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RESEARCH
SERVICES SECTION

TECHNICAL SUMMARY

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PROJECT COST:
$51,180

Researchers quantified the effectiveness of roadway lighting for reducing nighttime crashes at isolated rural intersections.

LRRB
LOCAL ROAD RESEARCH BOARD

Safety Impacts of Street Lighting at Isolated Rural Intersections

What Was the Need?

In 2003, intersection-related crashes accounted for approximately 31 percent of fatal crashes in Minnesota, and about 37 percent of these crashes occurred at night, dusk or dawn. A number of research studies, including an investigation by the Minnesota Local Road Research Board in the late 1990s, have suggested that lighting rural intersections is a cost-effective strategy for reducing nighttime crashes. However, many Minnesota highway agencies do not routinely install or maintain streetlights at rural intersections or retain formal guidelines or warrants for installation. Additionally, the benefits of lighting intersections have not been fully quantified, which precludes effective cost-benefit analyses.

What Was Our Goal?

This study was initiated to evaluate the effectiveness of street lighting in reducing nighttime crashes at isolated rural intersections so that Minnesota agencies could make more informed lighting decisions. The primary objectives were to:

- Quantify the effectiveness of rural lighting in reducing nighttime crashes at isolated rural intersections.
- Provide recommendations for selecting, monitoring and analyzing new lighting installations at isolated rural intersections.
- Investigate and refine the recommended lighting guidelines from the original LRRB study, "Safety Impacts of Street Lighting at Isolated Rural Intersections," 1999.

An additional objective was to increase the number of locations evaluated in the original study (12 intersections were reviewed in that study) to increase confidence in the results.

What Did We Do?

Two methods were used to analyze rural intersection crash data for Minnesota:

- A comparative analysis evaluated nighttime and daytime crashes at lighted and unlighted rural intersections statewide using the Mn/DOT intersection attribute database of rural intersections. Daytime and nighttime volumes were determined, and daytime and nighttime crash rates were calculated for each intersection.
- On a more detailed level, a before-and-after study looked at 48 individual, isolated rural intersections to compare the nighttime crash history before and after installation of roadway lighting. A survey of counties provided locations for many of the intersections, while the remainder of the data came from site visits and the intersection and crash databases. When possible, a three-year "before" and a three-year "after" analysis period were used. A Poisson regression analysis was used to evaluate crash rate before and after lighting was installed.

What Did We Learn?

Results from the analyses indicate that street lighting can mitigate the frequency and severity of nighttime crashes at rural intersections.

Results from the comparative analysis showed that unlighted intersections had a ratio of night to total crashes 27 percent higher than lighted intersections. The actual night crash rate, determined by descriptive statistics, was 3 percent lower at lighted intersections. The ratio of nighttime to daytime crash rates was 42 percent higher for unlighted

continued

"The results of this study can help to facilitate the use of intersection lighting by all Minnesota highway agencies."

–Roger Gustafson,
Carver County Engineer

"Lighting can be expensive for smaller communities. This research helped identify the point where it becomes cost-effective to install intersection lights."

–Shauna Hallmark,
Transportation Engineer, Center for Transportation Research and Education, Iowa State University

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The intersection of County State Aid Highways 20 and 13 N in Washington County had no reported nighttime crashes during a three-year period following the installation of roadway lighting.

intersections. Property damage, personal injury and fatal crashes were extracted from the data to examine the ratio of personal injury crashes to total crashes. Lighted and unlighted intersections had similar percentages of crashes for each of the three categories.

All of the descriptive statistic measurements for the before-and-after study show a reduction in night crash experience after lighting was installed. The study identified reductions in the ratio of night to day crashes (36 percent), night crash rate (19 percent), night crash frequency (13 percent) and number of crashes per intersection (13 percent). For the Poisson analysis, 33 of the 48 intersections were evaluated, those having at least three full years of before-and-after data. The Poisson model showed that the night crash rate in the before period was considerably higher—59 percent—than the crash rate in the after period.

Severity of intersection crashes was also compared for the before-and-after periods. The number of nighttime personal injury and fatal crashes at county intersections showed no change, compared to a 15 percent decrease in these types of crashes at state intersections. Overall, there was an 11 percent reduction in the number of personal injury and fatal crashes at night for all intersections.

These results are consistent with the results of the original LRRB study, which found that street lighting at rural intersections yielded a 25 to 40 percent reduction in nighttime crash frequency and an 8 to 26 percent reduction in nighttime crash severity.

What's Next?

The findings from this study were used during development of the Minnesota Strategic Highway Safety Plan, a living document that specifically lists lighting of rural intersections as a low-cost, proactive safety strategy eligible for funding through the Central Safety Fund. County engineers and district traffic engineers use the recommendations from the Safety Plan when implementing lighting. Over the past three years, Mn/DOT has provided Safety Fund dollars to numerous counties for lighting rural intersections.

To facilitate the use of intersection lighting by all Minnesota highway agencies, the report recommends that Mn/DOT consider revising its lighting guidelines in the Traffic Engineering Manual and subsequent documents to apply the guidelines to a higher percentage of rural intersections, provide quantifiable volume and crash measurements, and consider roadway functional classification. The modifications would give Mn/DOT and other agencies expanded flexibility and justification to install lighting at intersections as a proactive or reactive safety measure.

This Technical Summary pertains to the LRRB-produced Report 2006-35, "Safety Impacts of Street Lighting at Isolated Rural Intersections—Part II," published September 2006. The full report can be accessed at http://www.lrrb.org/PDF/200635.pdf.