



## Memorandum

**To:** Imran Ahmed, Senior Projects Manager  
Dakota County

**From:** Gina Heim, Engineer

**Date:** February 27, 2024

**Subject:** County State Aid Highway 54 Safety Improvements and Multimodal Connectivity Project – 2024 RAISE Program Application Benefit-Cost Analysis Memorandum

### Introduction

This memorandum summarizes the assumptions, methodology and results developed for the benefit-cost analysis of the No Build and Build Alternatives evaluated as part of the County State Aid Highway 54 Safety Improvements – 2024 RAISE Program Application. The objective of a benefit-cost analysis (BCA) is to bring all the direct effects of a transportation investment into a common measure (dollars), and to account for the fact that benefits accrue over an extended period while costs are incurred primarily in the initial years. The core elements that can be monetized are travel time, vehicle operating costs, vehicle crashes, environmental impacts, quality of life, capital costs and remaining capital value, and operating and maintenance costs. The benefit-cost analysis can provide an indication of the economic desirability of an alternative, but decision-makers must weigh the results against other considerations, effects, and impacts of the project.

County State Aid Highway (CSAH) 54 is a high-speed, two-lane undivided highway that runs parallel to the Vermillion River near the Minnesota-Wisconsin border. It is a rural major collector roadway inside Ravenna Township with annual average daily traffic (AADT) volume of 4,200 vehicles per day (vpd, 2019) and a statutory speed limit of 55 mph. CSAH 54 is a major connection for employers and recreation sites on Prairie Island, and the Treasure Island Resort and Casino attracts visitors from the Twin Cities year-round as a premier vacation getaway. Further, Dakota County neighbors the Prairie Island Indian Community (PIIC), a Mdewakanton Sioux Indian reservation and federally recognized tribe. In recent years, traffic heading to and from Prairie Island has nearly doubled, yet CSAH 54 remains unchanged as the main route for residents, Tribal members, and visitors to access regional facilities.

CSAH 54 has a highly documented crash history with many different crash types, including two fatal crashes, occurring on the roadway in the last five years. The roadway lacks turn lanes at intersections and standard paved shoulders, which have exacerbated serious crashes in recent years with increased traffic volumes. CSAH 54 does not have quality pedestrian access, even though it runs alongside the Mississippi River Trail (MRT) which follows the Mississippi River from Minnesota to the Gulf of Mexico.

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CSAH 54 intersects with CSAH 68 at the southern end of the project corridor. CSAH 68 is also a high-speed, two-lane undivided highway that carries 6,400 vpd (2018) and has a posted speed limit of 55 mph. Turning from CSAH 54 onto CSAH 68 is one of the only two ways to get to the Twin Cities from Prairie Island and vice-versa. The traffic volumes along CSAH 54 are expected to increase to 6,400 vpd by 2040, as Dakota County is one of the fastest growing counties in Minnesota in recent

