



TECHNICAL SUMMARY

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LRRB PROJECT COST:

\$138,914



Sharrows can be marked with or without stripes. By themselves, sharrows seem to have no more impact on traffic than do no bicycle facilities at all.



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Clearly Marked Bicycle Lanes Enhance Safety and Traffic Flow

What Was the Need?

The availability of multimodal traffic facilities encourages travelers to use a range of transportation methods, from driving to riding on public transit and bicycling. Although bicycle use is low compared to motor vehicle and public transit use, MnDOT's [Complete Streets](#) program encourages cities and counties to dedicate roadway space to bicycle facilities to expand transportation options and "maximize the health of our people, economy and environment."

Planners and engineers typically consider bicycle facilities from the bicyclist's perspective. It is less common to design and plan for bicycle use from the driver's perspective. However, effective multimodal planning requires an understanding of how bicycles affect traffic if congestion-causing interactions are to be avoided, particularly on high-volume roads. Bicycle facilities must invite use, ensure safety for all road users and at the same time not slow traffic.

What Was Our Goal?

This project aimed to investigate interactions between drivers and bicyclists on urban roadways that employ various bicycle facility designs, and to determine how different bicycle facilities affect traffic. Researchers sought to look at bicycle facilities from the driver's point of view.

What Did We Do?

The investigation team reviewed 44 bicycle facility design manuals and guidance documents, 31 research papers on implementation or assessment of facility designs, and design manuals used by seven other Complete Streets programs from around the United States to identify facility designs that warranted further study.

With help from the MnDOT Technical Advisory Panel and local planners, the team selected nine sites in Duluth, Mankato, Minneapolis and St. Paul that offered a range of facilities—buffered bicycle lanes, striped bicycle lanes, sharrows (shared-use arrows), signed shared lanes and shoulders of various widths.

At each site, they set up one to three cameras and videotaped during daylight hours for five to 51 days. Researchers then trimmed the video data into relevant car-and-bicycle-interaction time frames. This yielded from 16 to 307 hours of video from each site for detailed analysis.

The research team then reviewed the video and analyzed how drivers behaved when encountering bicyclists on roads with and without bicycling facilities. Researchers grouped driver behavior into five categories: no change in trajectory, deviation within lane, encroachment on adjacent lane, completion of full passing maneuver and queuing behind bicyclists. Researchers confirmed their observations with statistical modeling. After analyzing the results of behavior as it correlated with facility type, researchers presented the traffic flow implications of different bicycle facility designs.

Researchers evaluated bicycle and motor vehicle interactions at nine locations in Duluth, Mankato, Minneapolis and St. Paul. Results show that on shared roadways without clearly marked bicycle facilities, drivers are more inclined to pass bicyclists, encroach on other traffic lanes or line up behind bicyclists than on roadways with clearly striped or buffered facilities.

“This project gave us qualitative information and some quantitative information. The observations made provide something we can build on.”

—James Rosenow,
Design Flexibility
Engineer, MnDOT Office
of Project Management &
Technical Support

“The solid line makes the absolute difference in bicycle facilities—something that we haven’t seen in any other study. We found that the presence of a clearly marked or buffered bicycle lane makes a large difference in the way drivers behave around bicyclists.”

—John Hourdos,
Director, Minnesota Traffic
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Minnesota

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Bicycle lanes marked with solid lines or separated by buffers are much more likely than signs to promote safer driver behavior around bicyclists.

What Did We Learn?

Literature Review. Almost all design guidance drew heavily on directives from the American Association of State Highway and Transportation Officials or the National Association of City Transportation Officials. Of the 62 bicycle facility design elements identified in bicycle guidance documents, fewer than half have been studied in any way for efficacy, safety or traffic impact.

Video Analysis. On roadways with sharrows, signs for shared lanes or no bicycle facilities, drivers were more likely to encroach on adjacent lanes than were drivers on roadways with buffered or striped bicycle lanes.

Queuing, or lining up behind bicyclists, showed the greatest potential to impact traffic flows. The highest rates of lining up occurred on roads without bicycle facilities and roads with shared facilities but no marked lanes.

Implications. Sharrows may alert drivers to the presence of bicyclists, but in the impact they make on traffic, sharrows differ little from no bicycle facilities. Roadways with signs indicating shared lanes also show little difference in driver behavior from roadways with no facilities. Therefore, where space allows, buffered or striped bicycle lanes should be used instead of sharrows or signs to increase the predictability of driver behavior and reduce queuing impacts on traffic.

What’s Next?

This study provides enough data to support the recommendation of dedicated, striped or buffered bicycle facilities where demand or interest exists. However, the detailed video analysis conducted for this project provides only part of a three-dimensional study of the efficacy and value of various bicycle facility designs. Further study will be needed to quantify facility and vehicle-bicycle interaction in terms of other traffic impacts like speed and traffic flow coefficients, and to quantify crash rates and other safety impacts. Research is also needed to investigate bicycle facility demand and bicycle use on roadways that do not currently have bicycle facilities.

This Technical Summary pertains to the LRRB-produced Report 2017-23, “Traffic Impacts of Bicycle Facilities,” published June 2017. The full report can be accessed at mndot.gov/research/reports/2017/201723.pdf.