What are some factors to consider when evaluating various operational impacts of a four- to three-lane conversion project?

NOTE : Though the 2023 edition of the Manual on Uniform Traffic Control Devices (MUTCD) is referenced in this summary, the 2023 edition had not yet been adopted within Iowa at the time this document was written. The reader is advised to determine the edition of the MUTCD currently in use in Iowa and refer to that edition for guidance. If needed, this summary will be updated when a final decision on the use of the 2023 MUTCD in Iowa is made.

A wide variety of factors should be considered when assessing whether a four-lane undivided to three-lane (four- to three-lane) conversion alternative should be included as an option for more detailed evaluation. Many of these factors are described in detail in the Federal Highway Administration (FHWA) *Road Diet Informational Guide* (Knapp et al. 2014). Appendix B of that document provides lists of factors, characteristics, and sample evaluative questions to consider when conducting an alternatives assessment. The following topics, which include some of these considerations along with several other design- and maintenance issues identified as part of this project, are addressed in this summary:

- Traffic signal timing and phasing
- Signal head and pole locations
- Large and/or slow-moving vehicles
- Lane widths
- Crossing and parallel railroads
- Winter maintenance

TRAFFIC SIGNAL PHASING AND TIMING

A four- to three-lane conversion may result in changes to the magnitudes, patterns, and types of traffic movement volumes. These shifts can be estimated or predicted with various existing analysis and simulation tools and need to be considered when determining whether adjustments are needed to traffic signal phasing and/or timing. For example, the amount of through volume that needs to be served during a traffic signal phase may increase, and/or a left-turn phase may need to be added. It is also possible that the number of pedestrians may increase along the corridor, which may require changes in signal phasing to serve them (e.g., through the addition of a leading pedestrian interval). Changes in the locations of stop lines at signalized intersections can also impact the timing of traffic signal phases.

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Traffic signal on a three-lane road

Overall, the level of analysis needed to evaluate the impacts of a four- to three-lane conversion on traffic signal phasing and timing may increase with larger overall volumes but is also dependent upon how or even whether traffic patterns change. Some resources for the analysis of traffic signal phasing and timing include, but are not limited to, the *Highway Capacity Manual* (TRB 2022), FHWA *Signalized Intersections Informational Guide* (Chandler et al. 2013), and the *Manual on Uniform Traffic Control Devices* (MUTCD) (FHWA 2023).

SIGNAL HEAD AND POLE LOCATIONS

The types and locations of signal heads and poles may need to change after a four- to three-lane cross section conversion. For example, lane usage and pavement marking lane lines will shift after a four-lane undivided roadway is converted to three lanes, and the types, number, and locations of signal heads will likely need to change with that shift. The options for signal head types and the desirable locations for signal heads are included in the MUTCD (FHWA 2023). Signal poles may also need to be shifted based on changes to curblines and/or the geometrics needed for larger design vehicles turning left or right at signalized intersections. The geometrics needed to accommodate these larger vehicles, and the impacts of these geometrics on traffic control, should be assessed on a case-by-case basis.

LARGE AND/OR SLOW-MOVING VEHICLES

The choice of cross section and lane widths may impact how large and/or slow-moving vehicles interact with other vehicles along a converted roadway. As noted above, the turning capabilities of the appropriate design vehicles should be considered when determining geometrics and, to the extent possible, lane markings. Larger vehicles that sporadically use the corridor may need to be accommodated without major changes to geometrics or lane markings. For example, passenger vehicles can sometimes slow and move around stopped delivery vehicles and/or city buses.

An important consideration is how often these large and/or slow-moving vehicles use the roadway and whether their impact is large enough to warrant the removal of a four- to three-lane conversion as an alternative. For example, there is a difference between the impact of multiple bus stops on a converted roadway (which might be mitigated with turnouts as needed) and that of an occasional agricultural vehicle. Decisions related to this corridor characteristic should be evaluated with respect to the new designation of cross section space, the context of the roadway corridor, and whether and how often the cross section space is expected to be used. Some of the corridor characteristics that may be impacted by the choice of a design vehicle include turning radii at intersections, stop line locations, and signal pole and sign locations.

During some parts of the year in Iowa, for example, some slow-moving and wide agricultural vehicles may travel the roadways. This is not atypical, and potential delays should be expected by drivers. Depending on the context of the roadway corridor, however, this travel might occur along an undivided four-lane roadway. As noted in other summaries in this series and the FHWA *Road Diet Information Guide*, the context of the corridor being evaluated is an important consideration (Knapp et al. 2014).

LANE WIDTHS

Four- to three-lane conversions are typically implemented to improve corridor safety, and it has been found that these safety impacts are generally the result of separating through and turning vehicles, which, in turn, reduces vehicle conflicts. In addition, the three-lane corridor design has also been shown to dramatically reduce the variability in vehicle speeds. The vehicles that, in other circumstances, would be traveling at the highest speeds are much less frequent because there is only one through lane in each direction. Overall, however, studies have shown that the reduction in 85th percentile or average vehicle speed after a four- to three-lane conversion is generally less than 5 mph (Knapp et al. 2014).

A cross section conversion that uses the existing curb-to-curb width or pavement width requires a consideration of lane widths. The choice of lane width "influences operations, safety, quality of service, and the security felt by road users" (Knapp et al. 2014). The relationship between lane width and safety is addressed in another summary in this series, and the capacity and level of service impacts of lane width choice can be determined through the analyses described in the *Highway Capacity Manual* (TRB 2022).

