

Research Stage 1 Problem Statement

PROPOSED TITLE: Network deployment of wet weather pavement markings to improve safety

1. Concisely describe the transportation issue (including problems, improvements, or untested solutions) that Oregon needs to research.

Oregon experiences significant rainfall and extended wet-season driving conditions, yet current pavement marking practices (and currently FHWA standards) rely primarily on dry-weather retroreflectivity thresholds and broad ADT-based placement criteria. Research shows that wet-reflective markings significantly improve nighttime visibility and can reduce wet-weather crashes.

While a few States have or are developing installation criteria drawing on roadway geometry, crash risk, and weather factors rather than volume alone, there are no robust network-wide decision-making criteria in use. With roadway departure crashes a significant safety concern in Oregon, efforts to retain vehicles on the roadway are very cost effective and new pavement marking criteria coupled with enhanced data availability and pavement measurement retroreflectivity research in Oregon, offers a strong argument that this research could deliver large benefits in enhanced resource deployment of pavement markings and improving safety outcomes.

In short, Oregon lacks a systematic, evidence-based method to identify where these markings are most needed and most cost-effective. This research will determine how Oregon can adopt risk-based methods to prioritize installation and maintain wet-retroreflective markings that improve safety under Oregon's unique climate conditions.

2. What final product or information needs to be produced to enable this research to be implemented?

The project should deliver a **decision-support framework** for the targeted deployment and lifecycle management of wet-retroreflective pavement markings in Oregon. This includes (1) a risk-factor model for identifying segments where wet-reflective markings yield the highest safety benefit (e.g., horizontal curvature, shoulder absence, winter precipitation, rainfall intensity), (2) material performance guidance based on wet-weather studies, and (3) options for integrating LiDAR condition assessments, and crash-based prioritization.

Deliverables should include:

- Recommended updates to ODOT's **Traffic Line Manual**, **striping plans**, and **maintenance inspection procedures**.
- A **placement matrix** linking roadway features, crash risk, and wet-weather exposure.
- A cost-effective comparison of candidate materials under Oregon weather conditions
- Potential integration with fleet-based or camera-derived condition monitoring (e.g., LiDAR-based retroreflectivity screening)

3. (Optional) Are there any individuals in Oregon who will be instrumental to the success of implementing any solution that is identified by this research? If so, please list them below.

ODOT Research is looking for individuals that have expert knowledge of the problem, key approval authority, will otherwise help oversee the study, or will implement the results of this work. Please don't list ODOT research staff.

Name	Title	Email	Phone
Frank Belleque	Traffic Markings and Sign Engineer	Frank.Belleque@odot.oregon.gov	503-428-6874
Rebecca Burrow	Maintenance Services Manager	Rebecca.BURROW@odot.oregon.gov	503-951-9333

4. Other comments:

Wet-retroreflective materials have been shown to meaningfully reduce wet-weather crashes, improve driver preview distance, and enhance night visibility.

Despite these advances, few agencies have developed **comprehensive risk maps** that integrate weather exposure, geometry, shoulder width, and safety outcomes to optimize placement—an identified research gap in the literature

5. State of Oregon Decision Making Lenses

State decision making lenses are a part of the state of Oregon's policy structure. State policy and federal policy are not always aligned. The state will prioritize research according to state policy, however ODOT may be required to skip prioritized proposals based on constraints placed on the use of federal funds. If state funds are available ODOT will attempt to fund prioritized research that is deemed ineligible for federal funding.

Please complete the following three sections. Your answers to these questions will be applied on a programmatic basis to support agency decisions. Answering yes to the questions below is not required. Resolving a narrowly focused technical research problem may meet agency needs without answering yes to any of the following questions. The ODOT Research Section will seek a balanced portfolio some projects will answer yes to one of the three categories below (e.g. climate, equity, and/ or safety) and other projects in a different category.

We are looking for an overall program balance and no one project is expected to balance all categories. Generally, a research problem statement is expected to be able to answer yes with clear and verifiable information in only one of the three categories below, some projects may be able to answer yes in two or even three categories. Some projects (i.e. needs focused on specific elements of infrastructure design), may have no 'yes' answers but may still be a high value research need.

Climate

Oregon recognizes the climate crisis and makes systemic changes to reduce emissions caused by travel. To that end, we seek research that reduces carbon emissions from construction activities and materials, and from maintenance equipment and operations. Oregon envisions a transportation system that is resilient, this means a system that is durable in the face of seismic events and extreme weather to avoid negative impacts, withstand them or bounce back quickly to resume system function. We seek research that improves the ability of the transportation system to adapt or cope with more frequent and extreme weather events. This may include innovations in data and data sharing, construction materials and project design, communication, emergency planning and response, and more. Similarly, we seek research that avoids negative impacts on key habitats and ecosystems that can buffer or reduce damage to infrastructure and improve environmental conditions for wildlife and native vegetation. For definitions and details please review the equity vision, goals, and objectives of the [ODOT Strategic Action Plan](#) and [Oregon Transportation Plan](#).

5a. Will addressing the transportation issue identified as a need in Question 1 develop, or **validate methods for the estimation, measurement, or monitoring** of transportation generated greenhouse gases (GHG)?

☐ Yes

☒ No

☐ Unsure

5b. If climate or GHG is not the focus of this **transportation issue** identified in this problem statement, will the research apply a GHG analysis to transportation infrastructure, planning, operations, maintenance, or materials?

☐ Yes

☒ No

☐ Unsure

5c. Will addressing the **transportation issue** include development or testing of construction practices, methods, or materials to establish potential reductions in greenhouse gas emissions?

