

Fiscal 2012 – 2013  
BIENNIAL WORK PROGRAM  
STATE PLANNING AND RESEARCH

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**PART II – RESEARCH**

**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)**

June 2011

**Prepared by**

**Oregon Department of Transportation**

**In Cooperation With**

**FEDERAL HIGHWAY ADMINISTRATION**

Fiscal Years 2012 and 2013  
July 1, 2011 to June 30, 2013



# BIENNIAL WORK PROGRAM FOR STATE RESEARCH

## PART II – RESEARCH

Project SPR-PL-STP-PR12 (001)

July 1, 2011 to June 30, 2013

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**BIENNIAL WORK PROGRAM  
FOR STATE PLANNING AND RESEARCH (SPR)  
PART II – RESEARCH  
July 1, 2011 to June 30, 2013**

**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 surveillance 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:

- A. Solicit transportation users for research needs.
- B. Review all research problem statements and obtain the information necessary to formulate a research program.
- C. Chair Expert Task Groups in order to recommend promising research projects for Research Advisory Committee consideration.
- D. Select principal investigators and Technical Advisory Committee members for each project.
- E. Conduct literature research as required.
- F. In some cases, conduct research projects.
- G. 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.
- H. Promote the implementation of the research findings through distribution of research results to appropriate persons for their consideration and use.
- I. Provide expertise for ODOT in specialty areas pertaining to research and technology.
- J. Participate in state-sponsored seminars and training meetings to help implement new research findings.
- K. Provide a liaison with FHWA, universities, consultants, and other agencies conducting and supporting research for ODOT.
- L. Provide a continuous liaison and surveillance of progress and expenditures for all research projects.
- M. Provide liaison with the Transportation Research Board and the Cooperative Research Programs.
- N. Prepare annual and biennial budgets for research activities.
- O. 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'11 or anticipated for FY'12.

**RESEARCH SECTION ACTIVITIES IN ADDITION TO THE CORE RESEARCH PROGRAM**

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 2011 is \$544,996. The estimated level of direct support for FY 2012 is expected to be close to the FY’11 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 fees, and related services provided to the State by TRB. The annual fee for FY 2010, FY 2011 and FY 2012 is \$105,175. Funds for FY’11 were obligated through TPF 5(240), which included a surcharge of approximately 2.5% 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 eleven SPR Transportation Pooled Fund projects for FY 2011 and will participate in funding at least seven in FY 2012. Oregon initiated TPF-5(221) “Accelerated Bridge Construction (ABC) Decision Making and Economic Modeling Tool” and led that study in FY’10 and FY’11. In addition to TRB and NCHRP support, \$172,500 was committed to Pooled Fund projects in FY’11 and \$175,000 is targeted for FY’12.

**TABLE 1: COOPERATIVE RESEARCH**

Study No.	Title	FY’11	FY’12	FY’13
1264	Bulb-T Beam as Alternate ABC Side-By-Side Box Beam	\$20,000	\$ 0	\$ 0
1289	Executive Workshops for State DOTs to Support Commercialization of Electric Vehicles (EV) and Infrastructure	\$ 0	\$20,000	\$ 0
1290	Member-level Redundancy in Built-up Steel Members	\$10,000	\$10,000	\$ 0
1302	Tools for Evaluation of Gusset Plate Connections in Steel Truss Bridges	\$20,000	\$20,000	\$20,000
TPF-5(065)	Traffic Control Device Consortium	\$15,000	\$ 0	\$ 0
TPF-5(209)	Support for the Transportation Curriculum Coordination Council	\$15,000	\$15,000	\$15,000
TPF-5(220)	Accommodating Oversize/Overweight Vehicles at Roundabouts	\$15,000	\$ 0	\$ 0
TPF-5(221)	Accelerated Bridge Construction Decision Making & Economic Modeling Tool	\$0	\$ 0	\$ 0
TPF-5(227)	Advancements on LRFD for Foundations and other Geotechnical Features	\$ 20,000	\$ 0	\$ 0
TPF-5(237)	Transportation Library Connectivity and Development	\$15,000	\$ 0	\$ 0
TPF-5(238)	Standards to Eliminate Fracture Critical Concerns in Two Girder Bridges	\$10,000	\$10,000	\$0
TPF-5(241)	Western States Rural Transportation Consortium	\$2,500	\$2,500	\$2,500
TPF-5(247)	Field Testing Hand-held Thermographic Inspection Technologies	\$30,000	\$30,000	\$ 0
	Unidentified Projects	\$ 0	\$ 67,500	\$ 137,500
	<b>Subtotal for Pooled Fund Projects</b>	<b>\$ 172,500</b>	<b>\$ 175,000</b>	<b>\$ 175,000</b>
TPF 5(240)	TRB Subscription FY’11 <sup>1</sup>	\$26,951		
NA	TRB Subscription <sup>1</sup> FY’12 and FY’13		\$26,951	\$26,951
TPF-5(411)	2011 NCHRP Assessment <sup>1</sup>	\$136,239		
TPF-5(412)	2012 NCHRP Assessment <sup>1</sup>		\$136,239	
TPF-5(413)	2013 NCHRP Assessment <sup>1</sup>			\$136,239
	<b>Total</b>	<b>\$335,690</b>	<b>\$338,190</b>	<b>\$338,190</b>

<sup>1</sup>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 Research funds. The balance was covered with SPR Planning funds.

**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 \$325,000 through December 2010.

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 \$825,000 for the 2009-2011 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

### **TABLE 2: REVISED BIENNIAL BUDGET FOR FISCAL 2012 AND 2013**

#	TITLE	FY'12	FY'13	Project
				Total
300	SPR Admin	\$5,000	\$5,000	
301	SPR Project Development	\$200,000	\$200,000	
302	SPR Implementation	\$50,000	\$50,000	
303	Unidentified Projects		\$ 555,812	
304	Research Discretionary Fund	\$100,000	\$100,000	
	<b>Continuing Projects</b>			
642	Mechanistic Pavement Design Input Parameters	\$1,000	\$ -	\$183,626
658	Institutional Barriers to Incident Clearance.	\$1,000	\$ -	\$58,284
665	Access Management Best Practices Manual	\$1,000	\$ -	\$59,127
672	Mechanistic Pavement Design Instrumentation	\$1,500	\$ -	\$103,867
682	Replacing Thermal Sprayed Zinc Anodes	\$1,000	\$ -	\$230,881
686	Exposure to NOHM During Construction	\$1,000	\$ -	\$199,925
710	Analysis and Design of Pipe Ramming Installations	\$143,156	\$ -	\$346,533
711	Internal Curing of Concrete Bridge Decks	\$39,616	\$ -	\$234,838
712	Near-Surface Mounted CFRPs for Shear Strengthening	\$1,000	\$ -	\$412,135
713	Asphalt Binder Grade Selection for HMAC with RAP/RAS	\$8,509	\$ -	\$250,024
714	Feasibility of Using Safety Edge in Oregon	\$48,781	\$ -	\$126,424
715	Effect of Fluvial Performance Standard on Maintenance	\$9,170	\$ -	\$ 78,356
716	Supplemental Performance Measures for OHP Mobility Standards	\$45,738	\$ -	\$146,955
717	Relating TSMO Strategies to Policy Goals	\$42,000	\$ -	\$162,192
718	Mechanistic Design Guide Calibration for Pavement Rehabilitation	\$73,210	\$ -	\$165,299
719	Climate Change Impact on Coastal River Estuaries in Oregon	\$20,000	\$20,000	\$286,828
720	Quantifying Safety Performance of Driveways on State Highways	\$22,787	\$ -	\$133,912
721	Evaluation of Alternative Pedestrian Traffic Control Devices	\$33,000		\$123,067
728	Shrinkage Limits and Testing Protocols for High Performance Concrete	\$104,000	\$48,000	\$227,850
729	Criteria for Selection/Application of Advanced Traffic Signal Systems	\$123,000	\$ -	\$165,000
730	Copper removal from storm water runoff using fish bone meal	\$149,000	\$149,000	\$373,394
731	Underwater Noise Generation and Propagation from Pile Driving	\$103,500	\$45,500	\$248,500
732	Comparison of Pelletized Lime with other Anti-stripping Additives	\$118,426	\$47,075	\$186,239
733	Safety Performance Measures for Roundabout Applications in Oregon	\$99,392	\$42,708	\$148,000
734	Premature Asphalt Concrete Pavement Cracking	\$65,000	\$64,000	\$128,000
735	Measuring the Performance of Transit Relative to Livability	\$71,810	\$ -	\$117,845
736	Corrosion Monitoring System for Reinforced Concrete Structures	\$113,956	\$92,044	\$247,500
737	Wireless Data Collection System for Travel Time Estimation	\$61,000	\$ -	\$124,250
738	Determining Outsourcing Feasibility & Standard Pricing Methodologies	\$100,310	\$1,500	\$150,810
739	Characterizing Oregon's Supply Chains	\$43,000	\$30,500	\$106,000
	<b>New Projects</b>			
740	Impacts of Potential Seismic Landslides on Lifeline Corridors	\$75,000	\$125,000	\$265,000
741	Bridge Seismic Retrofit Measures Considering Subduction Earthquakes	\$61,000	\$121,500	\$283,000
742	Mitigating Effects of Chloride Deicer Exposure on Concrete	\$72,000	\$105,000	\$248,000
743	Variable Speed Limit System for Wet and Extreme Weather Conditions	\$40,000	\$80,000	\$160,000
744	Profiler repeatability and accuracy using the IRI model	\$50,000	\$55,000	\$105,000
745	Residential Location Choices for Transportation Decision Making	\$45,000	87,500	\$175,000
746	Use, Test & Evaluation of a Mobile Work Zone Barrier System	\$50,000	\$98,000	\$163,000
747	Operational Guidance for Bicycle-Specific Traffic Signals	\$40,000	\$79,000	\$119,000
	<b>Total</b>	\$2,433,861	\$2,202,139	
	<b>80 Percent Federal Funds</b>	\$1,947,089	\$1,761,711	
	<b>20 Percent State Funds</b>	\$486,772	\$440,428	

**TABLE 3: FY'12 RESEARCH PROGRAM FUNDING, INCLUDING UNIVERSITY  
TRANSPORTATION CENTER FUNDS**

#	TITLE	FY'12 ODOT	FY'12 UTC	Total ODOT	Total UTC
300	SPR Admin	\$5,000			
301	SPR Project Development	\$200,000			
302	SPR Implementation	\$50,000			
303	Unidentified Projects				
304	Research Discretionary Fund	\$100,000			
	<b>Continuing Projects</b>				
642	Mechanistic Pavement Design Input Parameters	\$1,000		\$183,626	
658	Institutional Barriers to Incident Clearance.	\$1,000		\$58,284	\$33,000 (1)
665	Access Management Best Practices Manual	\$1,000		\$59,127	\$42,500 (1)
672	Mechanistic Pavement Design Instrumentation	\$1,500		\$103,867	\$76,781 (1)
682	Replacing Thermal Sprayed Zinc Anodes	\$1,000		\$230,881	\$30,000 (3)
686	Exposure to NOHM During Construction	\$1,000		\$199,925	
710	Analysis and Design of Pipe Ramming Installations	\$143,156		\$346,533	
711	Internal Curing of Concrete Bridge Decks	\$39,616		\$234,838	
712	Near-Surface Mounted CFRPs for Shear Strengthening	\$1,000		\$412,135	
713	Asphalt Binder Grade Selection for HMAC with RAP/RAS	\$8,509		\$250,024	
714	Feasibility of Using Safety Edge in Oregon	\$48,781		\$126,424	
715	Effect of Fluvial Performance Standard on Maintenance	\$9,170		\$ 78,356	
716	Supplemental Performance Measures for OHP Mobility Standards	\$55,738		\$146,955	
717	Relating TSMO Strategies to Policy Goals	\$42,000		\$162,192	
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719	Climate Change Impact on Coastal River Estuaries in Oregon	\$20,000		\$286,828	
720	Quantifying Safety Performance of Driveways on State Highways	\$22,787		\$133,912	
721	Evaluation of Alternative Pedestrian Traffic Control Devices	\$33,000		\$123,067	
728	Shrinkage Limits and Testing Protocols for High Performance Concrete	\$104,000		\$227,850	
729	Criteria for Selection/Application of Advanced Traffic Signal Systems	\$123,000	\$52,667 (2)	\$165,000	\$96,000
730	Copper removal from storm water runoff using fish bone meal	\$149,000		\$373,394	
731	Underwater Noise Generation and Propagation from Pile Driving	\$133,500		\$278,500	
732	Comparison of Pelletized Lime with other Anti-stripping Additives	\$118,426		\$186,239	
733	Safety Performance Measures for Roundabout Applications in Oregon	\$99,392		\$148,000	
734	Premature Asphalt Concrete Pavement Cracking	\$65,000		\$128,000	
735	Measuring the Performance of Transit Relative to Livability	\$71,810	\$56,000 (1)	\$117,845	\$112,000
736	Corrosion Monitoring System for Reinforced Concrete Structures	\$113,956	\$40,000 (3)	\$247,500	\$70,000 (3)
737	Wireless Data Collection System for Travel Time Estimation	\$61,000	\$25,000 (1)	\$124,250	\$100,000
738	Determining Outsourcing Feasibility and Standard Pricing Methodologies	\$100,310		\$150,810	
739	Characterizing Oregon's Supply Chains	\$43,000	Pending (2)	\$106,000	
	<b>New Projects</b>				
740	Impacts of Potential Seismic Landslides on Lifeline Corridors	\$75,000		\$265,000	
741	Bridge Seismic Retrofit Measures Considering Subduction Earthquakes	\$61,000	Pending (1)	\$283,000	
742	Mitigating Effects of Chloride Deicer Exposure on Concrete	\$72,000	\$80,500 (3,4)	\$248,000	\$216,000
743	Variable Speed Limit System for Wet and Extreme Weather Conditions	\$40,000	Pending (3)	\$160,000	
744	Profiler repeatability and accuracy using the IRI model	\$50,000		\$105,000	
745	Residential Location Choices for Transportation Decision Making	\$45,000	Pending (1)	\$175,000	
746	Use, Test & Evaluation of a Mobile Work Zone Barrier System	\$50,000		\$163,000	
747	Operational Guidance for Bicycle-Specific Traffic Signals	\$40,000	Pending (1)	\$119,000	
	<b>TOTAL</b>	<b>\$2,472,861</b>	<b>\$173,748</b>	<b>\$7,073,661</b>	<b>\$776,281</b>

- 1.. Oregon Transportation Research Consortium (OTREC).
2. Transportation Northwest, University of Washington.
3. Western Transportation Institute.(WTI), University of Montana.
4. Alaska University Transportation Center (AUTC), University of Alaska Fairbanks.