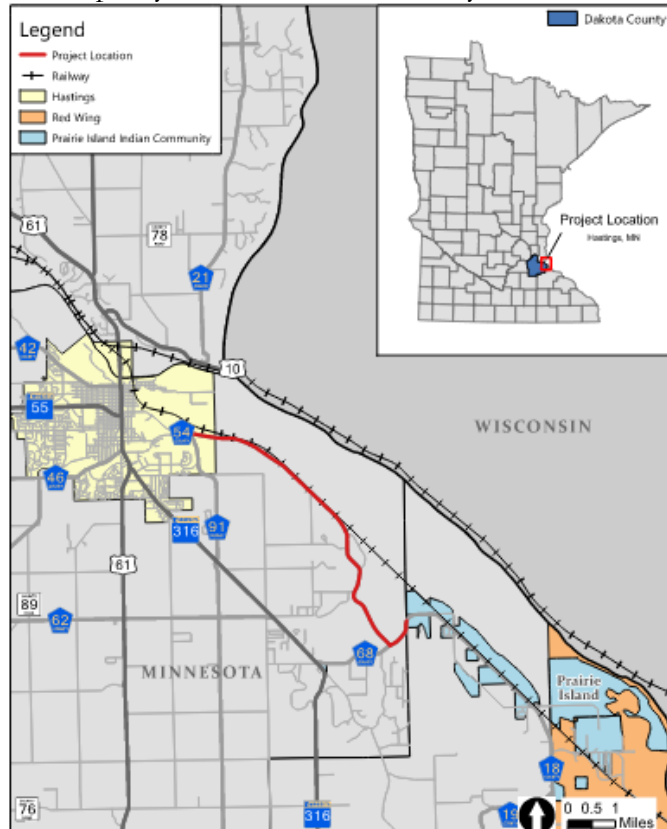


Figure 1: Project Segment Map

years. Growing travel demand requires the reconstruction of CSAH 54 to increase capacity, maintain safety, and implement Complete Streets based multimodal improvements for users of all abilities.

The Project will reconstruct 6.8 miles of CSAH 54, also known as the Ravenna Trail, from Glendale Road to CSAH 68 to improve safety, pavement conditions, and flow of traffic within this critical connection in Dakota County (Figure 1). Additionally, a roundabout will replace the existing T-intersection at the junction of CSAH 54 and CSAH 68 to enhance safety and reduce traffic delays. The Project will also construct 7.5 miles of new multiuse off-road trail along CSAH 54 and further extending along CSAH 68 to the County boundary on the east, connecting it to the Prairie Island Reservation.

## Description of Alternatives

For this analysis, a No Build and Build Alternative were under consideration.

### No Build Alternative

The No Build Alternative leaves the CSAH 54 project corridor in its current geometric and operational state. Planned maintenance and rehabilitation will continue, though no capital improvement projects will take place along the CSAH 54 project corridor.

### Build Alternative

The improvements for the Build Alternative considered in the BCA include:

- Reconstruction of approximately 6.8-mile segment of CSAH 54 to improve the deteriorated pavement conditions and improve the flow of traffic from Hastings to Prairie Island,
- Construction of approximately 7.5 miles of multi-use off-road trail to remedy existing gaps and provide safer non-motorized user connections:
  - On one side of CSAH 54 from Glendale Road to CR 68 intersection and
  - On one side of CR 68 from the intersection to Dakota County eastern boundary,
- Construction of a single lane roundabout (RAB) at the intersection of CSAH 54/CR 68 to enhance safety and reduce traffic delays at the intersection,
- Widening to eight feet shoulders along CSAH 54 from Glendale Rd to CR 68,
- Addition of dedicated turn lanes along CSAH 54 at roughly 6 intersections to reduce conflicts,
- Replacement of stormwater infrastructure to expand capacity and resolve flooding along the corridor, and
- Replacement of intersection lighting at CSAH 54/CR 68 intersection area.

The BCA for the Build Alternative also assumed the same programmed improvements to the regional transportation system that were assumed in the No Build Alternative.

## BCA Methodology

The following methodology and assumptions were used for the BCA:

1. **Main Components:** The main components analyzed included:

- Travel time due to delay (vehicle hours traveled – VHT)
- Operating costs due to miles traveled (vehicle miles traveled – VMT)
- Crash reductions by severity along CSAH 54, the detour route, and the intersection of CSAH 54 and CSAH 68
- Environmental and air quality impacts due to miles traveled
- Quality of life benefits due to trail facility improvements
- Initial capital costs: These costs were broken into distinct categories in accordance with service life (consistent with the recommendations of MnDOT Office of Transportation System Management, August 2022<sup>1</sup>) and were applied over the duration of the construction period according to estimated months of construction per year.
- Operating and maintenance costs: These costs include routine maintenance on the additional pavement, and planned preservation activities associated with both alternatives.
- Remaining Capital Value (Residual Value): The remaining capital value (value of improvement beyond the analysis period) was considered in the analysis.

