

# SPR RESEARCH PROGRAM

## SECOND-STAGE PROPOSAL SUMMARY

### PROBLEM NUMBER AND TITLE

24-13 Developing Guidance on Leading Pedestrian Intervals and Curb Extensions to Improve Pedestrian Safety at Signalized Intersections

### PROBLEM SUMMARY

Improving pedestrian safety continues to be critically important to ODOT's mission to provide a safe and reliable multimodal transportation system. Approximately 920 pedestrians were injured, and 78 pedestrians were killed in Oregon each year between 2016 - 2020. Some of these pedestrian-vehicle crashes occur at intersections, where agencies have installed either geometric or operational countermeasures to improve pedestrian safety. LPIs allow pedestrians to start their crossing prior to conflicting vehicles. Curb extensions improve the visibility of pedestrians to drivers, shorten the crossing distance, and slow turning vehicles. ODOT uses both options to improve pedestrian safety but guidance is lacking to optimally select these options.

### ODOT OBJECTIVES

Developing enhanced guidance on when and where to implement LPIs either solely or in conjunction with curb extensions, no turn on red, or other changes will provide ODOT with refined tools to improve pedestrian safety at intersections. The proposed research will support the ODOT Strategic Action Plan's priority of a modern transportation system and the Strategic Action Plan's goal of safety.

### BENEFITS

This study will produce guidance on LPI and curb extensions. The research will identify the improvement in pedestrian safety when these countermeasures are used individually and when they are used in conjunction with other countermeasures to improve pedestrian safety. Tradeoffs for their application will be considered. These findings will be developed in a form that can be easily integrated into agency design and practice documents. The results of scaled adoption will be enhanced pedestrian safety at signalized intersections and improved return on the investments.

### SCHEDULE, BUDGET AND AGENCY SUPPORT

**Estimated Project Length:** 24 months.

**Estimated Project Budget:** \$210,000

**ODOT Support:**

Angela Kargel, State Traffic Services Engineer and Unit Manager, Oregon DOT

Christina McDaniel-Wilson, State Traffic Safety Engineer, Oregon DOT

Christopher Primm, State Traffic Operations Engineer, Oregon DOT

### FOR MORE INFORMATION

For additional detail, please see the complete STAGE 2 RESEARCH PROBLEM STATEMENT online at:  
<https://www.oregon.gov/odot/Programs/ResearchDocuments/24-13.pdf>

# SPR RESEARCH PROGRAM

## SECOND-STAGE PROBLEM STATEMENT

### FY 2024

#### PROBLEM NUMBER AND TITLE

24-13 Developing Guidance on Leading Pedestrian Intervals and Curb Extensions to Improve Pedestrian Safety at Signalized Intersections

#### RESEARCH PROBLEM STATEMENT

Nationwide, pedestrian injuries and fatalities have significantly increased over the last decade with 6,516 fatalities and approximately 55,000 pedestrians injured in 2020 (NHTSA, 2020). The majority of these fatalities occurred in urban areas and approximately 15% of these occurred at intersections. Agencies have implemented operational countermeasures such as Leading Pedestrian Intervals (LPI) or geometric improvements such as curb extensions to improve pedestrian safety at intersections. In an LPI, the WALK indication is displayed for a few seconds prior to the green indication for the concurrent movement, which enables the pedestrians to establish themselves in the crosswalk and increases their visibility. LPIs have been found to reduce pedestrian-vehicle crashes (e.g., King 2000, Fayish and Gross 2010, Goughnour et al., 2018) and pedestrian-vehicle conflicts (Van Houten et al., 2000). There has been follow up research to study the economics benefits of LPIs (Sharma et al., 2017). Curb extensions extend the sidewalk or curb line into the street, thereby decreasing the crossing distance for pedestrians and improving their visibility, while reducing vehicular turning speeds. While the safety impacts of LPIs are well established, questions remain regarding when curb extensions should be implemented in conjunction with LPIs and what the combined effects are. NACTO's Urban Street Design Guide recommends that curb extensions be installed at high-conflict intersections to increase the effectiveness of an LPI and improve the visibility of pedestrians (NACTO, 2014). However, this recommendation is not supported by research. Guidance is also needed on where the LPIs should be implemented, when right turn on red should be restricted, and the appropriate time intervals needed to provide safety benefits, in particular at wider intersections like those that fall under the preview of state transportation agencies. Lastly, the use of LPIs reduces the available green time for other modes and users.



#### RESEARCH OBJECTIVES

Improving pedestrian safety continues to be critically important to ODOT's mission to provide a safe and reliable multimodal transportation system. Approximately 920 pedestrians were injured, and 78 pedestrians were killed in Oregon each year between 2016 - 2020. Some of these pedestrian-vehicle crashes occur at intersections, where agencies have installed either geometric or operational countermeasures to improve pedestrian safety. LPIs and curb extensions are countermeasures that are used on ODOT facilities to improve pedestrian safety. Developing enhanced guidance on when and where to implement LPIs either solely or in conjunction with curb extensions, no turn on red, or other changes will provide ODOT with refined tools to improve pedestrian safety at intersections. The proposed research will support the ODOT Strategic Action Plan's priority of modern transportation system and the Strategic Action Plan's goal of safety.