## **300 RESEARCH ADMINISTRATION**

### **OBJECTIVES**

Research administration includes the planning, coordination, and surveillance of SPR research and related activities. Also included are the necessary costs that cannot be assigned to individual projects.

The overall research effort can be effective if the work is coordinated between the various sections having an interest and a concern. Planning input and surveillance of progress by the Research Section will reduce duplication of effort and will assist in assuring that research objectives are diligently pursued. Carefully planned research is effective in developing safer, more attractive, and more economical transportation facilities.

### **RELATIONSHIP OF OBJECTIVES TO OVERALL PROGRAM**

Research takes on additional significance in the face of the rapid deterioration of the highway infrastructure experienced in recent years. Although new revenues have been made available to ODOT through recent federal and state legislation, there is a backlog of work needed to bring the overall condition of the highway infrastructure up to desirable standards. The research effort contributes to the development of improved materials and methods, thus helping to optimize the use of available resources.

A recent development of prime interest is the establishment of OTREC, a National University Transportation Center (UTC) in Oregon. The establishment of a partnership with state universities will allow ODOT to substantially increase Oregon's total transportation research investment in ways that directly benefit ODOT.

### **PREVIOUS WORK**

The review of progress on work that is underway is a continuing activity. Periodically, draft reports on research projects nearing completion are reviewed. A major activity has been in the review and consideration of studies conducted by other agencies. These include a variety of pooled fund projects.

However a prime focus of activity has been on OTREC, its system of governance, focus and strategic plan. The ODOT Research Manager has been appointed to the OTREC Executive Committee. A large part of this work has been revisions to the ODOT project selection process to integrate ODOT project selection with the anticipated UTC project selection process. More recently, new administrative issues have emerged in project management, in particular managing and reconciling project budgets that include joint ODOT/OTREC funding.

A related focus has been the Northwest Universities Transportation Research Consortium (NUTRC). Given the fact that there is a national, Regional or Tier 1 UTC in each of the four states making up Region 10, an effort has been launched to create an agreement to serve as a framework for collaboration on research activities and funding within the region, that includes at

least eight universities and four state DOT research programs. In this regard there have been meetings in Fairbanks, AK, Seattle, WA, Portland, OR, and Moscow, ID. Recently the regional consortium was joined by both Montana DOT and Western Transportation Institute (WTI), the National UTC at Montana State University. More recently the ODOT research manager was invited to join the WTI Research Advisory Committee.

**PROPOSED MAJOR ACTIVITIES AND ACCOMPLISHMENTS**

Effort will continue to focus on the development and coordination of a more effective research effort, and on providing recommendations for the implementation of promising research findings. In addition, the continued development of ODOT’s relationship with OTREC and the Northwest (Region 10) University Transportation Centers Consortium (NUTRC) as well as the coordination of UTC and SPR research project selection processes will continue to be a top priority.

**ORGANIZATIONAL RESPONSIBILITY**

This activity is primarily the responsibility of the ODOT Research Section but requires input from other parts of ODOT, primarily in research project selection and development, as well as the implementation of results.

**COST INFORMATION**

<b>SPR 300</b>	<b>FY’06</b>	<b>FY’07</b>	<b>FY’08</b>	<b>FY’09</b>	<b>FY’10</b>	<b>FY’11</b>	<b>FY’12</b>	<b>FY’13</b>
WORK PLAN BUDGET	\$60,000	\$50,000	\$30,000	\$30,000	\$30,000	\$10,000	\$5,000	\$10,000
SPENT TO DATE	\$43,479	\$14,996	\$9,493	\$4,269	\$ 805	\$500		
<b>REVISED BUDGET</b>	<b>\$43,479</b>	<b>\$14,996</b>	<b>\$9,493</b>	<b>\$4,269</b>	<b>\$ 805</b>	<b>\$500</b>		

*FY’11 expenditures are estimated.*

## **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'12 our intention is to select and fund no more than 8 new projects.

### **ORGANIZATIONAL RESPONSIBILITY**

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**

<b>SPR 301</b>	<b>FY'06</b>	<b>FY'07</b>	<b>FY'08</b>	<b>FY'09</b>	<b>FY'10</b>	<b>FY'11</b>	<b>FY'12</b>	<b>FY'13</b>
BUDGET	\$75,000	\$150,000	\$170,000	\$170,000	\$200,000	\$200,000	\$200,000	\$200,000
SPENT TO DATE	\$178,351	\$193,804	\$203,833	\$318,986	\$186,783	\$210,000	\$0	\$0
<b>REVISED BUDGET</b>	<b>\$178,351</b>	<b>\$193,804</b>	<b>\$203,833</b>	<b>\$318,986</b>	<b>\$186,783</b>	<b>\$210,000</b>	<b>N/A</b>	<b>N/A</b>

*FY'11 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.

In late 2001 the Research Section published its first Newsletter. The newsletter will continue throughout this Work Program period.

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. In FY'10, 28 conference papers, journal articles and other scholarly publications were produced by investigators, based on work funded by ODOT.

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 will once again be a major sponsor of the Northwest Transportation Conference, which is scheduled to be held at the CH2M Hill Alumni Center at Oregon State University, February 7-9. The event typically involves more than 100 speakers in 24 sessions over three days.

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

- Participated on the conference steering committee.
- Section staff will prepare and circulate a request for abstracts, and review the abstracts received for inclusion in the conference program.
- Section staff will organize several sessions and recruit speakers for those sessions.
- Research Section funds will be made available cover the fees charged by major speakers.
- Section staff will prepare 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 will sponsor and staff two vendor displays at the conference, one for the Research program and a second for the Oregon Technology Transfer Center.
- Section staff will chair sessions and present 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 will be discontinued and Research Notes will be somewhat curtailed commensurate with a reduction in staff.

## Projects.

Nine major projects are expected to be completed in FY’11. 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’11 a summary of the project objectives, outcome and implementation accomplished or expected, is presented below.

**SPR 654: Waterway Enhancement Construction methods.** This study investigated 19 fish passageways to discover factors that would lead to more reliable solutions for constructing fish passageways when highway crossings disturb natural waterways. The study focused on whether construction practices may play a significant role in the long-term success of these passageways. The investigation measured the physical channel characteristics of seasoned fish passageways and developed a rating—a Success Index—to measure how these channels behaved as successful fish passageways.

The researchers additionally collected measurement information including slopes, channel configurations, crossing structure characteristics, and streambed soil characteristics. These physical metrics of the sites were correlated against the Success Index and other important fish passageway factors. Important findings include a relationship between downstream slope and scour, as well as an assessment that subsurface flow may be related to construction factors such

as material source.

As ODOT continues to construct the types of features examined by this study, it is anticipated that some of the recommendations in the report will be applied to the construction practices. These facilities can then be monitored to track their Success Index over time.

**SPR 661: Flexural Anchorage Performance at Diagonal Crack Locations.** Oregon has many reinforced concrete bridges built during the interstate system expansion that now have cracked concrete beams. Common practice when these bridges were built was to cut short the steel bars that run the length of the beams because the design code did not require full length bars. Modern code for load rating bridges reduces the calculated bond strength, and ultimately the beam capacity, when cracks are found near the bar cutoffs. The objective of this project was to determine the level of conservatism in the code and to provide alternative methods for predicting capacity if appropriate.

Testing on large-size beams showed that the current design code was conservative in predicting actual bond strength. Due to the conservatism, calculated load ratings could show a bridge with inadequate load capacity due to the crack-cutoff interactions. For those cases, the researchers described alternate analysis methods that more accurately predicted actual bond strength. The researchers also identified crack patterns for bridge inspectors to identify bar slippage.

Based on specifications within the current code, Oregon load rating engineers apply a reduced steel contribution to beam capacity near cutoffs. Consequently, load rating values for some locations near the bar cutoffs can be deficient. Load raters may be able to use the alternate methods of predicting the actual bond strength from this research to compute a more accurate beam capacity to achieve adequate load ratings and thereby avoid unnecessary load restrictions and bridge strengthening.

**SPR 662: Multimodal Freight Investment Criteria.** The Multimodal Freight Investment Criteria research project investigated and recommended new and supplemental investment criteria for freight projects in Oregon. Literature was reviewed nationally to examine measures and techniques for quantifying project benefits and costs. Investment programs in Oregon, primarily the multimodal program *ConnectOregon*, were evaluated to assess existing criteria used and selection techniques.

Freight community stakeholders were also solicited and existing and potential criteria were evaluated in terms of Oregon multimodal freight needs and issues. The criteria recommended in the research report are likely to be considered for 2014-2017 Statewide Transportation Improvement Program (STIP) project selection criteria, and considered and used in *ConnectOregon* IV, if funded.

**SPR 663: Copper Toxicity and EAS Listed Salmon.** In this study, storm water runoff from an urban high annual average daily traffic (AADT) site had consistently higher event mean concentrations of measured  $\text{Cu}^{2+}_{\text{diss}}$  and  $\text{Cu}^{2+}_{\text{free}}$  than the non-urban sites with lower AADT. First flush samples displayed consistently higher concentrations of both  $\text{Cu}^{2+}_{\text{diss}}$  and  $\text{Cu}^{2+}_{\text{free}}$ . A modified Competitive Ligand Exchange-Cathodic Stripping Voltammetry (CLE-ACSV) technique utilizing salicylaldehyde as an added ligand can be used to determine the speciation of copper in highway storm water runoff. Analytical results from composite storm water samples suggest that dissolved copper in highway storm water runoff is largely complexed by organic matter (typically > 99.9%), and that very little of the copper in storm water is bio-available; the concentrations of  $\text{Cu}^{2+}_{\text{free}}$  were generally several orders of magnitudes below levels found to inhibit olfaction in Endangered Species Act listed fish species. Elevated  $\text{Cu}^{2+}_{\text{diss}}$  levels proved to be the greatest indicator of high  $\text{Cu}^{2+}_{\text{free}}$  concentrations.

Urban sites with AADT and first flush samples characterized by elevated concentrations of  $\text{Cu}^{2+}_{\text{diss}}$  are of the greatest concern with respect to elevated free ionic copper concentrations. Available dissolved organic matter models in Visual MINTEQ overestimate  $\text{Cu}^{2+}_{\text{free}}$  concentrations when compared to analytically determined  $\text{Cu}^{2+}_{\text{free}}$  concentrations. This imparts a

conservatism that makes these models potentially useful for regulatory purposes.

The results of this research will be useful for determining locations where monitoring for dissolved copper may be called for on ODOT's highway system. The results also provide techniques for evaluating bioavailability of copper that don't involve analytic methods that are not commonly available. The information about speciation will also inform stormwater treatment methodologies relating to dissolved copper in highway runoff. All these things are important to ODOT's environmental compliance efforts.

**SPR 667: Assessment of Statewide Intersection Safety Performance.** The objective of this research was to quantify the safety performance of typical intersections with various geometric and operational categories (rural, urban, suburban, volumes, configuration, traffic control, geography). The objective was broken down into two sub-objectives:

- 1.) Assemble a statewide inventory of intersections including location, geometry, control and volume data into a database, to become a part of the growing Oregon Traffic Safety Data Archive (OrTSDA).
- 2.) Characterize the safety performance of typical Oregon intersections by a variety of geometric, operational, and volume features.

The investigators collected data from 500 intersections representing the full range of available location, traffic volume, traffic control, and geometric variables. Analysis determined average crash performance and to determine typical crash types by approach. The research categorized the results by simple metrics such as crash type proportions and crash severity distribution. The investigator has incorporated the intersection data into the Oregon Traffic Safety Data Archive (OrTSDA) for ease of future updating with new crash data.

The research team also checked the collected data for agreement with the safety performance models in the recently released Highway Safety Manual (HSM). The collected data is compatible with the HSM models and can be used to adapt the associated safety performance functions for local Oregon conditions.

The results of this research will be used by roadway designers to improve the identification of high crash rate intersections and to aid in the selection of corrective measures for existing intersections. The principles will also serve as an aid in identifying design issues in new construction and modifying those designs before they are built.

**SPR 680: Oregon Open-Graded Wearing Course Update.** This project evaluated open graded friction courses used in Oregon to gain an understanding of where they work, how they fail, and the influences of design and construction practices. The research included an evaluation of other regional uses of open graded mixes. This research has helped ODOT determine best construct practices for longer life and where to best use open graded wearing courses within the ODOT roadway network. Several recommendations for material selection, use for various traffic levels, expected pavement life and construction practices were made. Results of the research will be used to modify ODOT publications and specifications for the use of open graded wearing courses. The research will also be used to evaluate the appropriateness of the recent limited use of open graded mixes in Oregon.

**SPR 683: Calibration of the LFRD for the Wave Equation Analysis Program.** Many Oregon bridges are supported by groups of steel and concrete piles driven deep into the underlying soils. The load bearing capacity of a pile depends on a complex interaction involving pile dimensions, pile structural capacity, the surrounding soil properties, time to loading and the depth of the pile. ODOT uses The Wave Equation Analysis of Pile Driving program (WEAP), a common computer algorithm, to estimate pile

load bearing capacity while the pile is being driven. Starting in 2007, the FHWA required states to use Load and Resistance Factor Design (LRFD). The LRFD design method, as described in AASHTO, has a default resistance factor that is applied to the load bearing values generated by the WEAP program. It is known that by using the AASHTO LRFD default resistance factor with WEAP results in more conservative pile designs than those prior to LRFD. In essence, the new design code forces ODOT to build foundations beyond the high level of safety achieved with the previous design method.

The new AASHTO LRFD code allows recalibration of the resistance factors to account for standard of practice, site specific soil and pile conditions, and local judgment of transportation jurisdictions. Consequently, the objective of the research was to recalibrate the LRFD resistance factor for use with the WEAP program for Oregon pile driving.

The outcome of the research was an increase in the resistance factor compared to the default value. In addition, the research generated a resistance factor for a condition that did not have a default value in the code.

ODOT engineers will review the project results in depth to decide a course of action for implementation. It is anticipated that after the review, a policy statement will be generated on using an updated set of resistance factors. Implementation is also expected to include training for ODOT personnel and contractors on the new policy.