☐ Yes

☐ No

☒ Unsure (potential depending on material)

5d. Will solving the **transportation issue** in question 1 study or support the reduction of vehicle miles traveled and single occupancy vehicle travel or support transition to electric vehicles (or other types of zero emission vehicles) or low-carbon alternative fuels?

☐ Yes

☒ No

☐ Unsure

5e. Will the solving the **transportation issue** in question 1 lead to work that will support, measure, or monitor, transportation system resilience in response to expected climate events, effects, or natural disasters in general?

☒ Yes (support visibility and safety in extreme rainfall events)

☐ No

☐ Unsure

5f. Will solving the **transportation issue** in question 1 lead to work that may result in better environmental conditions for wildlife and native vegetation?

☐ Yes

☒ No

☐ Unsure

5g. If you answered yes to any of the climate questions above or can provide alternative details related to

climate, please provide additional information:

Although climate is not the primary focus, the research supports Oregon's climate resilience goals. Oregon's transportation system needs to operate reliably during more frequent and intense precipitation events. Wet-reflective markings maintain visibility and reduce crash risk during heavy rainfall, aligning with climate-resilience objectives.

Equity

Equity can have many dimensions and impacts relating to communities and transportation. It is important that problem statement proposals clearly explain the equity dimensions or impacts being examined. Oregon commits to social equity in the OTP, specifically to *improve access to safe and affordable transportation for all, recognizing the unmet mobility needs of people who have been systemically excluded and underserved. Create an equitable and transparent engagement and communications decision-making structure that builds public trust.* We seek research that studies elements of this goal or applies analysis to specific transportation topics to ensure the resulting research recommendation is consistent with agency equity goals. For definitions and details please review the equity vision, goals, and objectives of the [ODOT Strategic Action Plan](#) and [Oregon Transportation Plan](#).

5h. Is the **transportation issue** identified as a need in Question 1 specifically focused on transportation equity?

☐ Yes

☒ No

☐ Unsure

5i. If the **transportation issue** is not focused on transportation equity, will the primary topic be assessed for equity benefits or impacts within the research project?

☐ Yes

☐ No

☒ Unsure ([Wet-weather crash risk is elevated in rural, low-income, and underserved areas where lighting is limited](#))

5j. Is the implementation of potential findings from this research likely to directly involve participation from an identified group that would benefit from an equitable process or outcome?

☐ Yes

☐ No

☒ Unsure ([see above](#))

5k. Is the intended final product or information expected to support ODOT's equity efforts (Including but not limited to supporting one of the equity related objectives of the [ODOT's Strategic Action Plan](#) or [Oregon Transportation Plan](#)) ?

☒ Yes

☐ No

☐ Unsure

5l. If you answered yes to any of the equity questions above or can provide alternative details related to equity, please provide additional information:

While not an equity-focused project, the research aligns with ODOT equity goals because underserved communities often rely on roadways with limited lighting, narrow shoulders, and higher curve density—features associated with increased wet-weather crash severity. Risk-based placement of wet-reflective markings ensures resources are directed to areas with demonstrable safety need rather than high-volume corridors alone.

Safety

Research outcomes may include interventions and countermeasures to prevent or reduce the frequency of crashes or other causes of transportation-related injury or death; or may include measures to reduce severity of injury (including prevention of death) after a crash or other injurious event. For definitions and details please review the equity vision, goals, and objectives of the [ODOT Strategic Action Plan](#), [Oregon Transportation Safety Action Plan](#) and [Oregon Transportation Plan](#).

5m. Will solving the **transportation issue** in question 1 support improving **safety culture** for either transportation workers or the traveling public?

☒ Yes

☐ No

☐ Unsure

5n. Will the solving the **transportation issue** support improving safety through **healthy and livable communities**?

☒ Yes

☐ No

☐ Unsure

5o. Will solving the **transportation issue** support improving safety through using **best available technologies**?

☒ Yes

☐ No

☐ Unsure

5p. Will solving the **transportation issue** support improving safety through **communication and collaboration**?

☒ Yes

☐ No

☐ Unsure

5q. Will solving the **transportation issue** support improving safety through **investing strategically**?

☒ Yes

☐ No

☐ Unsure

5r. If you answered yes to any of the safety questions above or can provide alternative details related to safety, please provide additional information:

Safety is the central focus of this proposal. Evidence demonstrates that wet-reflective markings reduce wet-weather crashes across rural and urban contexts, improve nighttime preview distances, and provide superior visibility compared to conventional paint or bead systems. The research will directly lead to a network level strategic investment procedure for wet weather pavement markings and enhance safety.

6. Corresponding Submitter's Contact Information:

Name:	Nick Fortey
Title:	Safety and Operations Engineer
Affiliation:	FHWA Oregon Division
Telephone:	503-316-2565
Email:	nick.fortey@dot.gov

7. ODOT Sponsor Contact Information (Required if Submitter is not an ODOT employee)

Name:	Frank Belleque
Title:	Traffic Markings and Sign Engineer
Crew Number:	7611
Telephone:	503-428-6874
Email:	Frank.Belleque@odot.oregon.gov

This form is not a grant application or contract document. Please do not include proprietary information on this form. Once this form is received ODOT may revise and publish the problem statement. If selected, ODOT will assign investigator(s) of the department's choosing to conduct research.

[Disclosure: This proposal was developed using Chat GPT as drafting support and using Consensus AI for gathering and evaluating pertinent research.](#)