## WORK TASKS, COST ESTIMATE AND DURATION

This study will include the following research tasks to achieve the stated research objectives.

### ***Task 1: Review research and policies for LPI and Curb Extension implementation***

Conduct a literature review to better establish the extent of previous or parallel research on the relationship between the LPI and curb extension on signalized intersection safety. Fully document what is known to assist timing practitioners in making informed decisions on LPI deployment, summarization and scoring of factors that impact the effectiveness of LPI (e.g.: number of turn lanes, crosswalk setback, street furniture in sight triangle, approach speeds, signal operation scheme (pre-time, actuated, coordinated), etc.) and how those factors impact desired LPI duration are crucial. Document what is known about the use of LPI without audible pushbuttons and assess whether policy changes on their implementation are warranted.

### ***Task 2: Select sites for video data collection and define driving simulator experiment***

Driving simulation study: Develop a plan for engaging participants in a driving simulation study. The participant sample will be controlled for age, gender, and education level, with a target sample size of approximately 30 subjects. The sampling plan, planned testing activities, and questionnaire will be submitted for Institutional Review Board (IRB) approval.

Conflict-based field study: Design a data collection plan for signalized intersections. Develop a video footage analysis plan for an appropriate number of pedestrian crossings with combinations of curb extensions and LPI through leading safety indicators using automated measures.

### ***Task 3: Conduct video data collection***

Record video footage of 10-12 locations with combinations of LPI and curb extensions that may be compared with a similar number of crossings in the absence of both treatments.

### ***Task 4: Conduct driving simulator experiment***

Conduct driving simulation testing in which the study participants drive through the simulated environment. Record simulator data (e.g., eye tracking, vehicle positioning and speed, yielding characteristics) for further analysis.

### ***Task 5: Data Analysis***

Analyze the simulator and field data to evaluate driver and pedestrian behavior at when interacting at signalized intersection crosswalks with LPIs and curb extensions.

### ***Task 6: Development of Guidance and Final Report***

A final report incorporating the research findings will be developed according to ODOT specifications. This report will contain specific recommendations on how to best operate combinations of LPI and curb extensions and a prioritization for applying these treatments in the field.

***Key Deliverables:*** Current literature indicates significant crash reductions involving pedestrians where LPIs are implemented with durations between three and seven seconds. Resource limitations, site specific conditions and impacts on congestion and network operations indicate a need to better understand what site conditions produce the best results, whether there are sites that are unsuitable and how to optimize LPI duration. For timing practitioners to be able to make informed decisions on LPI deployment, summarization and scoring of factors that impact the effectiveness of LPI and how those factors impact desired LPI duration are crucial.

***Estimated Project Length:*** 24 months.

***Estimated Project Budget:*** \$210,000

## IMPLEMENTATION

- Use deliverables to quantitatively assess ODOT signal inventory to produce a priority list of signals in order of greatest expected benefit.
- Define policy elements indicating features requiring omission of LPI or additional mitigation

## POTENTIAL BENEFITS

This study will produce guidance via a final report on LPI and curb extension installations when to use them solely vs. in conjunction with other countermeasures to improve pedestrian safety. Tradeoffs for their application will be considered. These findings will be developed in a form that they can be easily integrated into agency design and practice documents. The results of scaled adoption will be improved pedestrian safety at signalized intersections and improved return on the investments currently being made on LPI and curb extension implementation.

## PEOPLE

### ***ODOT champion(s):***

Angela Kargel, State Traffic Services Engineer and Unit Manager, Oregon DOT

Christina McDaniel-Wilson, State Traffic Safety Engineer, Oregon DOT

Christopher Primm, State Traffic Operations Engineer, Oregon DOT

### ***Problem Statement Contributors:***

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# STAFF REVIEW PAGE

## Literature Check

### TRID&RIP

A review of TRID & RIP databases found no existing research that answers the research question

## Technology & Data assessment

No Identified T&D output

At the end of this project, the implementing unit(s) within ODOT will need to coordinate the adoption of new technology or data in order to realize the full potential of this research.

## Cross-agency stakeholders

- List stakeholders or impacted units
  - ODOT Traffic and Roadway Section
  - ODOT Regions' Traffic Units
  - ODOT Intelligent Transportation Systems (ITS) Section
  - ODOT Pedestrian and Bicycle Program
  - Transportation Safety Office, DMV
  - City of Portland
- Identify any issues of concern raised by an ODOT stakeholder. Note expected mitigation  
No