**SPR 684: Calibrating the Future HSM Predictive Methods for Oregon.** The recently published *Highway Safety Manual* (HSM) includes safety predictive methods that can quantitatively estimate the safety of a transportation facility. The resulting information can provide a guideline to identify opportunities to improve transportation safety. The safety performance functions (SPFs) included in the HSM, however, were developed for several states other than Oregon. Because there are differences in crash reporting procedures, driver population, animal populations, and weather conditions (to name a few), the State of Oregon needs to use calibrated SPFs when applying the procedures for local Oregon conditions. The goal of this research project was to calibrate the HSM predictive method SPFs for conditions in the State of Oregon.

To approximate the total expected crash frequency for a facility, the SPFs calculate estimated crash frequency for a base condition. The estimates calculated by SPFs are then modified by applying crash modification factors (CMFs) to address non-base condition characteristics for specific locations. The predictive method can estimate safety separately for intersections and segments. The HSM currently includes predictive methods for rural two-lane two-way roads; rural multilane highways, and urban and suburban arterials. SPFs for these facility types must be calibrated to provide accurate results.

The project report provides Oregon specific SPFs for various configurations of segments and intersections on:

- Rural Two-Lane, Two-Way Roads;
- Rural Multilane Highways; and
- Urban and Suburban Arterials

The project report warns that Oregon crash reporting procedures and thresholds introduce a significant difference in observed crash proportions for total crashes. As a result, the use of severity-based calibration factors or Oregon-specific fatal plus injury SPFs are more appropriate for cost-benefit based decisions.

The report also points out that the calibration factor for four-lane divided facility has limited usability due to small sample size and difference between four-lane divided facilities in the HSM SPFs data set and the segments in the Oregon calibration set. The report recommends use of the calibration factor for other multi-lane facilities as a reasonable substitute.

ODOT is adopting the procedures contained in the HSM as tools to better estimate the safety impacts of new construction and changes to existing intersections and road segments. The Oregon specific calibration factors will be used to provide the most accurate predictions of the safety impacts for the design decisions implemented.

**SPR 685: Safety Evaluation of Curve Warning Advisory Speed Signs.** The use of advisory speed signs on horizontal curve locations in the State of Oregon varies from the guidance given in the 2009 edition of the *Manual of Uniform Traffic Control Devices (MUTCD)*. Earlier research (SPR 641, *Methodologies for Estimating Advisory Curve Speeds on Oregon Highways*) evaluated the implications of modifying advisory speed thresholds and identification procedures were Oregon to adopt the *MUTCD* guidance. The research did not evaluate the safety implications of modifying the advisory speed policy in Oregon.

The objective of SPR 685 was to evaluate the safety implications of advisory speeds at horizontal curve locations on Oregon rural two-lane highways. This was achieved through collection of speed data at randomly selected curve locations where advisory speed signs were posted as well as through a review of historic crash information. The Oregon State University (OSU) researchers developed a statistical model that identified critical variables that are associated with the posted speed and how they ultimately relate to the expected crash frequency. They found that the differential between the posted speed and the advisory speed, the Advisory Speed Differential (ASD) and the side friction demand (SFD) were the most critical variables. The research team developed a term called the advisory speed crash factor (ASCF) to represent the SFD and ASD joint effect. This value appears to convincingly explain the safety impact of drivers searching for a balance between the discomfort of driving a curve too fast and the inconvenience of slowing down.

The research team developed a computational method for determining the appropriate advisory speed based on the ASCF. This method, called the OSU method, is an alternative to the current Ball-Bank indicator method. The underlying principle is that the advisory speed value should be such that the value of the ASCF is minimized. The researchers also developed a spreadsheet that ODOT staff can use to determine recommended advisory speed values that will minimize the ASCF. This analysis can be performed using basic geometric characteristics (horizontal radius and superelevation) and site speed limit. Often the horizontal radius can be satisfactorily estimated by analyzing aerial images and the associated superelevation rate can be estimated from information in the *Oregon Highway Design Manual*, thus avoiding a field visit.

## 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.

## ORGANIZATIONAL RESPONSIBILITY

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

<b>SPR 302</b>	<b>FY'06</b>	<b>FY'07</b>	<b>FY'08</b>	<b>FY'09</b>	<b>FY'10</b>	<b>FY'11</b>	<b>FY'12</b>
BUDGET	\$65,000	\$50,000	\$50,000	\$50,000	\$50,000	\$50,000	\$50,000
SPENT TO DATE	\$41,829	\$44,344	\$37,500	\$51,336	\$52,933	\$40,000	\$0
<b>REVISED BUDGET</b>	<b>\$41,829</b>	<b>\$44,344</b>	<b>\$37,500</b>	<b>\$51,336</b>	<b>\$52,933</b>	<b>\$40,000</b>	<b>N/A</b>

*FY'11 expenditures are estimated.*

## **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**

Six projects and activities were active and two were completed in FY’11. New projects and activities for the FY’12 Small Projects Discretionary Fund have yet to be identified. Activity and spending levels were light in FY ’11 because of continuing major project development workload. 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 are 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*).

- **ODOT Solar Highway.** This project is being carried out jointly with the Oregon Innovative Partnerships Program (OIPP). The goal is to identify and develop opportunities to install solar and other technologies for alternative power generation. The first wave of such projects involves a partnership with OIPP, PGE and US Bank, to generate electric power on ODOT right-of-way using conventional solar panels. The Research Section was not part of that effort, but moving forward, the Research Section has begun to assist OIPP in evaluating new opportunities for alternative energy. One such investigation involves solar panels incorporated into the design of highway sound walls. A second involves the installation of solar and wind generation on the Astoria bridge to support the bridge’s lighting requirements (Status is *ongoing*).

**Projects.**

- **Red Light Camera.** This project is a field test of enforcement using red light cameras. Treatment and control locations have been identified on Mission Boulevard (OR 22) in Salem. Data collection and analysis is ongoing and a preliminary report has been circulated in draft form. Completion depends on availability of additional crash data, and is expected late in FY’11 (status is *complete*).
- **Polymer Bridge Deck Overlays.** Thin polymer overlays improve condition of bridge decks after exposure to service. Oregon has had inconsistent results with overlays. Failures include excessive aggregate pull out from the matrix, fractured aggregate, cracking, and de-lamination. Studded tires most likely reduce their service life. The project objective is to provide a performance comparison of commercially available thin overlay products for bridge decks. In all, nine products were placed in test sections during the summer of 2007. Construction activities have been documented and will be published, along with an interim report in the spring of 2009. A final report will be prepared, based on three seasons of studded tire wear, in the summer of 2011 (status is *complete*).
- **Digital Image Rectification of Gusset Plate Connection in Steel Truss Bridges.** In previous work, Oregon State University (OSU) developed a method of obtaining geometric data for analyzing gusset plates using digital images of the plates. However, there are situations in which a gusset plate cannot be captured in a single image. Also, thorough analysis needs to consider any out-of-plane distortion of the plates. The research will build on OSU's digital imaging methods to develop a procedure to incorporate multiple images and to measure out-of-plane deformations. (Status is *continuing*).

**ORGANIZATIONAL RESPONSIBILITY**

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**

<b>SPR 304</b>	<b>FY’06</b>	<b>FY’07</b>	<b>FY’08</b>	<b>FY’09</b>	<b>FY’10</b>	<b>FY’11</b>	<b>FY’12</b>
ORIGINAL BUDGET	100,000	\$150,000	\$100,000	\$100,000	\$100,000	\$100,000	\$100,000
SPENT TO DATE	\$108,222	\$83,586	\$118,014	\$96,121	\$61,764	\$43,000	\$0
<b>REVISED BUDGET</b>	<b>\$108,222</b>	<b>\$83,586</b>	<b>\$118,014</b>	<b>\$96,121</b>	<b>\$61,764</b>	<b>\$43,000</b>	<b>N/A</b>

*FY’11 expenditures are estimated.*

## **642 MECHANISTIC PAVEMENT DESIGN INPUT PARAMETERS**

### **OVERVIEW**

NCHRP project 1-37A developed a new mechanistic pavement design guide to replace the 1993 AASHTO Guide for the Design of Pavement Structures. The new guide will be used for both new work and pavement rehabilitation. However, this guide will require a significant effort to develop the required inputs and calibrate the design guide models to Oregon conditions. This research develops data for several of the required inputs.

### **OBJECTIVES:**

- Test and select appropriate back calculation software
- Determine material properties for typical aggregate sources, sub-grade soils, and HMAC mix volumetrics and develop a process for long term monitoring and validation of the input properties.
- Make a recommendation on the use of available climatic data resources
- Provide a starting calibration of the M-E transfer functions used to relate stresses and strains to pavement performance and develop a plan for long-term validation.
- Validate assumptions used in a previous M-E analysis of the I-5 N. Albany – N. Jefferson (SB) pavement design.

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\\_642](http://www.oregon.gov/ODOT/TD/TP_RES/ActiveProjects.shtml#SPR_642)

### **PROPOSED ACTIVITIES**

Task 1: Conduct a Literature Review and Select Back Calculation Software.

Task 2: Investigate Climate Data.

Task 3: Perform Material Characterization.

Task 4: Perform Calibration of Transfer Functions.

Task 5: Perform M-E Pavement Design Validation.

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

**ACCOMPLISHMENTS** (see Quarterly Reports at the link above.)

## ORGANIZATIONAL RESPONSIBILITY

ODOT Research

ODOT Pavement Services Unit

Oregon State University (Contract of \$120,000 ended in FY'08 with \$119,097 expended.)

## COST INFORMATION

<b>SPR 642</b>	<b>FY'06</b>	<b>FY'07</b>	<b>FY'08</b>	<b>FY'09</b>	<b>FY'10</b>	<b>FY'11</b>	<b>FY'12</b>	<b>TOTAL</b>
STAGE 2 BUDGET	\$40,000	\$80,000	\$0	\$0	\$0	\$0	\$0	<b>\$120,000</b>
WORK PLAN BUDGET	\$101,000	\$60,583	\$0	\$0	\$0	\$0	\$0	<b>\$161,583</b>
SPENT TO DATE	\$ 50,567	\$100,762	\$18,529	\$5,953	\$4,415	\$2,400	NA	<b>\$182,626</b>
<b>REVISED BUDGET</b>	<b>\$ 50,567</b>	<b>\$100,762</b>	<b>\$ 18,529</b>	<b>\$5,953</b>	<b>\$4,415</b>	<b>\$2,400</b>	<b>\$1,000</b>	<b>\$183,626</b>

*FY'11 expenditures are estimated.*

## **658 IDENTIFY AND ADDRESS INSTITUTIONAL BARRIERS DELAYING INCIDENT CLEARANCE**

### **OVERVIEW**

ODOT has a comprehensive incident management program in place. Due to cooperative efforts among ODOT, Oregon State Police, local police, and emergency providers most incidents are cleared rapidly. However, a major traffic-related incident can take considerable time to clear and cause major delays and significant economic impacts at peak travel periods in metropolitan areas. It is not known to what extent institutional constraints and inefficiencies contribute to delays in incident clearance.

### **OBJECTIVES**

The research proposed in this study will address several key objectives. These are summarized as follows:

1. Examine recent traffic incidents in the Portland area to determine the extent to which the incident and associated traffic obstructions impacted systemic traffic operations;
2. Develop an enhanced implementation plan for addressing institutional barriers that may affect the rapid clearance of incidents;
3. Identify specific legislative initiatives or administrative procedures that should be implemented to minimize delayed incident clearance and estimate the benefit of the recommended changes.

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\\_658](http://www.oregon.gov/ODOT/TD/TP_RES/ActiveProjects.shtml#SPR_658)

### **PROPOSED ACTIVITIES**

Task 1: Convene a Multi-Agency TAC:

Task 2: Literature Review:

Task 3: Data Collection and Assessment

Task 4: Evaluation of Current Incident Response Procedures

Task 5: Economic Analysis of Incident Response

Task 6: Recommendations and Benefit Estimation

Task 7: Reports and Implementation Plan

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

**ACCOMPLISHMENTS** (see Quarterly Reports at the link above.)

## ORGANIZATIONAL RESPONSIBILITY

ODOT Research Section

ODOT Traffic/Roadway Section

Oregon State University (Agreement for \$41,700, fully expended through FY'10).

Oregon Transportation Research and Education Consortium (commitment of \$33,000).

## COST INFORMATION

<b>SPR 658</b>	<b>FY'07</b>	<b>FY'08</b>	<b>FY'09</b>	<b>FY'10</b>	<b>FY'11</b>	<b>Fy'12</b>	<b>TOTAL</b>
STAGE 2 BUDGET	\$33,000	\$33,000	\$0	\$0	\$0		<b>\$66,000</b>
WORK PLAN BUDGET	\$2,537	\$22,773	\$26,427	\$0	\$0		<b>\$51,737</b>
SPENT TO DATE	\$ 2,686	\$25,791	\$23,471	\$ 4,136	<b>\$1,200</b>	NA	<b>\$57,284</b>
<b>REVISED BUDGET</b>	<b>\$ 2,686</b>	<b>\$25,791</b>	<b>\$23,471</b>	<b>\$ 4,136</b>	<b>\$1,200</b>	<b>1,000</b>	<b>\$58,284</b>
<b>UTC COMMITMENT (OTREC)</b>	<b>\$16,500</b>	<b>\$16,500</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>		<b>\$33,000</b>

## **OVERVIEW**

The OHP identifies Access Management as the single largest contributor to highway safety and essential to the efficiency and protection of existing and planned state highways. Other states, notably Florida and Colorado, have recently developed best practices manuals as an aid in identifying and applying the best management techniques. ODOT needs a similar manual to provide objective and quantifiable justification for access management decisions and to promote better public understanding of access management decisions.

## **OBJECTIVES**

- Develop measurable criteria to evaluate access management techniques and improvements;
- Survey practices in other states and their techniques in developing those practices;
- Determine data collection practices necessary to properly measure outcomes.

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\\_665](http://www.oregon.gov/ODOT/TD/TP_RES/ActiveProjects.shtml#SPR_665)

## **PROPOSED ACTIVITIES**

Task 1: Literature Review.

Task 2: Best Practices Synthesis.

Task 3: ODOT Data Collection Practice Review.

Task 4: Oregon “Best Outcomes” Identification.