Tradeoffs, if any, are another consideration when selecting lane widths. In Iowa, two reference documents are typically considered in roadway design: the Iowa DOT *Design Manual* (Iowa DOT 2019), which references, among other things, the American Association of State Highway and Transportation Officials (AASHTO) *A Policy on Geometric Design of Highways and Streets* (AASHTO 2018), and the Iowa Statewide Urban Design and Specifications (SUDAS) *Design Manual* (SUDAS 2024). As noted in another summary in this series about the safety impacts of lane width decisions, the Iowa DOT *Design Manual* includes sections related to roadway design criteria, including design criteria worksheets with preferred and acceptable geometrics and typical roadway cross sections (Iowa DOT 2019). The typical cross sections in that document include lane widths of 11 to 12 feet in urban areas (including some with a 14 foot two-way left-turn lane) and 12 feet in rural areas (Iowa DOT 2019). The SUDAS *Design Manual*, on the other hand, includes discussions of geometric design elements related to lane widths and presents geometric design tables with preferred (e.g., 10.5 to 12 feet) and acceptable lane widths, including parking lane widths, for various functional classes of roadway (SUDAS 2024). Additional information on various geometric elements, including lanes, in the context of a Complete Streets approach is provided in another section of the SUDAS *Design Manual* (SUDAS 2024). The preferred widths, SUDAS notes, are those that the designer should try to meet or exceed.

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Two-way left-turn lane on a three-lane roadway

At the national level, the *Road Diet Informational Guide* notes that the lane widths used in practice typically range from 10 to 12 feet and that the widths of turn lanes usually match those of through lanes (but are seldom less than 10 feet) (Knapp et al. 2014). The guide also indicates that TWLTL widths typically range from 10 to 16 feet and that parking lanes range from a minimum width of 8 feet (passenger cars occupy approximately 7 feet) to a desirable width of 10 to 12 feet (to provide some separation from the traffic flow). Note that in Iowa, the Iowa DOT *Design Manual* indicates that a normal TWLTL width is 14 feet while noting that 10 to 12 foot widths can be considered in restricted right-of-way locations (Iowa DOT 2019).

CROSSING AND PARALLEL RAILROADS

The presence of crossing or nearby parallel railroads is a corridor characteristic that should be considered closely when a four- to three-lane conversion is being evaluated as an option. Railroad crossings on roadways converted from two lanes in each direction to one lane in each direction will have different vehicle queuing characteristics before and after the conversion. The queues produced could be twice as long after the conversion compared to before the conversion (if no additional geometric mitigation is provided), and if this is not considered acceptable it may render the conversion unfeasible. The presence of parallel railroads in close proximity to a corridor being evaluated for conversion should also be considered with regard to the impacts on the operation of the corridor's intersections. For example, parallel railroad crossings will likely impact signalized intersection operations (e.g., phasing, timing), and the vehicles waiting will queue along the corridor being considered for conversion. Turning vehicles waiting for the train to pass will queue in the TWLTL in one direction and in the through lane in the other direction. In this situation, there may be a need to add a right-turn lane with adequate storage at the intersection(s) impacted by the parallel railroad crossing in order to allow through vehicle flow on the main corridor. Additional capacity may also be needed for left-turning vehicles.

The number of trains that cross or run parallel to a corridor being considered for a four- to three-lane conversion and the amount of time trains might block the flow of vehicle traffic are two important pieces of information to gather and take into account for any analysis of cross section alternatives.

WINTER MAINTENANCE

Issues with winter maintenance have not generally been raised as a significant concern when jurisdictions have considered four- to three-lane roadway cross section conversions. The amount of pavement width and/or curb-to-curb width that needs to be cleared of snow does not typically change much. However, it is recognized that changes in the use of the cross section width and/or alterations of curb locations may require a different approach to winter maintenance. Bulb-outs of curbing, for example, may require a slower clearing process and/or the use of markers to help guide plow operators.

The presence of a TWLTL along a roadway cross section may also be new to some jurisdictions. Those with no experience snow plowing a roadway with a TWLTL are encouraged to reach out to the Public Works Service Bureau and/or the Iowa County Engineers Association Service Bureau. Both entities have forums that allow communication with those that have experience clearing and storing snow on roadways with this type of lane. Discussions with those that have experience clearing snow in similar situations indicate that some of the variables that may impact the approach taken along a roadway with a TWLTL include the level of through and turning volumes (sometimes related to the number of access points), equipment/staffing availability, the presence of bicycle and/or parking lanes, and snow storage space. The specific approach to winter maintenance along a three-lane roadway, however, is generally based on the unique characteristics of the corridor.

SUMMARY

Several geometric and operational factors that might impact the feasibility of a four- to three-lane conversion are addressed in this summary. These factors, which include traffic signal phasing and timing, signal head and pole locations, large and/or slow-moving vehicles, lane widths, crossing and parallel railroads, and winter maintenance, were identified as part of this project. Many more factors that may be used to determine feasibility are identified and addressed in the *Road Diet Informational Guide* (Knapp et al. 2014) and should also be considered.

References available in: Knapp, K., and D. Veneziano. 2024. *Roadway Cross Section Reconfiguration: Responses to 14 Commonly Asked Questions*. Iowa Local Technical Assistance Program, Institute for Transportation, Ames, IA. https://intrans.iastate.edu/uploads/2024/10/roadway_cross_section_reconfiguration_w_cvr.pdf.