



IMPLEMENTATION SUMMARY

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LRRB IMPLEMENTATION PROJECT COST:

\$59,940



Flashing LEDs improve the visibility of stop signs, causing some drivers to reduce their speed when approaching them.



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Improving Safety at Rural Intersections: A Guide to Current Technology

What Was the Need?

Rural unsignalized intersections are too often sites of fatal and injury crashes in Minnesota and nationwide. These crashes are typically caused when a driver on a minor road fails to stop or yield, or misjudges the gap in traffic on the main road.

New technology to address this issue has been developing rapidly over the past decade. Minnesota Local Road Research Board (LRRB) research developed the Advanced LED Warning System for Rural Intersections (ALERT) system, consisting of signs with flashing LED lights to improve visibility. Another recent development is Intersection Conflict Warning Systems (ICWS), which warn drivers of other traffic approaching an intersection.

While research has shown that these technologies are effective at reducing the quantity and severity of crashes, the rapid evolution of these technologies makes it difficult for local engineers to make informed implementation decisions.

What Was Our Goal?

The goal of this project was to synthesize the available information about ICWS and flashing LED stop signs into an easy-to-use guide.

What Did We Implement?

LRRB research to develop the ALERT system has included reports [2011-04](#), “Advanced LED Warning Signs for Rural Intersections Powered by Renewable Energy,” and [2014-10](#), “Advanced LED Warning System for Rural Intersections: Phase 2 (ALERT-2).”

Research on ICWS that this project implements includes the “[MnDOT RICWS Safety](#)” report, North Carolina Department of Transportation’s “[Evaluation of the Safety Effectiveness of ‘Vehicle Entering When Flashing’ Signs and Actuated Flashers at 74 Stop-Controlled Intersections in North Carolina](#),” [NCHRP Report 500, Volume 5: A Guide for Addressing Unsignalized Intersection Collisions](#), and the work of the [Traffic Control Devices pooled fund](#).

How Did We Do It?

Investigators collected and assembled the information about ICWS and LED stop signs, including:

- The history of ICWS and LED stop sign technology in Minnesota, including a timeline of research, development and deployment projects dating back to 1998.
- An overview of the principles of selecting intersection safety strategies, based on MnDOT’s [Traffic Safety Fundamentals Handbook](#) and Federal Highway Administration’s [Highway Safety Improvement Program](#).
- Descriptions of LED stop sign and ICWS technologies, including highlights of research about their impacts on safety, configuration options and guidance to their appropriate and cost-effective use.

This project created a guide to flashing LED stop signs and Intersection Conflict Warning Systems, two emerging technologies that can improve safety at rural intersections. The guide will help local engineers understand the factors they need to consider when deciding whether and where to implement these technologies.

“These intersection safety technologies have been developing quickly, and there’s been extensive research that shows that they’re good at reducing the number and severity of crashes.”

—**Rena Kuehl**,
Senior Associate Traffic
Safety Engineer, SRF
Consulting Group, Inc.

“This guide won’t make the decision of whether or where to install ICWS or LED stop signs, but it will show local engineers the costs and the things they need to consider when making that decision.”

—**Ted Schoenecker**,
MnDOT Deputy State
Aid Engineer

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ICWS technologies provide information to drivers about approaching traffic on crossing roadways, which can help drivers to evaluate gaps in traffic and make safer decisions.

- Design considerations, including their impact on initial costs and maintenance requirements.

Investigators also assembled a collection of case studies of ICWS and LED stop sign installations in Minnesota. These case studies include descriptions of the systems installed, positive and negative feedback or media coverage received, and lessons learned.

What Was the Impact?

The Intersection Safety Technologies Guidebook provides a base of information so local engineers can respond to questions about these technologies and make preliminary determinations as to whether to explore them further. ICWS technologies, for example, are suitable for targeted locations where crashes are due to driver decision error. LED stop signs can improve sites where crashes are caused when drivers fail to see existing stop signs.

Installation costs for an LED stop sign are approximately \$2,000 for a passive (constantly flashing) sign or \$20,000 for a system that includes a traffic detector to control the flashing lights. ICWS typically cost \$50,000 for systems that detect approaching vehicles on either the major road or the minor road, or \$100,000 to \$150,000 for systems that detect vehicles on all approaches. The guide also describes the planning, design and maintenance costs that need to be considered before installation, which can total up to \$35,000 initially and \$1,000 in annual maintenance per intersection for ICWS systems.

The case studies showed relatively few problems with LED stop signs or ICWS technologies, although some outreach may be valuable to ensure that the public understands the system. The project also developed a six-page quick-reference guide about details that engineers need to consider while planning and designing a system.

What’s Next?

The primary audience for these guides is county engineers, although some cities will also find value in them. The guides should fill the need for a document to help educate engineers about this technology and to help them communicate with supervisors, board members or the public.

The guides are complete and ready for implementation, so no further research is currently planned. However, it may be valuable to monitor the development of intersection safety technologies and update the guides as the technology evolves.

This Technical Summary pertains to the LRRB-produced Report 2016RIC10, “Intersection Safety Technologies Guidebook,” published May 2016. The full report can be accessed at mndot.gov/research/TS/2016/2016RIC10.pdf.