Task 5: Develop Access Management Best Practices Manual

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

**ACCOMPLISHMENTS** (see Quarterly Reports at the link above.)

## **ORGANIZATIONAL RESPONSIBILITY**

ODOT Research Section – Mark Joerger

ODOT Access Management Unit

Oregon State University (Agreement for \$46,054 fully expended through June, 2010).

Oregon Transportation Research and Education Consortium (commitment of \$42,500).

## COST INFORMATION

<b>SPR 665</b>	<b>FY'08</b>	<b>FY'09</b>	<b>FY'10</b>	<b>FY'11</b>	<b>Fy'12</b>	<b>TOTAL</b>
STAGE 2 BUDGET	\$51,000	\$34,000	\$0	\$0		\$85,000
WORK PLAN BUDGET	\$28,434	\$23,120	\$2,000	\$0		\$53,554
SPENT TO DATE	\$2,204	\$47,856	\$4,567	\$3,500	NA	\$58,127
<b>REVISED BUDGET</b>	<b>\$2,204</b>	<b>\$47,856</b>	<b>\$4,567</b>	<b>\$3,500</b>	<b>1,000</b>	<b>\$59,127</b>
<b>UTC COMMITMENT (OTREC)</b>	<b>\$22,500</b>	<b>\$20,000</b>	<b>\$0</b>			<b>\$42,500</b>

*FY'11 expenditures are estimated.*

## **OVERVIEW**

Part of the process for successful implementation of the new mechanistic empirical pavement design procedure is calibration of the design process such that the theory behind the process can be accurately related to actual performance. Currently, several assumptions about the response of pavement structures due to actual loading are necessary to develop an appropriate design. Actual responses (i.e., performance) can only be verified through an investigation of the engineering properties of the materials used during construction coupled with measurement of their response to actual (in-service) loading conditions. Currently, only two adjacent sections of roadway in Oregon have been instrumented. Information collected from these two subsections will be sufficient for initial calibration, but limited to only these two structures.

## **OBJECTIVES**

The objective of this research is to provide data to support calibration of additional pavement structures across the state. Four pavement sections would be instrumented to evaluate the impact of pavement thickness, climate, traffic, and sub-grade on pavement performance.

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

[http://www.oregon.gov/ODOT/TD/TP\\_RES/ActiveProjectsII.shtml#SPR\\_672](http://www.oregon.gov/ODOT/TD/TP_RES/ActiveProjectsII.shtml#SPR_672)

## **PROPOSED ACTIVITIES**

Task 1: Instrumentation.

Task 2: Data Collection.

Task 3: Laboratory Testing.

Task 4: Data Analysis.

Task 5: Report.

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

**ACCOMPLISHMENTS** (see Quarterly Reports at the link above.)

## ORGANIZATIONAL RESPONSIBILITY

ODOT Research Section

ODOT Pavement Services

Oregon State University (Agreement for \$76,781 fully expended through FY'10. *Payment for an invoice of \$20,483 dated 05/24/2010 is being withheld pending delivery of a final report.*)

Oregon Transportation Research and Education Consortium (additional commitment of \$76,781).

## COST INFORMATION

<b>SPR 672</b>	<b>FY'08</b>	<b>FY'09</b>	<b>FY'10</b>	<b>FY'11</b>	<b>FY'12</b>	<b>TOTAL</b>
STAGE 2 BUDGET	\$87,500	\$87,500	\$0	\$0	\$0	<b>\$175,000</b>
WORK PLAN BUDGET	\$68,086	\$14,695	\$0	\$0	\$0	<b>\$82,781</b>
SPENT TO DATE	\$2,205	\$55,566	\$20,102	\$24,494	NA	<b>\$102,367</b>
<b>REVISED BUDGET</b>	<b>\$2,205</b>	<b>\$55,566</b>	<b>\$20,102</b>	<b>\$24,494</b>	<b>1,500</b>	<b>\$103,867</b>
<b>UTC COMMITMENT (OTREC)</b>	<b>\$55,000</b>	<b>\$21,781</b>	<b>\$0</b>	<b>\$0</b>		<b>\$76,781</b>

*FY'11 expenditures are estimated.*

## **682 REPLACING THERMAL SPRAYED ZINC ANODES**

### **OVERVIEW**

ODOT has historic reinforced concrete bridges at the coast that employ impressed current cathodic protection (CP) to greatly reduce the corrosion of the embedded steel reinforcement. The cathodic protection systems rely on passing an electric current into the concrete through zinc metal anodes that have been sprayed onto the surface of the concrete. Some of these zinc anodes are nearing the end of their design lives, while others are beginning to separate from the concrete prematurely possibly due to erratic current controllers or initial contractor inexperience during installation. Anode sections that have de-bonded no longer protect the underlying steel reinforcement. When the natural rate of corrosion resumes, the unprotected sections are on the path to concrete spalling and steel section loss - the conditions that required ODOT to undertake expensive repairs and protection schemes.

Currently, there is no procedure established by ODOT to remove old anodes, prepare the concrete surface, and install new anodes.

### **OBJECTIVES**

The objectives of the research are the following:

- Determine the most cost-effective method to remove existing zinc anodes; and
- Develop a protocol to prepare the concrete surface for the new anode.

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

[http://www.oregon.gov/ODOT/TD/TP\\_RES/ActiveProjectsIII.shtml#SPR\\_682](http://www.oregon.gov/ODOT/TD/TP_RES/ActiveProjectsIII.shtml#SPR_682)

### **PROPOSED ACTIVITIES**

Task 1: Survey of the Current Practice.

Task 2: Investigation of Zinc Anode Removal Methods

Task 3: Final Report and Presentation.

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

**ACCOMPLISHMENTS** (see Quarterly Reports at the link above.)

### **ORGANIZATIONAL RESPONSIBILITY**

ODOT Research Section  
ODOT Bridge Preservation Unit

Montana State University (Agreement for \$190,000, expiring 09/30/10, with \$178,000 expended through FY'10)  
 Western Transportation Institute (additional commitment of \$30,000).

**COST INFORMATION**

<b>SPR 682</b>	<b>FY'09</b>	<b>FY'10</b>	<b>FY'11</b>	<b>FY'12</b>	<b>TOTAL</b>
STAGE 2 BUDGET	\$61,250	\$122,500	\$61,250	\$0	<b>\$245,000</b>
WORK PLAN BUDGET	\$131,227	\$ 69,773	\$0	\$0	<b>\$201,000</b>
SPENT TO DATE	\$96,035	\$90,086	\$45,000	\$1,000	<b>\$197,459</b>
<b>REVISED BUDGET</b>	<b>\$96,035</b>	<b>\$90,086</b>	<b>\$45,000</b>	<b>\$1,000</b>	<b>\$205,994</b>
<b>UTC Commitment (WTI)</b>	<b>\$15,000</b>	<b>\$15,000</b>			<b>\$ 30,000</b>

*FY'10 expenditures are estimated.*

## **686 HEALTH RISK EXPOSURE TO NATURALLY OCCURRING HAZARDOUS MINERALS DURING CONSTRUCTION ACTIVITY**

### **OVERVIEW**

The Ash Grove Cement in Baker County recently discovered that some of their limestone contains elevated levels of mercury. The Department of Environmental Quality (DEQ) has identified Ash Grove as one of the largest industrial emitters of mercury in the nation. A naturally occurring hazardous materials (NOHM) analysis of the site would have shown old hot springs deposits in close proximity to the mine site and would have flagged the area for potentially elevated levels of mercury. ODOT's rock source pits and private sources—used for state highway projects—could contain NOHM, as does rock moved from cuts to fills during construction activities. Many elements, rocks and minerals meet the NOHM criteria, particularly those that pose health hazards through their physical properties. Low levels of NOHM seem to be of little consequence, but when NOHM have been concentrated or exposed to the accessible environment, the exposure may cause or pose a substantial present or potential hazard.

Recently, the Federal Highway Administration warned ODOT Technical Services about a zeolite mineral, Erionite, associated with cut and fill work near Durkee, Oregon. This mineral is considered so hazardous that the EPA requires anyone who intends to manufacture, import or process any article containing Erionite to notify the EPA 90 days in advance. Erionite is just one NOHM in Oregon; there are many others, including asbestos.

In response to NOHM threats, ODOT Hazmat personnel have raised several questions. First, what are the NOHM in Oregon that could pose environmental and health concerns related to ODOT's geologic investigations and environmental assessment of projects, and potential pollution liability? Second, where are NOHM located in the state and their relationship to state highway right-of-way including material sources, staging areas, disposal sites, and stockpile sites?

### **OBJECTIVES**

**Objective 1: Identification and knowledge.** Develop list of NOHM that may plausibly occur in Oregon, and tailor and query existing mineral and geologic databases to determine where such occurrences may intersect ODOT operations; setting priorities based on hazard assessment.

**Objective 2: Detection.** Develop tools such as digital maps that inform ODOT personnel of the potential location of NOHM using results of Objective 1 as a screening tool and build awareness of environmental and health impact. **Objective 3: Control and management—**Develop and implement best management practices for identified NOHM determined in Objective 1 and located in Objective 2.

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

[http://www.oregon.gov/ODOT/TD/TP\\_RES/ActiveProjectsIII.shtml#SPR\\_686](http://www.oregon.gov/ODOT/TD/TP_RES/ActiveProjectsIII.shtml#SPR_686)

## PROPOSED ACTIVITIES

Task 1: List of NOHM Candidates.

Task 2: Methods for Detecting NOHMs

Task 3: Data Collection and Integration.

Task 4: Process Data to Tag NOHMs.

Task 5: Develop Sampling and Detecting Procedures.

Task 6: Exercise Sampling and Detecting Procedures.

Task 7: Catalog of Oregon NOHMs.

Task 8: Compile NOHM Database File(s).

Task 9: Develop NOHM GIS Interpretive Layer

Task 10: Write Final Report.

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

**ACCOMPLISHMENTS** (see [Quarterly Reports](#) at the link above.)

## ORGANIZATIONAL RESPONSIBILITY

ODOT Research Section

ODOT Geo-Environmental Section

Oregon Department of Geology and Mineral Industries (Agreement for \$180,000 expiring in March 2011, with approximately \$106,000 expended through June 2010).

## COST INFORMATION

<b>SPR 686</b>	<b>FY'09</b>	<b>FY'10</b>	<b>FY'11</b>	<b>FY'12</b>	<b>TOTAL</b>
STAGE 2 BUDGET	\$65,000	\$124,000	\$0	\$0	<b>\$189,000</b>
WORK PLAN BUDGET	\$75,000	\$115,000	\$0	\$0	<b>190,000</b>
SPENT TO DATE	\$52,302	\$ 103,959	\$42,664	\$1,000	<b>\$198,925</b>
<b>REVISED BUDGET</b>	<b>\$52,302</b>	<b>\$103,959</b>	<b>\$42,664</b>	<b>\$1,000</b>	<b>\$199,925</b>

*FY'10 expenditures are estimated.*

## **710 ANALYSIS AND DESIGN OF PIPE RAMMING INSTALLATIONS**

### **OVERVIEW**

Large diameter steel culverts (pipes) are often installed beneath fills or embankments using pipe ramming. Pipe ramming has the advantage of not producing measurable settlements and not impacting the flow of traffic. Pipe ramming involves installing the new pipe sections using hydraulic/ pneumatic hammers, conceptually similar to the driving of bridge foundation piles.

The most authoritative resource on pipe ramming is the US Army Corps of Engineers' guidelines. This guide is silent on the selection of the impact hammer.

### **OBJECTIVES**

There is a need to develop a reliable method to specify pipe ramming equipment and methods based on actual site and pipe characteristics. The objective of this research is to develop more detailed, data supported methods to design and specify the installation of culverts using pipe ramming. The research will develop procedures and guidelines to assist designers in specifying steel pipe culverts and associated installation equipment.

Significant cost savings could be realized by designing and specifying steel pipe culverts for pipe ramming projects with the optimum pipe properties. Likewise, quick and problem free installations should result from applying the optimum equipment and operations. Given clearer design and specification guidance, ODOT may reap cost savings by more frequently using pipe ramming with its associated advantages.

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

[http://www.oregon.gov/ODOT/TD/TP\\_RES/ActiveProjectsIII.shtml#SPR\\_710](http://www.oregon.gov/ODOT/TD/TP_RES/ActiveProjectsIII.shtml#SPR_710)

### **PROPOSED ACTIVITIES**

The research tasks proposed to achieve the objectives of this pipe ramming study are described in the following sections.

Task 1: Literature and Project Review.

Task 2: Assess Available Data and Determine Knowledge Gaps.

Task 3: Perform and Analyze Instrumented Field Study.

Task 4: Assess Pipe Ramming Dynamics.

Task 5: Develop Design Guidance. D.

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

**ACCOMPLISHMENTS** (see Quarterly Reports at the link above.)

## ORGANIZATIONAL RESPONSIBILITY

ODOT Research Section

ODOT Geo-Environmental Section

Oregon State University (Agreement for \$328,000, expiring 6/30/2012, with approximately \$190,000 expended through FY'11).

## COST INFORMATION

<b>SPR 710</b>	<b>FY'10</b>	<b>FY'11</b>	<b>FY'12</b>	<b>FY'13</b>	<b>TOTAL</b>
STAGE 2 BUDGET	\$65,600	131,200	131,200	\$0	<b>328,000</b>
WORK PLAN BUDGET	\$44,315	\$218,033	\$80,652	\$0	<b>\$343,000</b>
SPENT TO DATE	\$54,177	\$149,200	NA	\$0	<b>\$203,377</b>
<b>REVISED BUDGET</b>	<b>\$54,177</b>	<b>\$149,200</b>	<b>\$143,156</b>	<b>\$0</b>	<b>\$346,533</b>

*FY'11 expenditures are estimated.*

## **711 INTERNAL CURING OF CONCRETE BRIDGE DECKS**

### **OVERVIEW**

Current Oregon Department of Transportation (ODOT) Standard Specifications for curing of high-performance bridge deck concrete requires wet curing for a duration of a minimum of 14 days. This long wet cure reduces evaporation that can lead to cracking, and it provides water to the bulk concrete to participate in the chemical reactions in the cement paste during hardening. There is a need for accelerated/alternate curing techniques to allow for increased construction efficiency while still producing crack-free concrete in these high-performance bridge decks.

Lightweight aggregate saturated with water can provide internal curing to mitigate autogenous shrinkage and improve other engineering properties in high-performance concrete mixtures. Most of the field internal curing trials have been done in conjunction with standard curing regimes as a means to improve properties and reduce cracking potential. However, internal curing could allow for earlier removal of external wet curing while relying on the inherent characteristics of well designed high-performance concrete to provide the specified engineering properties.

