



TECHNICAL SUMMARY

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LRRB PROJECT COST:

\$106,192



Relocating the controller cabinet to ground level makes maintenance easier and safer.



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OFFICE OF TRANSPORTATION
SYSTEM MANAGEMENT

Improving the Flashing LED System to Reduce Collisions at Rural Intersections

What Was the Need?

Rural through/stop intersections, where the only control device is a stop sign on the minor approach, pose a high risk for vehicle crashes. Over the past 10 years in Minnesota, more than 40 percent of fatal intersection-related crashes occurred at through/stop intersections. Most of these crashes are related to drivers on the minor approach who have difficulty determining an appropriate gap in cross traffic that will permit safe crossing or turning. At many intersections, this is exacerbated by reduced visibility due to hills or vegetation growth.

MnDOT previously funded a [project](#) to develop and test the Advanced LED Warning System for Rural Intersections (ALERT-1), which used wireless vehicle detection technology and flashing light-emitting diodes on warning signs triggered by oncoming cross traffic. The flashing LEDs were intended to alert drivers to the importance of determining whether an available gap in traffic would be sufficient for turning or crossing. In that test, ALERT-1 successfully kept drivers on the minor approach from rolling through the intersection without stopping, but only when traffic on the main road triggered the flashing LEDs. However, roll-throughs increased when there was no conflicting traffic on the main road.

The increase in drivers disregarding the stop sign was unacceptable, particularly given the potential for catastrophe if the electronics in the warning system were to fail. Also, issues with ALERT-1's power supply and ease of maintenance needed to be addressed before the system could be widely implemented.

What Was Our Goal?

The objective of this project was to produce and test a new version of the ALERT system (ALERT-2) that addressed ALERT-1's shortcomings.

What Did We Do?

ALERT-2's system design was similar to ALERT-1, including a "Cross Traffic" sign with blinking LEDs on the main highway, "Vehicle Approaching" signs with LEDs on the minor approaches, and non-intrusive sensors and wireless communication to activate and deactivate the flashing LEDs. To address stop sign roll-throughs, ALERT-2 added blinking LEDs to the stop signs on the minor approaches. The blinkers are activated when the vehicle passes the corresponding "Stop Ahead" sign and cease when the vehicle reaches the stop sign.

In ALERT-1, the system's batteries, controller circuits and charge controller were mounted behind the sign panels, which made them difficult and unsafe to maintain since road signs are not designed to support a human's weight, and hilly terrain often made it difficult to find a stable base for the ladder needed to reach them. To make the ALERT-2 electronics easier and safer to maintain, researchers developed a custom cabinet for them that was mounted on the signpost less than 2 feet from the ground, as recommended by [AASHTO Roadside Design Guide](#).

Researchers also updated the system's batteries. ALERT-1 used solar-recharged lithium-ion batteries, but they performed poorly at cold temperatures. In ALERT-2, researchers

This project updated the Advanced LED Warning System for Rural Intersections (ALERT) to help improve driver compliance with stop signs, make the system's electrical components easier and safer to access and maintain, and improve battery life.

“In Phase 1, ALERT-1 failed during the first winter due to lack of sunlight to recharge the batteries. ALERT-2 has lasted two Duluth winters without failure because the batteries have so much more capacity.”

–Victor Lund,
Traffic Engineer, St. Louis
County Public Works

“At rural intersections controlled by stop signs on the crossing road, this system can save lives particularly if a blind spot from trees or hills prevents the stopped car from seeing the through traffic.”

–Taek Kwon,
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In Phase 1, flashing LEDs on traffic signs (left) were part of the ALERT system. In Phase 2, LEDs were added to stop signs on the minor approach (right) to attract driver attention and reduce roll-throughs.

used solar-recharged absorbed glass mat batteries that are less expensive per operating hour. The batteries have successfully powered the system for two years without interruption.

The system was tested at the intersection of Lismore Road and Lakewood Road in Duluth, Minnesota. A severe vertical curve on the west approach of Lismore Road significantly reduces visibility for vehicles stopped on Lakewood Road.

What Did We Learn?

Video cameras recorded vehicle movement through the intersection both before and after ALERT-2 was installed. ALERT-2 reduced the overall rate of roll-throughs at the stop sign on the minor approach from 28.15 percent before installation to 14.27 percent after. ALERT-2 maintained the success of ALERT-1 in nearly eliminating roll-throughs when there was traffic on the main road. It also performed significantly better than ALERT-1 at reducing roll-throughs when there was no conflicting traffic. Under ALERT-2, the rate of no-conflict roll-throughs was 16.22 percent compared to 24 percent under ALERT-1.

After installation of ALERT-2, average vehicle speed on the main road decreased by 3.89 mph when the “Cross Traffic” sign was blinking.

A mail-in survey distributed among residents living within 2 miles of the intersection found that 92 percent of respondents felt ALERT-2 improved the safety of the intersection, and 98 percent of respondents agreed that the blinking stop signs attracted driver attention.

What's Next?

Researchers believe that the system is ready to be commercialized for installation at rural two-way stop intersections similar to the test site, where the main road has no traffic control devices and minor approaches are controlled by stop signs.

While no further research is currently underway, participants identified possible areas of further study, including collecting data over a longer period and at more sites, and investigating driver behavior to further reduce the rates of drivers disregarding stop signs when no opposing traffic is apparent.

This Technical Summary pertains to the LRRB-produced Report 2014-10, “Advanced LED Warning System for Rural Intersections: Phase 2 (ALERT-2),” published February 2014. The full report can be accessed at <http://www.lrrb.org/PDF/201410.pdf>. The report for Phase 1 of the research can be viewed at <http://www.lrrb.org/PDF/201104.pdf>. A video demonstrating the system is available at <https://www.youtube.com/watch?v=9eOJ4qIBrQU>.