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<sup>1</sup> Table 5: <http://www.dot.state.mn.us/planning/program/benefitcost.html>

2. **Analysis Years:** The analysis assumed that construction would take place over a two-year period and be completed in 2028. Therefore, the year 2029 was assumed to be the first full year that benefits will be accrued from the project. The analysis focused on the estimated benefits for the 20-year period from 2029 to 2048, but also included the two years of construction from 2027 to 2028 to accurately display any disbenefits that may occur due to construction. The present value of all benefits and costs was calculated using 2022 as the year of current dollars.
3. **Economic Assumptions:** The value of time, vehicle operating costs, emissions costs, and cost of crashes were obtained from the *Benefit Cost Analysis Guidance for Discretionary Grant Programs*, dated December 2023. The analysis was completed using an assumed discount rate of 3.1 percent.
4. **Development of Travel Time Savings and Vehicle Operating Costs:** Travel time changes in the CSAH 54 study area over the analysis period were captured by calculating the difference in VHT based on detour routes during construction and lower posted speeds due to poor conditions in the No Build scenario. The travel time savings described in the methodology above were accrued for 365 days each year.

Vehicle operating cost changes in the CSAH 54 study area over the analysis period were captured by calculating the difference in VMT based on detour routes during construction and lower posted speeds due to poor conditions in the No Build scenario. The vehicle operating cost savings were accrued through reduced mileage in the Build scenario compared to the No Build scenario. The vehicle operating costs described in the methodology above were accrued for 365 days each year. Changes due to the increase of travel time and operating costs were calculated using costs per hour and mile traveled that account for vehicle occupancy and different vehicle types.

5. **Vehicle Occupancy and Vehicle Types:** The composite cost per mile used in the BCA accounted for the percentage split of autos and trucks in the travel area. The composite cost per hour accounted for vehicle occupancy ratios and the percent split of autos and trucks traveling in the area. Key assumptions for these areas included:
  - The truck percentage used in the analysis was 5 percent based on discussions with Dakota County on expected truck volumes and previous studies done on the area.
  - Vehicle occupancy that was used in the analysis is consistent with values provided by *Benefit Cost Analysis Guidance for Discretionary Grant Programs*, dated December 2023. The analysis assumed occupancy of 1.67 people per automobile and 1.00 people per truck.
6. **Safety Analysis:** The Build Alternative safety improvements on the CSAH 54 corridor quantified in the BCA are the widening of the pavement shoulders, dedicated turn lanes, and converting a side-street stop to a roundabouts. Existing 5-year (2019 through 2023) crash data was collected for the study area and was disaggregated by locations where improvements are being proposed. Most proposed improvements as described in the Build Alternative description above are expected to generate safety benefits by reducing the number and severity of crashes along the corridor. This safety analysis is conservative in choosing Crash Modification Factor (CMF) values that only apply to the Build scenario properly. Each CMF was only applied to the applicable crashes. For example, the CMF applicable to a roundabout construction was only applied to crashes at that intersection,

and the CMF applicable to adding dedicated turn lanes was only applied to crashes along CSAH 54 at intersections.

CMFs used in the BCA were obtained and applied for the following specific project improvements:

- Construction of a single lane roundabout (RAB) at the intersection of CSAH 54/CSAH 68 to enhance safety and reduce traffic delays at the intersection,
- Widening to eight feet shoulders along CSAH 54 from Glendale Rd to CSAH 68,
- Addition of dedicated turn lanes along CSAH 54 at roughly six intersections to reduce conflict and delays

Other CMFs were researched and not included due to poor quality or incorrect roadway types. Therefore, safety improvements for pavement quality and intersection lighting were not included in the analysis. There are additional geometric improvements that are expected to improve safety but not quantified in this analysis. These are described in the Factors Not Quantified section of this memo. The estimated reduction of existing intersection crashes was calculated by applying the CMF to crashes identified at each intersection or segment as applicable.