### **OBJECTIVES**

The goal of this research project is to determine if the incorporation of saturated lightweight aggregate into high-performance concrete bridge deck mixtures can significantly reduce external curing requirements (currently 14 days) while maintaining crack-free or crack-resistant concrete.

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

[http://www.oregon.gov/ODOT/TD/TP\\_RES/ActiveProjectsIII.shtml#SPR\\_711](http://www.oregon.gov/ODOT/TD/TP_RES/ActiveProjectsIII.shtml#SPR_711)

### **PROPOSED ACTIVITIES**

Task 1: Literature Review.

Task 2: Materials Selection and Procurement..

Task 3: Laboratory Evaluation.

Task 4: Field Trials.

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.)

## ORGANIZATIONAL RESPONSIBILITY

ODOT Research Section

ODOT Bridge Section

Oregon State University (Agreement for \$214,825, expiring 12/31/2011, with approximately \$172,500 expended through FY'11).

## COST INFORMATION

<b>SPR 711</b>	<b>FY'10</b>	<b>FY'11</b>	<b>FY'12</b>	<b>FY'13</b>	<b>TOTAL</b>
STAGE 2 BUDGET	\$54,000	\$ 108,000	\$54,000	\$ 0	<b>\$216,000</b>
WORK PLAN BUDGET	94,148	101,363	39,314	\$ 0	<b>234,825</b>
SPENT TO DATE	\$94,222	\$100,000	NA		<b>\$194,222</b>
<b>REVISED BUDGET</b>	<b>\$94,222</b>	<b>\$ 100,000</b>	<b>\$ 39,616</b>	<b>\$ 0</b>	<b>\$233,838</b>

*FY'11 expenditures are estimated.*

## **712 PERFORMANCE OF NEAR-SURFACE MOUNTED CFRPS FOR SHEAR STRENGTHENING OF RC BRIDGE GIRDERS**

### **OVERVIEW**

One area of focus for Oregon bridge rehabilitation has been in shear strengthening of conventional reinforced concrete deck girder bridges (RCDG). A new strengthening system called Near-Surface-Mount (NSM) CFRP has emerged that may permit shear and flexural strengthening of RCDG bridge members. This relatively new technology involves cutting a groove in the surface concrete, filling the groove with an epoxy adhesive, and positioning CFRP material in the groove.

Early research results for this approach are mixed, and inconclusive. Experimental results are needed to quantify the structural performance of members strengthened with NSM-CFRP for validation of design methods for shear strengthening, as well as to enhance economy, and refine detailing and constructability. Further, experience with NSM-CFRP may facilitate other applications such as flexural strengthening of bridge members with poor flexural cut-off details.

### **OBJECTIVES**

The objectives of the proposed research are to develop analysis, design, detailing, and installation quality assurance recommendations for NSM-CFRP shear applications, as well as to compare the cost of NSM versus external CFRP reinforcement installations.

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

[http://www.oregon.gov/ODOT/TD/TP\\_RES/ActiveProjectsIII.shtml#SPR\\_712](http://www.oregon.gov/ODOT/TD/TP_RES/ActiveProjectsIII.shtml#SPR_712)

### **PROPOSED ACTIVITIES**

- Task 1: Literature Review.
- Task 2: Bond Performance.
- Task 3: Shear Performance.
- Task 4: Analysis and Design Methods.
- Task 5: Reporting.

More information on proposed activities can be found in the Project Work Plan at the link below:

[http://www.oregon.gov/ODOT/TD/TP\\_RES/ActiveProjectsIII.shtml#SPR\\_712](http://www.oregon.gov/ODOT/TD/TP_RES/ActiveProjectsIII.shtml#SPR_712)

**ACCOMPLISHMENTS** (see Quarterly Reports at the link above.)

## ORGANIZATIONAL RESPONSIBILITY

ODOT Research Section

ODOT Bridge Section

Oregon State University (Agreement for \$400,000 ending 12/31/2011 fully expended through FY'11).

## COST INFORMATION

<b>SPR 712</b>	<b>FY'10</b>	<b>FY'11</b>	<b>FY'12</b>	<b>FY'13</b>	<b>TOTAL</b>
STAGE 2 BUDGET	\$102,500	\$205,000	\$102,500	\$0	<b>\$410,000</b>
WORK PLAN BUDGET	<b>183,000</b>	<b>201,000</b>	<b>26,000</b>	\$0	<b>410,000</b>
SPENT TO DATE	\$230,685	\$180,450	NA		<b>\$411,135</b>
<b>REVISED BUDGET</b>	<b>\$ 230,685</b>	<b>\$180,450</b>	<b>\$1,000</b>	<b>\$ 0</b>	<b>\$412,135</b>

*FY'11 expenditures are estimated.*

## **713 ASPHALT BINDER GRADE SELECTION FOR HMAC WITH RECYCLED ASPHALT PRODUCTS**

### **OVERVIEW**

Oregon currently allows up to 30% recycled asphalt pavement (RAP) to be used in hot mixed asphalt concrete (HMAC). ODOT has also been approached about allowing the use of recycled asphalt shingles (RAS) in HMAC. RAS contains asphalt cement that is substantially stiffer than that used in HMAC in Oregon; hence, inclusion of RAS in HMAC could significantly impact the properties of the blended binder.

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

[http://www.oregon.gov/ODOT/TD/TP\\_RES/ActiveProjectsIII.shtml#SPR\\_713](http://www.oregon.gov/ODOT/TD/TP_RES/ActiveProjectsIII.shtml#SPR_713)

### **OBJECTIVES**

This research is intended to investigate how the proportion of RAP or RAS impacts the blended binder properties as well as those of mixtures containing varying proportions of RAP or RAS.

### **PROPOSED ACTIVITIES**

- Task 1: Literature Review.
- Task 2: Preliminary Procedures.
- Task 3: Experiment Plans.
- Task 4: Laboratory Study.
- Task 5: Develop Recommended Procedures.
- Task 6: 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.)

### **ORGANIZATIONAL RESPONSIBILITY**

ODOT Research Section  
ODOT Pavement Services  
Oregon State University (Agreement for \$185,000 expiring 7/31/2011, with approximately \$180,000 expended through FY'11).

**COST INFORMATION**

<b>SPR 713</b>	<b>FY'10</b>	<b>FY'11</b>	<b>FY'12</b>	<b>FY'13</b>	<b>TOTAL</b>
STAGE 2 BUDGET	\$ 78,334	\$156,666	\$0		<b>\$235,000</b>
WORK PLAN BUDGET	\$ 97,309	\$136,054	\$0		<b>\$233,363</b>
SPENT TO DATE	\$73,515	\$168,000	NA		<b>\$241,515</b>
<b>REVISED BUDGET</b>	<b>\$73,515</b>	<b>\$168,000</b>	<b>\$8,509</b>	<b>\$</b>	<b>\$250,024</b>

*FY'11 expenditures are estimated.*

## **714 FEASIBILITY OF USING SAFETY EDGE IN OREGON**

### **OVERVIEW**

Lane departure crashes represent a substantial portion of our statewide crashes. Often these crashes involve a vehicle that runs off the road. Safety projects including barriers, rumble strips, etc., have been implemented and appear to be making a difference in reducing roadway departure crashes. However, one relatively low cost solution yet to be used in Oregon is Safety Edge, a paving technique that improves the angle between the roadway edge and graded shoulder to minimize the vertical drop off and improve the chance of recovery. The Federal Highway Administration has identified the Safety Edge to be a proven safety countermeasure and actively encourage states to use it.

### **OBJECTIVES**

Notwithstanding FHWA's recommendation to deploy the Safety Edge, presumed benefits may vary depending on specific site conditions. It is important to determine where and when the Safety Edge should be constructed. A first step to achieve this is to perform an evaluation of the cost, benefit, and feasibility of utilizing Safety Edge on pavement preservation projects, which includes a comparison with alternative measures such as rumble strips and enhanced pavement markings.

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\\_714](http://www.oregon.gov/ODOT/TD/TP_RES/ActiveProjectsIV.shtml#SPR_714)

### **PROPOSED ACTIVITIES**

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

- Task 1: Literature Review.
- Task 2: National Review.
- Task 3: Project Identification.
- Task 4: Field Trials.
- Task 5: Evaluation and Recommendations.
- Task 6: Reports.

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

**ACCOMPLISHMENTS** (see Quarterly Reports at the link above.)

## ORGANIZATIONAL RESPONSIBILITY

ODOT Research Section

ODOT Traffic/Roadway Section

Oregon State University (Agreement for \$112,494 expiring in November 2011, with approximately \$65,000 expended through FY'11).

## COST INFORMATION

Note: The materials and labor cost of safety edge installation is not included in the budget.

<b>SPR 714</b>	<b>FY'10</b>	<b>FY'11</b>	<b>FY'12</b>	<b>FY'13</b>	<b>TOTAL</b>
STAGE 2 BUDGET	\$32,181	\$64,364	\$21,455		<b>\$118,000</b>
WORK PLAN BUDGET	\$6,080	\$91,600	\$25,314	<b>\$0</b>	<b>\$122,994</b>
SPENT TO DATE	\$4,930	\$72,713	NA	\$0	<b>\$77,643</b>
<b>REVISED BUDGET</b>	<b>\$4,930</b>	<b>\$72,713</b>	<b>\$48,781</b>	<b>\$0</b>	<b>\$126,424</b>

*FY'11 expenditures are estimated.*

## **715 EFFECT OF IMPLEMENTATION OF THE FLUVIAL PERFORMANCE STANDARD ON MAINTENANCE OF BRIDGES AND CULVERTS**

### **OVERVIEW**

The "fluvial performance standard", developed for the OTIA III Bridge Program, sets a minimum opening width for bridges and culverts to protect channel processes and in-stream habitat. Cost of longer bridges and wider spans with imposition of this standard is a concern. Costs are being tracked, but no analysis of potential benefits has been completed. For example, the frequency of sediment cleanout or removal of drift accumulation on bridge piers and bridge and culvert scour repair may be substantially reduced. Assessment of the cost of implementation should include these offsetting benefits.

### **OBJECTIVES**

This project would include a comparative study of types of maintenance issues, frequency of maintenance actions and costs of those actions between bridges and culverts that meet the fluvial performance standard and those that do not. This will entail examination of plans to determine conformance with the fluvial performance standard, site visits to identify similar stream conditions, and analysis of the relevant maintenance records. Analysis would focus on determining if there is a substantial difference in maintenance requirements and costs given similar stream conditions.

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\\_715](http://www.oregon.gov/ODOT/TD/TP_RES/ActiveProjectsIV.shtml#SPR_715)

### **PROPOSED ACTIVITIES**

Task 1: Classify Bridge Projects and select a sample of study sites.

Task 2: Compile a list of maintenance related issues relevant to impaired stream function and assess maintenance records to identify comparative metrics.

Task 3: Gather, reduce and analyze comparative metrics, and interpret results.

Task 4: Draft a 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.)

### **ORGANIZATIONAL RESPONSIBILITY**

ODOT Research Section

ODOT Geo-Environmental Section

Oregon State University (Agreement for \$74,000 expiring with about \$65,000 expended through 6/30/2011).

## COST INFORMATION

<b>SPR 715</b>	<b>FY'10</b>	<b>FY'11</b>	<b>FY'12</b>	<b>FY'13</b>	<b>TOTAL</b>
STAGE 2 BUDGET	\$ 27,334	\$ 54,666	\$0		<b>\$ 82,000</b>
WORK PLAN BUDGET	\$ 27,172	\$ 56,828	<b>\$0</b>		<b>\$ 84,000</b>
SPENT TO DATE	\$ 21,186	\$48,000			<b>\$ 69,186</b>
<b>REVISED BUDGET</b>	<b>\$ 21,186</b>	<b>\$ 48,000</b>	<b>\$9,170</b>		<b>\$78,356</b>

*FY'11 expenditures are estimated.*

## **716 SUPPLEMENTAL PERFORMANCE MEASURES FOR OREGON HIGHWAY PLAN (OHP) MOBILITY STANDARDS**

### **OVERVIEW**

The 1999 Oregon Highway Plan directs how ODOT plans, manages and funds state highways. It establishes highway mobility standards, measured through volume to capacity ratios (v/c). While v/c effectively serves many aspects of planning work, it is less effective under congested conditions, as well as for assessing operations, safety and alternate mode improvements. As it becomes more difficult to meet current v/c standards, more parties are looking toward the development of alternate mobility standards, which must be v/c-related for application consistency.

### **OBJECTIVES**

The goal of this project is to identify alternative performance measures that can effectively supplement the v/c mobility standards. The objectives of the project include the following: a) prepare an inventory of potential alternative measures; b) assess the validity of the alternative measures against internal and external criteria; and c) assess the compatibility of the alternative measures with other ODOT objectives such as least cost planning, GHG reduction or facilitating economic development.

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\\_716](http://www.oregon.gov/ODOT/TD/TP_RES/ActiveProjectsIV.shtml#SPR_716)

### **PROPOSED ACTIVITIES**

#### Phase I

- Task 1: Literature Review.
- Task 2: Information Gathering.
- Task 3: Case Study Analysis.
- Task 4: Selection of Mobility Measures.

#### Phase II

- Task 1: Model Mobility Measures for Case Studies
- Task 2: Sensitivity Analysis of Selected Mobility Measures
- Task 3: 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.)

## ORGANIZATIONAL RESPONSIBILITY

ODOT Research Section

Oregon Planning Section

Portland State University (Agreement for \$127,117 with \$93,500 expended through 6/30/11).

## COST INFORMATION

<b>SPR 716</b>	<b>FY'10</b>	<b>FY'11</b>	<b>FY'12</b>	<b>FY'13</b>	<b>TOTAL</b>
STAGE 2 BUDGET	\$42,500	\$85,000			<b>\$127,500</b>
WORK PLAN BUDGET	\$69,544	\$67,374			<b>\$136,918</b>
SPENT TO DATE	\$52,217	\$44,000	NA		<b>\$96,217</b>
<b>REVISED BUDGET</b>	<b>\$52,217</b>	<b>\$ 44,000</b>	<b>\$ 45,738</b>		<b>\$141,955</b>

*FY'11 expenditures are estimated.*

## **717 RELATING TSMO STRATEGIES TO POLICY GOALS**

### **OVERVIEW**

ODOT and other transportation agencies have turned to low cost strategies to address transportation problems. The majority of these strategies are grouped under, what is sometimes termed Transportation System Management and Operations (TSMO) strategies. TSMO strategies are characterized as follows: Transportation System Management (TSM); Transportation Demand Management (TDM); and Intelligent Transportation Solutions (ITS). While the efficacy of TSMO strategies is recognized, the linkages of the various TSMO tools and strategies in relation to differing policy goals is not well understood by policy makers, and as a result their effectiveness has been limited.

