**	**FY'16**	**FY'17**	**TOTAL**
STAGE 2 BUDGET	$ 74,740	$112,110	$0	$0	$186,850
WORK PLAN BUDGET					
SPENT TO DATE					
REVISED BUDGET					

769 SAFE AND EFFECTIVE SPEED REDUCTIONS FOR FREEWAY WORK ZONES PHASE 2

OVERVIEW

In response to requests from the Associated General Contractors (AGC) Oregon-Columbia Chapter, ODOT began a research study in FY2013 (SPR-751) to look for ways to safely reduce speeds through work zones on preservation projects taking place on high-speed freeways. Freeway preservation projects typically require traffic lane reductions to allow workers to rehabilitate worn pavements. During lane closures, work activities take place immediately adjacent to live traffic – traffic that is often travelling at high speeds. ODOT is interested in strategies to safely reduce these speeds and subsequently improve the overall safety of the work zone for drivers and for workers.

Phase 1 of this study (SPR 751) included two paving projects, one on I-84 near The Dalles and one on I-5 just north of the McKenzie River Bridge. On each project, different traffic control measures (TCMs) were implemented and speed data was collected both prior to and within the work zone.

OBJECTIVES

The proposed research comprises augmenting the SPR-751 study to address the issues and needs identified by the TAC. This proposal includes conducting two additional case study projects at a reduced cost. The additional case studies will be on paving projects similar to SPR-751, and include a reduced total number of treatments focused on the following specific traffic control measures: "SPEED 50" signs, PCMS signs on a roller(s) or a stationary trailer(s), and radar speed reader trailers. As with SPR-751, the overall goal of the proposed research is to assist ODOT with enhancing the safety of work zones on high-speed roadways.

More detailed information regarding the project and its objectives can be found at the link below:

http://www.oregon.gov/ODOT/TD/TP_RES/ActiveProjects.shtml#SPR_769

PROPOSED ACTIVITIES

This project is under development in June of 2013. Once it begins, more information on proposed activities can be found in the Project Work Plan at the link above.

As a continuation of the SPR-751 High Speed Reduction study, the proposed research involves conducting two additional case studies of paving projects on high-speed roadways. The tasks to be undertaken are similar to those on the present study, and are as follows:

Task #1: Select case study projects.

Task #2: Implement proposed TCMs.

Task #3: Data analysis.

Task #4: Documentation and dissemination.

ACCOMPLISHMENTS

This project is under development in June of 2012. Once it begins, accomplishments may be viewed by selecting Quarterly Reports at the link above.

RESPONSIBLE PARTIES

ODOT Research Section

ODOT Transportation Safety Division

Oregon State University (Agreement in development).

COST INFORMATION

SPR 769	**FY'14**	**FY'15**	**FY'16**	**FY'17**	**TOTAL**
STAGE 2 BUDGET	**$ 52,500**	$ 52,460	$0	$0	$104,960
WORK PLAN BUDGET					
SPENT TO DATE					
REVISED BUDGET					

770 IMPACT OF CASCADIA EARTHQUAKE ON SEISMIC EVALUATION CRITERIA OF BRIDGES

OVERVIEW

The seismic risk used for bridge design and retrofit is defined by hazard maps of ground acceleration values. To generate the maps, an algorithm called a Probabilistic Seismic Hazard Analysis (PSHA) is used to combine multiple regional sources of ground shaking. Each source has a different intensity, probability of occurrence, and distance to a specific location. For Oregon, one key source of ground shaking in the PSHA is from the Cascadia Subduction Zone (CSZ); however, a CSZ earthquake can have significantly different ground motion as a standalone event than what is captured in the values derived from the PSHA.

OBJECTIVES

The objective of this project is to provide ODOT with the best rational estimate of ground acceleration values for designing and retrofitting bridges.

More detailed information regarding the project and its objectives can be found at the link below:

http://www.oregon.gov/ODOT/TD/TP_RES/ActiveProjects.shtml#SPR_770

PROPOSED ACTIVITIES

Task #1: Literature review.

Task #2: Disaggregate PSHA data along highway routes.

Task #3: Contrast CSZ with PSHA design values.

Task #4: Contrast structural damage from subduction earthquakes.

Task #5: Evaluate the impact on the dual design criteria.

Task #6: Final Report and Recommendations.

This project is under development in June of 2013. 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 June of 2013. Once it begins, accomplishments may be viewed by selecting Quarterly Reports at the link above.

RESPONSIBLE PARTIES

ODOT Research Section

ODOT Bridge Section

Portland State University (Agreement in Development)

COST INFORMATION

SPR 770	**FY'14**	**FY'15**	**FY'16**	**FY'17**	**TOTAL**
STAGE 2 BUDGET	$ 50,500	$ 99,000	$ 50,500	$0	$ 200,000
WORK PLAN BUDGET					
SPENT TO DATE					
REVISED BUDGET					

771 RISK FACTORS ASSOCIATED WITH HIGH POTENTIAL FOR SERIOUS CRASHES

OVERVIEW

Crashes are random events and consequently, can occur at any location along the roadway. On roadways with higher traffic volumes, the more frequent occurrence of crashes allows for the direct identification of high crash locations using historical data. However, on local roads, crash occurrence, particularly fatal and serious injury crashes, is less frequent. This makes it difficult to identify trends and treat hazardous sites based on historical data. Geometric, traffic and other features may lend themselves toward crashes potentially happening in spot locations. Therefore, an approach to identifying these types of risk factors on low volume roads is necessary.

OBJECTIVES

The proposed research will identify risk factors and features that contribute to crashes along low volume roads and the cost effectiveness of countermeasures to address them. Research objectives include:

Identify risk factors and features that contribute to crash occurrence and which can be corrected by selected low cost countermeasures, with a specific focus on low and moderate volume roads with sporadic crash occurrence.

Develop a risk index of different factors and features that practitioners should look for and that can be addressed using selected low cost countermeasures along low and moderate volume roads.

Establish the cost effectiveness/thresholds for the low cost countermeasures that are selected for use in addressing risk factors on low to moderate volume roads.

Conduct limited case studies to demonstrate the use of the identified risk factors and application of the cost effectiveness thresholds that are developed.

More detailed information regarding the project and its objectives can be found at the link below:

http://www.oregon.gov/ODOT/TD/TP_RES/ActiveProjects.shtml#SPR_771

PROPOSED ACTIVITIES

This project is under development in June of 2013. 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 June of 2013. Once it begins, accomplishments may be viewed by selecting Quarterly Reports at the link above.

RESPONSIBLE PARTIES

ODOT Research Section

ODOT Traffic and Roadway Design Section

Western Transportation Institute (Agreement in development)

COST INFORMATION

SPR 771	**FY'14**	**FY'15**	**FY'16**	**FY'17**	**TOTAL**
STAGE 2 BUDGET	$ 53,833	$106,167	$0	$0	$160,000
WORK PLAN BUDGET					
SPENT TO DATE					
REVISED BUDGET					