

## PROJECT SUMMARY REPORT

# 0-7209: Develop Guidance for Sustainable Traffic Signal Operation Strategies to Support All Intersection Users

### Background

Maintaining The Bipartisan Infrastructure Law requires states and metropolitan planning organizations to use at least 2.5% of their planning funding on Complete Streets. It also provides Complete Streets funding through Rebuilding American Infrastructure with Sustainability and Equity (RAISE) grants and the National Highway Performance Program, as well as the Surface Transportation Block Grant Program. Complete Streets are roadways designed to provide safe mobility to all users, including drivers, pedestrians, bicyclists, and transit users as well as people of all ages and abilities. The Complete Streets concept focuses safety projects on all users particularly on pedestrians and bicycle riders and this emphasis is supported by crash statistics indicating there were 7,148 pedestrian crash fatalities in the US during 2024. However, there are conflicts between many complete streets safety countermeasures and operational efficiency. Implementing more pedestrian/bicycle countermeasures, requires a robust understanding of the true safety benefits and delay impacts of these countermeasures.

### What the Researchers Did

The research team conducted a thorough review of the state of the art and state of the practice of complete street pedestrian and bicycle safety countermeasures. They developed a thorough review of techniques used to compute crash modification factors for safety countermeasures, including signal operations strategies. They produced a discussion of thirty-seven safety countermeasures showing likely safety impacts, incremental delay impacts and estimated costs for each. They estimated incremental delay for the countermeasures through an extensive micro-simulation experiment. Three thousand six hundred simulation runs were performed using ranges of intersection configurations, traffic demands and pedestrian volumes.

### What They Found

Value of Research:

The research team prepared a Value of Research (VoR) report that contains economic-based calculations, the description of economic variables used within the calculations, and the qualitative values of TxDOT's selected benefit areas.

Predictions of Countermeasure Impacts:

The research team found that many of the 37 countermeasures can be expected to reduce pedestrian crashes and have little or no expected delay impacts on vehicular traffic. For example, countdown pedestrian signals can be expected to produce a crash modification factor of 0.3 and have no significant impact on vehicular delay. However, adding a leading pedestrian interval (LPI) to an intersection signal timing plan can produce a 0.81 crash modification factor but if pedestrian volumes are heavy, addition of the LPI can cause significant vehicular delay. The 37 countermeasures that were evaluated are listed in Table 1. Positive and negative impacts as well as predicted costs are provided for all 37 countermeasures.

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Figure 1. Pedestrian countdown signal head

Table 1. Countermeasures Evaluated

|                                    |  |
|------------------------------------|--|
| Sidewalks                          | Leading Pedestrian Indicator               |
| Pedestrian Signal Heads            | Exclusive Pedestrian Phase                 |
| Countdown Signal Heads             | Protected-Only Left Turns                  |
| Crosswalks                         | Pedestrian Sensed Protected-Only Left Turn |
| High Visibility Crosswalks         | Split Phase Signal Timing                  |
| Curb Ramps                         | Flashing Yellow Arrow                      |
| Skewed Intersections               | Right On Red Restrictions                  |
| Curb Extensions                    | Reduce Cycle Length                        |
| Pedestrian Signal Phase            | Increase Cycle Length                      |
| RCUT Intersections                 | Bike Lane Thru Intersection                |
| Signal-Stage Crossings             | Bike Lane to Intersection                  |
| Road Diet                          | Bike Lane Lateral Shift                    |
| Remove Channel Turn Lane           | Pedestrian Refuge Island                   |
| Alternative Channel Turn Lane      | Centerline Hardening                       |
| Reduce Curb Radius                 | Intersection Lighting                      |
| Add Truck Apron                    | Transit Signal Priority                    |
| Bike Signals                       | Bus Queue Jumps                            |
| Leading Bicycle Interval           | Traffic Calming                            |
| Raised Bicycle/Pedestrian Crossing |  |

### What This Means

The extensive literature survey and simulation experiments conducted by the research team provide valuable information as well as potential recommendations for TxDOT to guide sustainable traffic signal operations strategies for all intersection users.

1. The countermeasure evaluations provide guidance on managing available safety funds efficiently through selection of the best countermeasure for each problem situation.
2. Better understanding of the impacts of countermeasures on crash expectations, as well as potential negative impacts on operations will enable more informed decisions regarding safety project choices.

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