### **OBJECTIVES**

The goal of the research is to identify the quantitative strengths and weaknesses of select TSMO strategies relative to specific policy goals. The data will be summarized in a comparison matrix that can be used by decision makers and reviewers to relate the trade-offs and benefits of each TSMO strategy in to ODOT's goals/objectives

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\\_717](http://www.oregon.gov/ODOT/TD/TP_RES/ActiveProjectsIV.shtml#SPR_717)

### **PROPOSED ACTIVITIES**

Task 1: Revisit ODOT policy goals relevant to TSMO.

Task 2: Select TSMO strategies to be Investigated.

Task 3: Literature review.

Task 4

a: Data collection.

b: Develop methodology for data quantification.

Task 5: Data analysis.

Task 6: Quantify TSMO atrategies.

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.)

## ORGANIZATIONAL RESPONSIBILITY

ODOT Research Section

Oregon State University (Agreement for \$156,522 expires 6/30/11. Approximately \$115,000 will be expended through FY '11. The project is behind schedule and the contract will probably have to be amended with a no-cost time extension.)

## COST INFORMATION

<b>SPR 717</b>	<b>FY'10</b>	<b>FY'11</b>	<b>FY'12</b>	<b>FY'13</b>	<b>TOTAL</b>
STAGE 2 BUDGET	\$46,500	\$93,000	\$15,500		<b>\$155,000</b>
WORK PLAN BUDGET	\$66,567	\$97,955	2,000		<b>\$166,522</b>
SPENT TO DATE	\$39,952	\$80,240	NA		<b>\$125,192</b>
<b>REVISED BUDGET</b>	<b>\$ 39,952</b>	<b>\$ 80,240</b>	<b>\$ 42,000</b>	<b>\$0</b>	<b>\$162,192</b>

*FY'11 expenditures are estimated.*

## **718 MECHANISTIC DESIGN GUIDE CALIBRATION FOR PAVEMENT REHABILITATION**

### **OVERVIEW**

Internally, ODOT has been evaluating the MEPDG for new work sections for both flexible and rigid interstate pavement sections. This work has principally involved using ODOT-specific design inputs for traffic and, to a lesser degree, inputs using generic materials.

Work is also currently being conducted at Oregon State University to develop design inputs and evaluate the three principal pavement performance models (i.e., fatigue cracking, rutting, and thermal cracking models) that are integral to the design process of new work, but the majority of work involves rehabilitation of existing pavements. This project addresses calibration of the design process for rehabilitation.

### **OBJECTIVES**

The objective of the research is to provide ODOT with pavement performance models for HMAC overlays that predict fatigue cracking, rutting, thermal cracking, and reflection cracking calibrated to Oregon conditions.

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\\_718](http://www.oregon.gov/ODOT/TD/TP_RES/ActiveProjectsIV.shtml#SPR_718)

### **PROPOSED ACTIVITIES**

Task 1: Literature Review.

Task 2: Calibration Plan.

Task 3: Records Review.

Task 4: Condition Surveys.

Task 5: Model Calibration.

Task 6: 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.)

## ORGANIZATIONAL RESPONSIBILITY

ODOT Research Section

ODOT Pavement Services

Iowa State University (An agreement for \$148,000 expires in February 2012 with approximately \$70,000 expended through June 2011).

## COST INFORMATION

<b>SPR 718</b>	<b>FY'10</b>	<b>FY'11</b>	<b>FY'12</b>	<b>FY'13</b>	<b>TOTAL</b>
STAGE 2 BUDGET	\$49,333	\$98,667			<b>\$148,000</b>
WORK PLAN BUDGET	\$60,920	\$96,080	\$2,000		<b>\$159,000</b>
SPENT TO DATE	\$15,089	\$77,000	NA		<b>\$ 92,089</b>
<b>REVISED BUDGET</b>	\$15,089	<b>\$ 77,000</b>	<b>\$73,210</b>	<b>\$0</b>	<b>\$165,299</b>

*FY'11 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](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.)

## ORGANIZATIONAL RESPONSIBILITY

ODOT Research Section  
ODOT Geo-Environmental Section  
ODOT District 4  
US Forest Service  
National Marine Fisheries Service  
Oregon Department of Environmental Quality

## COST INFORMATION

<b>SPR 719</b>	<b>FY'10</b>	<b>FY'11</b>	<b>FY'12</b>	<b>FY'13</b>	<b>FY'14</b>	<b>FY15-19</b>	<b>TOTAL</b>
STAGE 2 BUDGET	65,778	24,358	24,358	24,358	34,358	131,790	<b>305,000</b>
WORK PLAN BUDGET	\$37,000	\$28,000	\$48,360	\$18,727	\$79,102	105,051	<b>\$316,240</b>
SPENT TO DATE	\$16,344	47,000		A			<b>\$63,344</b>
<b>REVISED BUDGET</b>	<b>\$16,344</b>	<b>\$47,000</b>	<b>\$20,000</b>	<b>\$20,000</b>	<b>\$21,632</b>	<b>\$161,852</b>	<b>\$286,828</b>

*FY'11 expenditures are estimated.*

## **720 QUANTIFYING SAFETY PERFORMANCE OF DRIVEWAYS ON STATE HIGHWAYS**

### **OVERVIEW**

Recent efforts to build a statewide inventory of existing highway approaches revealed that the Department has no permit record for a large number of approaches. A new ODOT policy directive will establish a process to assess when an un-permitted approach is a significant safety concern and what action is appropriate. A better understanding of the relationship between highway access, conflict patterns and types of crashes will help staff to recognize and prioritize safety concerns and take appropriate action under the directive.

### **OBJECTIVES**

The objective of this research is two-fold. The first objective is to analyze and assess the key issues related to ODOT access management decisions for driveways and second to provide factual support for changes to existing ODOT policies, statues and rules to support reduce crash risk on the state road network.

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\\_720](http://www.oregon.gov/ODOT/TD/TP_RES/ActiveProjectsIV.shtml#SPR_720)

### **PROPOSED ACTIVITIES**

Task 1 - Literature Review:

Task 2 - Data Collection:

Task 3 - Data Analysis:

Task 4 - Recommendations and 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.)

### **ORGANIZATIONAL RESPONSIBILITY**

ODOT Research Section

ODOT Access Management Unit

Oregon State University (Agreement for \$110,000 expires 3/31/2011 with approximately \$90,000 expended through FY'11).

**COST INFORMATION**

<b>SPR 720</b>	<b>FY'10</b>	<b>FY'11</b>	<b>FY'12</b>	<b>FY'13</b>	<b>TOTAL</b>
STAGE 2 BUDGET	\$27,500	\$55,000	\$27,500		<b>\$110,000</b>
WORK PLAN BUDGET	\$61,500	\$59,000	\$0		<b>\$120,500</b>
SPENT TO DATE	\$82,030	\$19,100	\$0		\$101,130
REVISED BUDGET	<b>\$82,030</b>	<b>\$19,100</b>	<b>\$21,937</b>		<b>\$123,067</b>

*FY'11 expenditures are estimated.*

## **721 EVALUATION OF ALTERNATIVE PEDESTRIAN TRAFFIC CONTROL DEVICES**

### **OVERVIEW AND OBJECTIVES**

The Federal Highway Administration (FHWA) recently issued Interim Approval for Optional Use of Rectangular Rapid Flashing Beacons (RRFB) (IA-11) as a supplement to standard pedestrian crossing or school crossing signs at crosswalks at uncontrolled approaches. Research in Florida cities show substantially higher compliance rates compared to crossings equipped with standard beacons. Florida's pedestrian law is a "yield" law whereas in Oregon drivers must stop for pedestrians so the results achieved here might differ.

Several Oregon cities plan to install RRFBs. Other pedestrian traffic control devices have been designed or installed on an experimental basis in Oregon. One such device is the HAWK also referred to as a pedestrian hybrid signal in the proposed next edition of the federal Manual on Uniform Traffic Control Devices (MUTCD). Proposed MUTCD amendments would allow jurisdictions to use these signals, to the extent that they comply with new guidelines.

### **OBJECTIVES**

The objective of the project is to use the OSU driving simulator and field studies to answer the following questions:

1. Does the dark signal confuse motorists, and do they come to a stop when they first see it?
2. Would placement of Hawk or RRFB signals at sides only be effective in reducing confusion, and would the side mounts be as effective in stopping vehicles?
3. Should the HAWK and RRFBs only be used at mid-block crossings?
4. What do drivers understand about flashing beacons?
5. Are there specific design or operations issues that should be addressed, especially when designing bicycle signals as part of HAWK installations at intersections?

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\\_721](http://www.oregon.gov/ODOT/TD/TP_RES/ActiveProjectsIV.shtml#SPR_721)

### **PROPOSED ACTIVITIES**

Task 1: Literature Review.

Task 2: Data Collection and Assessment.

Task 3: Assess Alternative Pedestrian Traffic Control Devices.

Task 4: Analysis and Recommendations.

Task 5: 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.)

**ORGANIZATIONAL RESPONSIBILITY**

ODOT Research Section

ODOT Traffic/Roadway Section

Oregon State University (Agreement for \$110,000 expires 8/31/2011 with approximately \$80,000 expended through FY'11).

**COST INFORMATION**

<b>SPR 721</b>	<b>FY'10</b>	<b>FY'11</b>	<b>FY'12</b>	<b>FY'13</b>	<b>TOTAL</b>
STAGE 2 BUDGET	\$30,000	\$60,000	\$30,000		<b>\$120,000</b>
WORK PLAN BUDGET	\$62,000	\$60,000	\$0		<b>\$122,000</b>
SPENT TO DATE	\$20,875	\$90,250			<b>\$ 100,912</b>
<b>REVISED BUDGET</b>	<b>\$20,875</b>	<b>\$90,250</b>	<b>\$22,787</b>		<b>\$133,912</b>

*FY'11 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](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.)

### **ORGANIZATIONAL RESPONSIBILITY**

ODOT Research Section

ODOT Bridge Section

Oregon State University (Agreement for \$229,089 ending June 2013 with approximately \$71,000 expended in FY'11)

## COST INFORMATION

<b>SPR 728</b>	<b>FY'11</b>	<b>FY'12</b>	<b>FY'13</b>	<b>FY'14</b>	<b>TOTAL</b>
STAGE 2 BUDGET	\$ 62,500	\$120,000	\$62,500		<b>\$245,000</b>
WORK PLAN BUDGET	\$ 69,602	\$110,000	\$ 48,000	\$ 0	\$227,602
SPENT TO DATE	\$ 75,850				<b>\$ 75,850</b>
<b>REVISED BUDGET</b>	<b>\$ 75,850</b>	\$104,000	\$ 48,000		<b>\$227,850</b>

*FY'11 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](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.)

## ORGANIZATIONAL RESPONSIBILITY

ODOT Research Section

ODOT Traffic/Roadway Section

ODOT ITS Unit

University of Washington (Phase 1 agreement for \$154,000 with approximately \$35,000 expended through June 2011.)

## COST INFORMATION

<b>SPR 729</b>	<b>FY'11</b>	<b>FY'12</b>	<b>FY'13</b>	<b>FY'14</b>	<b>TOTAL</b>
STAGE 2 BUDGET	\$54,000	\$108,000	\$0		<b>\$162,000</b>
WORK PLAN BUDGET	\$65,000	\$98,000	\$0		<b>\$163,000</b>
SPENT TO DATE	\$42,000				<b>\$42,000</b>
<b>REVISED BUDGET</b>	<b>\$42,000</b>	<b>\$123,000</b>			<b>\$165,000</b>
<b>UTC Commitment (TransNow)</b>	<b>\$43,333</b>	<b>\$52,667</b>			<b>\$96,000</b>

*FY'11 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](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.)

### **ORGANIZATIONAL RESPONSIBILITY**

ODOT Research Section

ODOT Geo-Environmental Section

Oregon State University (Agreement for \$360,294 with approximately \$24,000 expended through June 2011.)

## COST INFORMATION

<b>SPR 730</b>	<b>FY'11</b>	<b>FY'12</b>	<b>FY'13</b>	<b>FY'14</b>	<b>TOTAL</b>
STAGE 2 BUDGET	\$1,000	\$132,333	\$132,333	132,334	<b>\$398,000</b>
WORK PLAN BUDGET	\$39,000	\$144,000	\$144,000	50,794	<b>\$377,794</b>
SPENT TO DATE	\$24,000				
<b>REVISED BUDGET</b>	<b>\$24,000</b>	\$149,000	\$149,000	\$51,794	<b>\$373,794</b>

*FY'11 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](http://www.oregon.gov/ODOT/TD/TP_RES/ActiveProjectsV.shtml#SPR_731)

### **PROPOSED ACTIVITIES**

1. Literature survey:
2. Determine pile driving sound generation mechanisms:
3. Model sound propagation:
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.)

**ORGANIZATIONAL RESPONSIBILITY**

ODOT Research Section

ODOT Geo-Environmental Section

Oregon State University Oregon (Agreement for \$232,000 with approximately \$90,000 expended through June 2011.)

**COST INFORMATION**

<b>SPR 731</b>	<b>FY'11</b>	<b>FY'12</b>	<b>FY'13</b>	<b>FY'14</b>	<b>TOTAL</b>
STAGE 2 BUDGET	\$35,000	\$118,000	\$87,000		<b>\$240,000</b>
WORK PLAN BUDGET	\$128,000	\$133,500	\$15,500		<b>\$277,000</b>
SPENT TO DATE	\$99,500				<b>\$99,500</b>
<b>REVISED BUDGET</b>	<b>\$99,500</b>	<b>\$103,500</b>	<b>\$45,500</b>		<b>\$248,500</b>

*FY'11 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](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.)

## ORGANIZATIONAL RESPONSIBILITY

ODOT Research Section

ODOT Pavement Services Unit

Oregon State University (Agreement for \$177,739 with approximately \$19,000 expended through June 2011.)

