NCHRP 3-54 (02)

Use of Protected/Permitted Left-Turn Signal Control in the U.S.

Presentation To TRB Signal Systems Committee
July 21, 2002
Project Objective

- **Project objective:** to evaluate the safety and effectiveness of different signal displays used with PPLT control
  - Determine PPLT usage in the U.S.
  - Evaluate safety and operational effects
  - Evaluate drivers’ understanding of various PPLT displays and indications
  - Evaluate field implementations of selected display(s)
- **Project deliverables:** recommend display(s) for uniform application across the U.S.
# Key Study Tasks and Status

<table>
<thead>
<tr>
<th>Task</th>
<th>Status</th>
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<tbody>
<tr>
<td>Agency Survey</td>
<td>Previously Completed</td>
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<tr>
<td>Driver Survey</td>
<td>Previously Completed</td>
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<tr>
<td>Conflict Analysis</td>
<td>Previously Completed</td>
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<tr>
<td>Operational Analysis</td>
<td>Previously Completed</td>
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<tr>
<td>Engineering Assessment</td>
<td>In Progress Updated Draft Working Paper 1</td>
</tr>
<tr>
<td>1st Interim Report</td>
<td>Previously Completed</td>
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<td><a href="http://www.kittelson.com/pplt">http://www.kittelson.com/pplt</a></td>
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<tr>
<td>1st Panel Meeting</td>
<td>Previously Completed</td>
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### Key Study Tasks and Status (cont.)

<table>
<thead>
<tr>
<th>Task</th>
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<tbody>
<tr>
<td>Confirmation Study</td>
<td>In Progress Draft Working Paper 7</td>
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<tr>
<td>Implementation Study</td>
<td>In Progress Draft Working Paper 8</td>
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<tr>
<td>2(^{nd}) Interim Report</td>
<td>In Progress Draft Report</td>
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<tr>
<td>2(^{nd}) Panel Meeting</td>
<td>July 24, 2002</td>
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<tr>
<td>Final Report</td>
<td>November 2002</td>
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Alternative Displays

- “Dallas” display (various locations)
- Flashing green arrow (Canada)
- Flashing circular yellow (Seattle)
- Flashing yellow arrow (Reno, Sparks, Germany, Switzerland)
- Flashing yellow arrow, right turns/peds (Carson City, Tucson)
- Flashing circular red (MI, MD)
- Flashing red arrow (DE, Cupertino, CA)
Photographic Driver Survey

If you want to turn left, and you see the traffic signals shown, you would...

1. GO
2. YIELD wait for gap
3. STOP then wait for gap
4. STOP

Press ENTER to continue
Photographic Driver Survey Results

- Flashing indications better understood than solid indications
- Circular ball indications better understood than arrow indications
- Simultaneous illumination of green arrow and red ball creates confusion
- Horizontal displays result in longer response times
Photographic Driver Survey Results (Cont.)

- The flashing yellow ball indication had the highest level of understanding
- The flashing yellow arrow indication had the second highest level of understanding
- The green ball indication had the third lowest level of understanding
- The flashing red arrow had the lowest level of understanding
Traffic Conflict Study Findings

- Left-turn conflict rates are low for all PPLT displays
- Few left-turn conflicts are related to PPLT display
- Most left-turn events are related to hesitation at onset of green indication
- Five-section horizontal displays increase driver work load and error
Crash Analysis

- No single PPLT signal display consistently performs better
Engineering Assessment Results

- The flashing yellow arrow and green ball indications can be used in both exclusive and shared PPLT signal display.
- The flashing yellow ball and flashing red arrow displays can only be used in the exclusive PPLT signal display.
Panel direction to Research Team:

- Conduct a confirmation study using a full scale driving simulator of the following displays
  - MUTCD green ball in a shared display
  - Dallas Display
  - Flashing yellow arrow

- Conduct an Implementation Study of the Flashing Yellow Arrow
Current Project Status

- Confirmation Study (WP 7)
- Field Implementation Study (WP 8)
- Engineering Assessment (Updated WP 1)
- Next Steps
Confirmation Study: UMASS Simulator
Example of Virtual World
Implementation Study (WP 8)

Identify 8 volunteer agencies around the United States that will implement the flashing yellow arrow display.

Implementation would be a change-over from existing PPLT display.

Prefer the exclusive PPLT display mounting.
Vertical FYA Display

1 Leading Left-turn (with opposing left)

Adjacent Thru Head

Reno, NV - “Flashing Arrow”
FYA Implementation Sites

- Implemented
- Near Implementation
## FYA Implementation Sites

<table>
<thead>
<tr>
<th>Agency</th>
<th>Implementation Date</th>
<th>Number of Implementation Sites</th>
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<tbody>
<tr>
<td>Montgomery County, Maryland</td>
<td>September 2000</td>
<td>3</td>
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<tr>
<td>City of Tucson, Arizona</td>
<td>May 2001</td>
<td>3</td>
</tr>
<tr>
<td>Jackson County, Oregon</td>
<td>May 2001</td>
<td>1*</td>
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<tr>
<td>Oregon Department of Transportation</td>
<td>June 2001</td>
<td>2</td>
</tr>
<tr>
<td>City of Beaverton, Oregon</td>
<td>April 2002</td>
<td>3</td>
</tr>
<tr>
<td>Broward County, Florida</td>
<td>June 2002</td>
<td>3</td>
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*One site in Jackson County meets the NCHRP 3-54 study requirements, though non-conforming displays have been implemented as other locations in the County as well with FHWA approval.
Montgomery County, Maryland
Woodburn, Oregon (OR DOT)
Beaverton, Oregon
Broward County, Florida
Broward County Relay
Next Steps

- Research Team presenting to Project Panel July 24, 2002.
- Working Paper release – we will notify you if you leave us contact info.
- Project completion expected January 2003.