Crashes were evaluated using existing and future forecasted AADT at each segment and intersection. All safety benefits were calculated for year 2019 and year 2040 and interpolated (or extrapolated) based on an annual growth rate to determine total safety benefits over the analysis period from year 2029 to 2048. Crash cost assumptions for the KABCO scale are consistent with values and methodologies published in the Benefit Cost Analysis Guidance for Discretionary Grant Programs, dated December 2023. Crash data used in the analysis and detailed calculations on crash cost estimates are included in the "Safety Improvements" tabs of the BCA Workbook.

7. **Environmental and Air Quality Impacts:** Changes in emissions are expected to be impacted by the vehicle miles traveled (VMT) in the No Build and Build scenarios. The change in miles traveled between No Build and Build conditions was calculated between the detour routes and the CSAH 54 route. Then the emissions were calculated by applying emissions costs to the miles traveled by vehicle type. Average emission rates per vehicle type were obtained from the Environmental Protection Agency's Motor Vehicle Emission Simulator (MOVES) version 3. Emission rates per vehicle type are provided in the BCA Workbook.

Total change in emissions and vehicle operating costs per mile traveled by mode were valued in accordance with the Benefit Cost Analysis Guidance for Discretionary Grant Programs, dated December 2023.

8. **Quality of Life Benefits:** Benefits associated with the trail construction are listed under the Quality of Life Benefits tab in the BCA Workbook. Benefits included those who were positively impacted by the trail, and also induced trips by the trail being built. These benefits accumulated to mobility cost savings, morality (health) cost savings, recreation cost savings, amenity (cycling facility improvement) cost savings, and congestion (reduced auto use) cost savings.

This project benefits the people who may bicycle to work or recreationally by helping to connect the broader regional trail network between the Prairie Island Indian Community and the city of Hastings and Ravenna Township.

9. **Operating and Maintenance Costs:** Roadway maintenance and rehabilitation costs and schedules were provided by Dakota County. These schedules were used to determine maintenance costs according to the year for the No Build and Build scenarios, as different maintenance activities occur at different frequencies. The cost estimate schedules are likely to fluctuate slightly due to actual roadway conditions as years progress in the No Build and Build scenarios.
10. **Calculation of Remaining Capital Value:** Because many components of the initial capital costs have service lives well beyond the 20-year analysis period, the remaining capital value was calculated for the Build Alternative. These values were expressed in terms of 2022 dollars and were added to other project benefits in accordance with USDOT guidance. In determining remaining capital value of the initial capital cost, the costs of the Build Alternative were separated into the following categories:
  - Right of Way
  - Major Structures
  - Grading and Drainage
  - Sub-Base and Base
  - Surface
  - Miscellaneous Costs – Includes mobilization, removals, temporary pavement and drainage, traffic control, contingency, and program delivery. These were assumed to be sunk costs and assigned zero remaining capital value.

Project components in each cost category were assumed a service life based on recommendations provided by MnDOT Office of Transportation System Management.

11. **Factors Not Quantified:** Several factors were not quantified as part of the analysis that could potentially add to the benefits assumed in the BCA. These factors include the following:
  - Safety benefits were calculated conservatively. Other safety benefits that were not included in the BCA but are expected to increase safety are:
    - ▲ Reduction in crashes due to the improved pavement conditions.
    - ▲ Improved safety at intersections with added intersection lighting.
    - ▲ Replacement of stormwater infrastructure to reduce corridor flooding.

## BCA Results

The BCA provides an indication of the economic desirability of a scenario, but results must be weighed by decision-makers along with the assessment of other effects and impacts. Projects are considered cost-effective if the benefit-cost ratio is at least 1.0. The larger the ratio number, the greater the benefits per unit cost. Results of the BCA are shown in Table 1: Total Project Results. See the BCA analysis workbook for detailed calculations.

Table 1: Total Project Results

	<b>Initial Capital Cost (2022 Dollars)</b>	<b>Project Benefits (2022 Dollars)</b>	<b>Benefit-Cost Ratio (3.1% Discount Rate)</b>	<b>Net Present Value (2022 Dollars)</b>
No Build vs. Build	\$32.5 million	\$78.9 million	2.43	\$46.4 million

**Appendix A**  
**Benefit-Cost Analysis Worksheet**