## COST INFORMATION

<b>SPR 732</b>	<b>FY'11</b>	<b>FY'12</b>	<b>FY'13</b>	<b>FY'14</b>	<b>TOTAL</b>
STAGE 2 BUDGET	\$38000	\$112,000	\$28,000		<b>\$178,000</b>
WORK PLAN BUDGET	\$	\$	\$0		<b>\$</b>
SPENT TO DATE	\$20,738				<b>\$20,378</b>
<b>REVISED BUDGET</b>	<b>\$20,738</b>	<b>118,426</b>	<b>47,075</b>		<b>186,239</b>

*FY'11 Expenditures are estimated.*

## **733 DEVELOPING SAFETY PERFORMANCE MEASURES FOR ROUNDABOUT APPLICATIONS IN OREGON**

### **OVERVIEW**

In recent years the construction of roundabouts 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 safety benefits of roundabouts in Oregon and the Pacific Northwest will enable ODOT and 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, these frequently cited statistics are primarily based on British and Australian research. Crash experience in the United States is less clear. The soon-to-be-released AASHTO *Highway Safety Manual* (HSM) includes a wide range for crash reduction factors associated with conversion of intersections to roundabouts. The reason for these vastly different estimates is confusing and merits validation for Oregon roundabouts so as to provide reliable, dependable information about safety as one component of the project design process.

In addition, safety assessment of roundabouts should incorporate consideration of all users including motorized vehicles (cars, heavy vehicles, and emergency vehicles), pedestrians, and bicycles. As a result, the goal of this proposed research is to calibrate safety performance functions or crash modification factors for Oregon roundabouts.

### **OBJECTIVES**

Currently Oregon has 44 single-lane roundabouts and 6 multilane roundabouts. This proposed research effort will evaluate the crash history at these roundabout locations to determine suitable safety performance metrics for use in evaluating roundabout decisions in the State of Oregon. Since this sample size (particularly for the multilane roundabouts) is relatively small and many of these roundabouts were constructed in recent years, it is reasonable to expand the analysis, if needed, to roundabout safety performance in the State of Washington where they currently have 24 multilane and 85 single-lane roundabouts.

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\\_733](http://www.oregon.gov/ODOT/TD/TP_RES/ActiveProjectsV.shtml#SPR_733)

### **PROPOSED ACTIVITIES**

**Task 1.** Conduct a literature search to identify the various roundabout safety performance functions and crash modification factors available to date and determine the basis for their development (number of sites, locations, characteristics, etc.)

**Task 2.** Identify potential sites, data requirements, and analysis procedures and develop a research approach to perform assessments.

**Task 3.** Acquire historic crash data and site information needed to perform the assessments identified in Task 2.

**Task 4.** Perform analytical assessment of data from Task 3 and develop the safety performance functions or crash modification factors.

**Task 5:** Prepare a comprehensive report of findings.

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.)

### **ORGANIZATIONAL RESPONSIBILITY**

ODOT Research Section

ODOT Roadway Design

Oregon State University (Agreement for \$140,000 ending in December 2012 with approximately \$4,000 expended through FY'11.)

### **COST INFORMATION**

<b>SPR 733</b>	<b>FY'11</b>	<b>FY'12</b>	<b>FY'13</b>	<b>FY'14</b>	<b>TOTAL</b>
STAGE 2 BUDGET	\$32,000	\$119,000	\$		<b>\$151,000</b>
WORK PLAN BUDGET	\$ 5,900	\$ 99,392	\$ 42,708		<b>\$148,000</b>
SPENT TO DATE	5,900				<b>\$5,900</b>
<b>REVISED BUDGET</b>					

*FY'11 Expenditures are estimated.*

## **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 (1). 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](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.)

## ORGANIZATIONAL RESPONSIBILITY

ODOT Research Section  
ODOT Pavement Services Unit  
Iowa State University (Agreement pending).

## COST INFORMATION

<b>SPR 734</b>	<b>FY'11</b>	<b>FY'12</b>	<b>FY'13</b>	<b>FY'14</b>	<b>TOTAL</b>
STAGE 2 BUDGET	\$21,500	\$85,500	\$21,000		<b>\$128,000</b>
WORK PLAN BUDGET	NA	NA	NA		<b>NA</b>
SPENT TO DATE	\$1,000				<b>\$1,000</b>
<b>REVISED BUDGET</b>					

*FY'11 Expenditures are estimated.*

## **735 MEASURING THE PERFORMANCE OF TRANSIT RELATIVE TO LIVABILITY**

### **OVERVIEW**

Performance measures need to be developed which gauge how components of transit (e.g. location, access, and connections) relate to components of livability (e.g. access to employment, and commercial/retail spaces), and to quantify transit's performance (use). This information is critical for the optimization of transit investments, not only to increase livability, but to promote alternate mode use, thereby decreasing congestion and vehicle emissions.

Current methods for measuring the performance of transit relative to livability are vague and undefined. Further, constituents of livability vary from state to state, highlighting the need to develop local, Oregon-specific performance measures. Within Oregon, livability has explicitly been outlined as a consideration for the Statewide Transportation Improvement Program (STIP) by HB 2001, and indirectly outlined in Policy 1B of the Oregon Highway Plan (OHP), which directs the state to work with local governments to coordinate land use and transportation planning.

### **OBJECTIVES**

The proposed research will develop GIS-based quantitative transit system performance indicators for livability criteria. The research will examine two spatial scales (regional and neighborhood) with two frameworks for evaluation (coverage and accessibility). At a regional scale, performance metrics will focus on the needs of people getting to work and to other destinations in addition to the geographic coverage of transit. At the neighborhood level, the urban form will be investigated to determine if it supports or hinders access to and use of the transit facility. The indicators will be validated using transit use/performance data (e.g. ridership) and performing regression analysis.

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\\_735](http://www.oregon.gov/ODOT/TD/TP_RES/ActiveProjectsV.shtml#SPR_735)

### **PROPOSED ACTIVITIES**

- Task 1: Literature Review and Identification of Measures.
- Task 2: Assessment of data availability.
- Task 3: Selection of study areas.
- Task 4: Develop measures.
- Task 5: Validate measures.
- 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.)

## ORGANIZATIONAL RESPONSIBILITY

ODOT Research Section

ODOT Planning Section

ODOT Transit Division

Portland State University

University of Oregon (Agreement for \$112,845 ending 05/31/2012 with approximately \$45,000 expended through FY'11).

## COST INFORMATION

<b>SPR 735</b>	<b>FY'11</b>	<b>FY'12</b>	<b>FY'13</b>	<b>FY'14</b>	<b>TOTAL</b>
STAGE 2 BUDGET	\$78,000	\$78,000			<b>\$156,000</b>
WORK PLAN BUDGET	\$74,813	\$43,032			<b>\$117,845</b>
SPENT TO DATE	\$46,035				<b>\$46,035</b>
<b>REVISED BUDGET</b>	<b>\$46,035</b>	<b>\$71,810</b>			<b>\$117,845</b>
<b>UTC Commitment (OTREC)</b>	<b>56,000</b>	<b>56,000</b>			<b>112,000</b>

*FY'11 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](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.)

## ORGANIZATIONAL RESPONSIBILITY

ODOT Research Section

OODT Bridge Section

Montana State University (Agreement for \$215,000 expiring 09/30/2013 with approximately \$38,000 expended through FY'11.)

## COST INFORMATION

<b>SPR 736</b>	<b>FY'11</b>	<b>FY'12</b>	<b>FY'13</b>	<b>FY'14</b>	<b>TOTAL</b>
STAGE 2 BUDGET	\$60,000	\$90,000	\$75,000		<b>\$225,000</b>
WORK PLAN BUDGET	\$41,500	\$113,956	\$92,044		<b>\$247,500</b>
SPENT TO DATE	\$41,500				<b>\$41,500</b>
<b>REVISED BUDGET</b>					
<b>UTC Commitment (WTI)</b>	\$20,000	\$40,000	\$11,000		<b>\$71,000</b>
<b>UTC Commitment (AUTC)</b>	\$50,000	\$50,000	45,000		<b>\$145,000</b>

*FY'11 Expenditures are estimated.*

## **737 WIRELESS DATA COLLECTION SYSTEM FOR TRAVEL TIME ESTIMATION AND TRAFFIC PERFORMANCE EVALUATION**

### **OVERVIEW**

From the perspective of the road users, real-time updates on travel times will permit better travel and route planning. ODOT will be able to use highway performance data to operate a more efficient transportation system and more effectively use limited resources for upgrades, expansions, and maintenance.

Research to date has demonstrated the feasibility of reading MAC addresses from Bluetooth-enabled devices present in vehicles moving past a fixed location and recording the time of this reading, which can be used as a basis for estimating travel time and delay. While the technology used to collect such travel time samples is evolving, there is little information available pertaining to the processing, reporting and accuracy of estimates based on such data.

The proposed research will build on of two prior projects supported by ODOT and OTREC focusing on hardware and system development for collecting travel time samples using Bluetooth technology. The main objective of these projects was to build and deploy a system of low cost Bluetooth-based readers that successfully read, transmit and store travel time samples computed from MAC addresses read from passing vehicles.

### **OBJECTIVES**

The objective of the proposed project is to complete the research and development for a travel time data collection system utilizing wireless reading of MAC addresses, as described above. This system will generate several types of reports for travel times over a specific road segment equipped with Bluetooth (BT) readers. These reports will include:

- An estimate of the average travel time over different historical time periods and information on the certainty of the estimates,
- The behavior of travel time data over time,
- If MAC address data is collected at an intersection, then intersection performance data reports will also be provided if research shows that accurate estimates can be generated from collected data.

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\\_737](http://www.oregon.gov/ODOT/TD/TP_RES/ActiveProjectsV.shtml#SPR_737)

### **PROPOSED ACTIVITIES**

Task 1: Literature Review.

Task 2: Develop different methods for computing travel time samples from collected MAC addresses, and evaluate distributed vs. centralized data filtering.

Task 3: Develop and implement procedures for identifying and removing travel time data sample outliers.

Task 4: Determine requirements for what data is stored and how long it is stored

Task 5: Develop and implement a data analysis methodology for generating travel time performance measures from collected travel time samples

Task 6: Develop and implement a data analysis methodology for generating other road system performance measures from collected travel time samples.

Task 7: Evaluate alternative methods for data flow and assess data volumes.

Task 8: Develop and 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.)

### **ORGANIZATIONAL RESPONSIBILITY**

ODOT Research Section

ODOT ITS Unit

Oregon State University (Agreement for \$118,000 ending 3/31/12, with approximately \$33,000 expended through FY'11.)

### **COST INFORMATION**

<b>SPR 737</b>	<b>FY'11</b>	<b>FY'12</b>	<b>FY'13</b>	<b>FY'14</b>	<b>TOTAL</b>
STAGE 2 BUDGET	\$75,000	\$150,000	\$		<b>\$225,000</b>
WORK PLAN BUDGET	\$59,000	\$66,000	\$0		<b>\$125,000</b>
SPENT TO DATE	\$63,250				<b>\$36,250</b>
<b>REVISED BUDGET</b>	<b>\$63,250</b>	<b>\$61,000</b>			<b>\$124,250</b>
<b>UTC Commitment (OTREC)</b>	<b>\$75,000</b>	<b>\$25,000</b>			<b>\$100,000</b>

*FY'11 Expenditures are estimated.*

## **738 DETERMINING OUTSOURCING FEASIBILITY AND STANDARD PRICING METHODOLOGIES**

### **OVERVIEW**

According to mandates of Oregon House Bill 2867, effective January 2010, without reasonably based cost estimates and comparative cost analyses between ODOT's internal cost estimates and consultant cost estimates, ODOT is precluded from outsourcing design and construction project delivery. ODOT needs to develop a methodology for cost estimating and comparative cost analyses between ODOT internal cost estimates and consultant cost estimates that is accurate and transparent, in order that outsourcing may continue as an essential element in ODOT's delivery of projects.

### **OBJECTIVES**

1. Document current ODOT procedures for estimating costs, determining internal overhead, determining consultant profit rates, conducting comparative analyses, and integrating delay costs and utilization rates into cost estimates.
2. Determine the cost estimating procedures of other DOT's and summarize normally accepted procedures for allocating internal overhead of public agencies to projects.
3. Provide guidelines for ODOT procedures that will assure all stakeholders that the mandate of Oregon House Bill 2867 is being, or will be, met.

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\\_738](http://www.oregon.gov/ODOT/TD/TP_RES/ActiveProjectsV.shtml#SPR_738)

### **PROPOSED ACTIVITIES**

- Task 1: Document ODOT practice.
- Task 2: Literature Review.
- Task 3: Agency surveys.
- Task 4: Interviews.
- Task 5: Analysis and Experimentation.
- 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.)

## ORGANIZATIONAL RESPONSIBILITY

ODOT Research Section

ODOT Major Projects Office

Oregon State University (Agreement for \$140,310 ending 6/30/2012 with approximately \$45,000 expended in FY'11).

## COST INFORMATION

<b>SPR 738</b>	<b>FY'11</b>	<b>FY'12</b>	<b>FY'13</b>	<b>FY'14</b>	<b>TOTAL</b>
STAGE 2 BUDGET	\$26,500	\$114,000	\$11,500		<b>\$152,000</b>
WORK PLAN BUDGET	\$49,000	\$100,310	\$ 1,500		<b>\$150,810</b>
SPENT TO DATE	\$49,000				<b>\$49,000</b>
<b>REVISED BUDGET</b>					

*FY'11 Expenditures are estimated.*

## **OVERVIEW**

Within the context of this research, we are concerned with the movement of goods from one location to another as they move through the supply chain to the end customer. Understanding the relationships between transportation and characteristics such as commodity, shipment size, origin and destination, and time sensitivity, is necessary in order to properly evaluate the impact of transportation investments and policies on components of the economy, such as supply chains.

Existing freight models, such as the commercial truck module of the Oregon statewide model, do not adequately capture the complexity of supply chains. The common approach has been to mimic passenger travel modeling methods, an approach clearly inadequate for current analytical needs and ODOT planning priorities.

Recent state legislation (HB 2001 and HB 2186) has created a need for better freight forecasting and planning tools. Preliminary analysis indicates eliminating all passenger car emissions will not be sufficient, and freight movement will have to incorporate greenhouse gas reduction strategies. In order to evaluate potential state policies and understand the effects on the Oregon economy, transportation system, and land use, freight forecast models must be developed.

Developing more detailed models of supply chain transportation will enable ODOT to better account for potential effects of policy or transportation system changes, and improve the analysis of possible changes from congestion management techniques and environmental policies.

## **OBJECTIVES**

The goal of this project is to examine Oregon's supply chains and characterize predictable patterns at the regional and statewide level. In doing so, we will develop a classification scheme for Oregon's supply chains, and a description of the transportation characteristics of each supply chain type, therefore linking transportation and supply chain functions. The project will identify relationships existing between: routing patterns and decision logics; types of freight-dependent industry sectors, commodity types, delivery scheduling, vehicle types, geographic locations, and other available information such as facility size or employee count.

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\\_739](http://www.oregon.gov/ODOT/TD/TP_RES/ActiveProjectsV.shtml#SPR_739)

## **PROPOSED ACTIVITIES**

- Task 1. Review current literature on supply chain categorization.
- Task 2. Review Oregon's Statewide Travel Model.
- Task 3. Identify and review available data.
- Task 4. Design and conduct a web survey.
- Task 5. Analysis of survey results.
- Task 6. Investigate data needs for model development
- Task 7. Develop final report and present results to ODOT representatives

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.)

**ORGANIZATIONAL RESPONSIBILITY**

ODOT Research Section

University of Washington (Agreement for \$95,000 expiring December 2012, with approximately \$47,000 expended through FY'11.)

ODOT Transportation Planning Analysis Unit

**COST INFORMATION**

<b>SPR 739</b>	<b>FY'11</b>	<b>FY'12</b>	<b>FY'13</b>	<b>FY'14</b>	<b>TOTAL</b>
STAGE 2 BUDGET	\$50,000	\$50,000	\$0		<b>\$100,000</b>
WORK PLAN BUDGET	\$50,000	\$51,000	\$0		<b>\$ 101,000</b>
SPENT TO DATE	<b>\$50,000</b>				<b>\$50,000</b>
<b>REVISED BUDGET</b>					

*FY'11 Expenditures are estimated.*

## **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](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.

This project is under development in June of 2011. 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 2011. Once it begins, accomplishments may be viewed by selecting [Quarterly Reports](#) at the link above.)

### **ORGANIZATIONAL RESPONSIBILITY**

ODOT Research Section  
ODOT Geo-Environmental Section  
Oregon State University

### **COST INFORMATION**

<b>SPR 740</b>	<b>FY'12</b>	<b>FY'13</b>	<b>FY'14</b>	<b>FY'15</b>	<b>TOTAL</b>
STAGE 2 BUDGET	75,000	125,000	65,000	\$0	<b>265,000</b>
WORK PLAN BUDGET					
SPENT TO DATE					
<b>REVISED BUDGET</b>					

## **741 BRIDGE SEISMIC RETROFIT MEASURES CONSIDERING SUBDUCTION EARTHQUAKES**

### **OVERVIEW**

The majority of Oregon's bridges were 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](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

This project is under development in June of 2011. 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 2011. Once it begins, accomplishments may be viewed by selecting [Quarterly Reports](#) at the link above.)

### **ORGANIZATIONAL RESPONSIBILITY**

ODOT Research Section

### **COST INFORMATION**

<b>SPR 741</b>	<b>FY'12</b>	<b>FY'13</b>	<b>FY'14</b>	<b>FY'15</b>	<b>TOTAL</b>
STAGE 2 BUDGET	\$61,000	121,500	100,500		<b>\$283,000</b>
WORK PLAN BUDGET					
SPENT TO DATE					
<b>REVISED BUDGET</b>					
<b>UTC Contribution (OTREC)</b>	<b>Pending</b>				

## **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 impart 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](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

This project is under development in June of 2011. 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 2011. Once it begins, accomplishments may be viewed by selecting [Quarterly Reports](#) at the link above.)

**ORGANIZATIONAL RESPONSIBILITY**

ODOT Research Section  
 ODOT Construction Section  
 Western Transportation Institute

**COST INFORMATION**

<b>SPR 742</b>	<b>FY'12</b>	<b>FY'13</b>	<b>FY'14</b>	<b>FY'15</b>	<b>TOTAL</b>
STAGE 2 BUDGET	\$72,000	\$105,000	\$71,000		<b>\$248,000</b>
WORK PLAN BUDGET					
SPENT TO DATE					
<b>REVISED BUDGET</b>					
UTC Contribution (WTI)	<b>\$35,500</b>	<b>\$35,500</b>	<b>\$0</b>		<b>\$71,000</b>
UTC Contribution (AUTC)	<b>45,000</b>	<b>56,500</b>	<b>\$43,500</b>		<b>\$145,000</b>

## **743 EVALUATE A VARIABLE SPEED LIMIT SYSTEM FOR WET AND EXTREME WEATHER CONDITIONS**

### **OVERVIEW**

From a safety standpoint, rain, snow or ice reduces pavement friction, increasing the potential for crashes when vehicles are traveling too fast for the conditions. The posted speed limit may not be appropriate during various weather conditions. Drivers become acclimated to traditional approaches to address the problem, such as the use of passive warning signs and flashing beacons. This is what has occurred on the ramps of the U.S. 26/Oregon 217 interchange. Consequently, new approaches are necessary to alert motorists and change their behavior accordingly when inclement weather presents the potential for reduced pavement friction at a given location.

One approach to address the problem of high vehicle speeds in inclement weather conditions is the use of variable speed limits (VSL) based on weather conditions. There has been limited use of VSLs in addressing weather conditions. Recent improvements in weather sensors such as new Road Weather Information System (RWIS) surface state sensors, make it possible to detect different pavement surface conditions (dry, wet, icy) with a high degree of precision thus improving the reliability of the emerging dynamic weather-responsive traffic management systems such as the proposed VSL system.

Variable speed limits were not anticipated or addressed in current Oregon speed limit statutes. The legal issues are being investigated to determine how variable speed limits can be utilized. ODOT's Traffic/Roadway Section is developing an Administrative Rule.

The proposed research is necessary to determine under what circumstances a VSL system should be utilized, what components are necessary for a speed adjustment system, and what algorithms are necessary to incorporate weather conditions in setting appropriate speed limits consistent with Oregon speed zoning laws and policies.

### **OBJECTIVES**

The proposed research will investigate the application of a speed limit adjustment system that incorporates weather conditions, evaluate its effectiveness once deployed, and develop guidelines to direct future consideration and deployment of similar 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/ActiveProjectsV.shtml#SPR\\_743](http://www.oregon.gov/ODOT/TD/TP_RES/ActiveProjectsV.shtml#SPR_743)

### **PROPOSED ACTIVITIES**

- Task 1: Literature Review.
- Task 2: Policy Review and Legal Implication Analysis
- Task 3: Evaluate Sensor Approaches
- Task 4: Develop Concept of Operations and Requirements Documents
- Task 5: Algorithm Development
- Task 6: Deployment Assistance
- Task 7: Evaluation
- Task 8: Development of Guidelines

Task 9: Develop and Prepare Draft and Final Reports  
 Task 10: Project Coordination and Management

This project is under development in June of 2011. 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 2011. Once it begins, accomplishments may be viewed by selecting [Quarterly Reports](#) at the link above.)

**ORGANIZATIONAL RESPONSIBILITY**

ODOT Research Section  
 ODOT District 2A  
 ODOT Roadway and Traffic Section  
 Western Transportation Institute

**COST INFORMATION**

<b>SPR 743</b>	<b>FY'12</b>	<b>FY'13</b>	<b>FY'14</b>	<b>FY'15</b>	<b>TOTAL</b>
STAGE 2 BUDGET	40,000	80,000	40,000		<b>160,000</b>
WORK PLAN BUDGET					
SPENT TO DATE					
<b>REVISED BUDGET</b>					
<b>UTC Contribution (WTI)</b>	Pending				

## **744 INERTIAL AND INCLINOMETER BASED PROFILER REPEATABILITY AND ACCURACY USING THE IRI MODEL**

### **OVERVIEW**

ODOT will be implementing an International Roughness Index (IRI) based smoothness incentive/disincentive program with an inertial profiler certification and a Quality Assurance program. The development of the program has been based on AASHTO provisional standards. ODOT has a “certification site” and an inclinometer based reference profiler. The question arises: Are the AASHTO provisional standards applicable when comparing an inertial profiler and an inclinometer profiler?

ODOT has attempted a field calibration process during the last construction season with mixed success. A second approach of establishing a site for inertial profilers for calibration has shown some promise. The ability to establish reference site off of a project site allows adequate time to establish the reference profile and ensures better quality control. The site itself has reduced safety concerns, as it is not located on a busy interstate highway. The inertial profiler that was certified at this site was able to show good repeatability, but could not meet the AASHTO accuracy criteria. Once testing guidelines are developed from this research, all contractors would be required to certify their systems at this site prior to performing work in Oregon.

### **OBJECTIVES**

- Determine the repeatability and accuracy of the reference profiler
- Develop the procedures/guidelines for an inclinometer based profiler certification
- Establish an appropriate test site for certification

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\\_744](http://www.oregon.gov/ODOT/TD/TP_RES/ActiveProjectsV.shtml#SPR_744)

### **PROPOSED ACTIVITIES**

- Task 1 – Literature Review and evaluation of existing certifications.
- Task 2 – Calibration and parameter testing of ODOT’s reference profiler.
- Task 3 – Inertial profiler tests at certification site.
- Task 4 – Develop Certification Procedure and QA/QC guidelines.
- Task 5 – Additional Literature Review for inertial profilers on concrete.
- Task 6 – Preliminary Pavement Texture Analysis.
- Task 7 – Final report and implementation.

This project is under development in June of 2011. 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 2011. Once it begins, accomplishments may be viewed by selecting Quarterly Reports at the link above.)

**ORGANIZATIONAL RESPONSIBILITY**

ODOT Research Section  
ODOT Pavement Services Unit

**COST INFORMATION**

<b>SPR 744</b>	<b>FY'12</b>	<b>FY'13</b>	<b>FY'14</b>	<b>FY'15</b>	<b>TOTAL</b>
STAGE 2 BUDGET	\$50,000	\$55,000	0		<b>\$105,000</b>
WORK PLAN BUDGET					
SPENT TO DATE					
<b>REVISED BUDGET</b>					

## **745 UNDERSTANDING RESIDENTIAL LOCATION CHOICES FOR CLIMATE CHANGE AND 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](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

This project is under development in June of 2011. 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 2011. Once it begins, accomplishments may be viewed by selecting [Quarterly Reports](#) at the link above.)

**ORGANIZATIONAL RESPONSIBILITY**

ODOT Research Section

**COST INFORMATION**

<b>SPR 745</b>	<b>FY'12</b>	<b>FY'13</b>	<b>FY'14</b>	<b>FY'15</b>	<b>TOTAL</b>
STAGE 2 BUDGET	\$45,000	87,500	\$42,500		<b>\$175,000</b>
WORK PLAN BUDGET					
SPENT TO DATE					
<b>REVISED BUDGET</b>					
<b>UTC Contribution (OTREC)</b>	<b>Pending</b>				

## **OVERVIEW**

A high percentage of highway maintenance activities are performed in a travel lane or adjacent shoulder with traffic in close proximity to the workers. Current practices for short duration work zones provide limited protection of the workers. Additionally, current safety measures such as truck mounted attenuators (TMAs) and spotters typically require additional personnel exposed to the hazards. Even with TMAs and spotters, the immediate work area remains unprotected, allowing errant vehicles to enter. Finally, a high percentage of work activities must be performed at night, increasing the risk to the workers.

A recent advancement in work zone safety for finite area work activities is the use of a Mobile Barrier System™ (MBS). An MBS is motorized (tractor/trailer combination) and can provide complete isolation of the work area for a distance of up to 100 feet. A limited number of road agencies have acquired mobile barriers and have reported favorably on their use and benefit to safety. Since this equipment is relatively expensive, the investment in one or more of these safety systems needs to be evaluated to demonstrate the safety benefit, the flexibility of use, and the increased efficiency of work activities compared to traditional means of protection. The proposed research involves acquiring an MBS to test in a variety of work zone environments.

## **OBJECTIVES**

The overall goal of the proposed research is to assist ODOT in evaluating the benefits and limitations of using an MBS in future work zone safety strategies and investments. Mobile barrier systems have been developed and are commercially available from two sources. The systems have been tested, primarily for their ability to withstand impacting vehicles. Rather than repeating these crash tests, the proposed research aims to evaluate: the efficiency in deploying and removing the system, its impacts on the work operations, the impacts on worker safety and productivity compared to traditional protective measures, and the types of projects for which it is most suitable.

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\\_746](http://www.oregon.gov/ODOT/TD/TP_RES/ActiveProjectsV.shtml#SPR_746)

## **PROPOSED ACTIVITIES**

Task 1 – Review literature and identify study site attributes.

Task 2 - Task 2 – Obtain MBS and train Users.

Task 3 – Site Application and Testing of MBS and Traditional Protective Measure.s

Task 4 – Data Analysis and System Evaluation.

Task 5 – Final report.

This project is under development in June of 2011. 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 2011. Once it begins, accomplishments may be viewed by selecting [Quarterly Reports](#) at the link above.)

**ORGANIZATIONAL RESPONSIBILITY**

ODOT Research Section  
 ODOT District 2A  
 ODOT Office of Maintenance and Operations  
 Oregon State University

**COST INFORMATION**

<b>SPR 746</b>	<b>FY'12</b>	<b>FY'13</b>	<b>FY'14</b>	<b>FY'15</b>	<b>TOTAL</b>
STAGE 2 BUDGET	\$50,000	\$98,000	\$15,000		<b>163,000</b>
WORK PLAN BUDGET					
SPENT TO DATE					
<b>REVISED BUDGET</b>					

## **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](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.

This project is under development in June of 2011. 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 2011. Once it begins, accomplishments may be viewed by selecting [Quarterly Reports](#) at the link above.)

**ORGANIZATIONAL RESPONSIBILITY**

ODOT Research Section

**COST INFORMATION**

<b>SPR 747</b>	<b>FY'12</b>	<b>FY'13</b>	<b>FY'14</b>	<b>FY'15</b>	<b>TOTAL</b>
STAGE 2 BUDGET	40,000	\$79,000	\$0		<b>\$119,000</b>
WORK PLAN BUDGET					
SPENT TO DATE					
<b>REVISED BUDGET</b>					
<b>UTC Contribution (OTREC)</b>	<b>Pending</b>				