BOLTON & MENK
Real People. Real Solutions.

430 E Grand Avenue
Suite 101
Des Moines, IA 50309

Ph: (515) 259-9190
Fax: (515) 233-4430
Bolton-Menk.com

BCA MEMORANDUM

Purpose

This memorandum documents the methodology and results of a benefit-cost analysis for the proposed build alternative for the Southwest Arterial Segment 1 Project in Cottage Grove, Minnesota. All tables referenced can be found in the BCA Memo here: www.CottageGroveMN.gov/SWArterialRoadwayProject.

Background Info

A primary goal for this project is to improve access, mobility, and safety for all modes including freight. Minnesota Department of Transportation (MnDOT) crash data from 2012-2021 showed that there were 25 crashes along the corridor. In all, there was one fatality and one suspected serious injury crash associated with this stretch of roadway in the 10-year time period. **Table 1** shows a summary of collisions along this stretch.

Table 1. 2012-2021 Crashes

KABCO Level	Severity	Number of Collisions
K	Killed	1
A	Incapacitating	0
B	Non-Incapacitating	1
C	Possible Injury	3
O	No Injury	20
	Total	**25**

Providing alternative modes of transportation is another priority for this project. There are currently no east-west pedestrian/bicyclist facilities. The ultimate goal is to provide continuity from Highway 61 at Keats Avenue to Grey Cloud Island for all modes of travel.

Table 2. Expected ADTs

Alternative	Year	
	2025	2044
No-Build	16,400	18,600
Build	20,200	22,700

The purpose of a benefit-cost analysis is to express the effects of an initial investment into a common measure, base-year dollars. This accounts for benefits occurring over long periods of time, while most of the costs are incurred as an initial investment. Under this approach, a project with monetized benefits that are greater than its costs will have a benefit-to-cost ratio greater than one and therefore is considered an economically beneficial endeavor.

Benefit-Cost Methodology

The monetary benefit for this project is quantified in terms of either a reduction or increase in vehicle miles traveled (VMT), vehicle hours traveled (VHT), project area collisions, vehicle emissions, and roadway maintenance. The costs considered for the project include surfacing, subbase/base, grading and drainage, signal and lighting construction, right-of-way acquisition, as well as engineering and design fees. The itemized cost breakdown of the build scenario is shown in Table A2. Remaining capital values of these roadway features at the end of the analysis period are subtracted from the total cost of the project. The salvage values can be found in Table A3 using a 7 percent discount rate.

The results of the analysis provide input for evaluating the overall benefit of the proposed improvements to the area. Since the current design is still preliminary, it should be noted that certain benefits and costs may change prior to final design, however these changes are anticipated to be relatively minor as initial cost estimates were made to be conservative.

General Assumptions

- All monetary values are discounted to the 2020 analysis year.
- The 20-year benefit period is based on a 2025 day-of-opening through the year 2044. Benefits are assumed to start November 1st, 2025, and end December 31st, 2044.
- Yearly Build and No-Build benefits are calculated based on linear interpolation over the 20-year analysis period.
- Longer travel times and rerouting of trips during construction years are not included in this analysis. Construction is anticipated to occur under traffic.
- Preliminary cost estimates were completed using unit costs for grading, base, and pavement. An appropriate risk factor given the early stage in the project development process was therefore used.
- 260 days per year was used in the analysis of weekday VHT, VMT, and emissions.
- Weekend VHT, VMT, and emissions were considered as well. A proportion of weekday VHT, VMT, and emissions benefits were applied to 105 weekend days per year. This process used a fraction of traffic for Saturdays and Sundays versus an average of Tuesday, Wednesday, and Thursday traffic to allocate weekend benefits since weekend traffic was not modeled as part of the traffic analysis.
- General assumptions regarding the costs associated with project area collisions, vehicle operating costs, time costs, component service life, analysis period, and discount rates can be found in **Table A1.**

Traffic Analysis

Traffic forecasts were determined under both no-build and build scenarios. The forecasts were determined based on historical Annual Average Daily Traffic (AADT) counts available from the MnDOT current year traffic count data collected in 2019. The AADT data along with historical AADT data was used to determine growth rates through the corridor. It was noted that volumes have spiked in recent years due to rapid growth, so a 2.5% annual growth was assumed.

Multiple large developments are anticipated to be finished by the end of the project, which are planned for large industrial warehousing and manufacturing. This type of industry is anticipated to bring large amounts of heavy vehicles. The table below displays the amount of additional anticipated trips to be introduced onto the area network by opening year 2025.

Table 3. Trip Generation Rates

Opening	Land Use	ITE Code	Proposed Size	AM Peak Hour		PM Peak Hour		Weekday	
				Entering	Exiting	Entering	Exiting	Entering	Exiting
2023	Northpoint Industrial Phase 1	130	768000 SF	273	41	64	242	1355	1355
2025	Northpoint Industrial Phase 2	130	2,638,0000 SF	940	140	222	832	2574	2574
2022	Renewal by Anderson: Manufacturing	140	11,000 SF	25	9	12	16	122	122
2023	Renewal by Anderson: Office	710	30,000 SF	52	7	10	51	204	204
2025	Renewal by Anderson: Warehouse	150	627,000 SF	76	23	28	74	515	515
2025	Graymont Village	210	213 units	41	117	134	76	678	679
2025	Mississippi Landing: Single Family	210	312 units	59	170	191	108	1437	1437
2025	Mississippi Landing: Senior Apartments	251	52 units	8	16	16	11	170	170
2025	Mississippi Landing: Senior Townhomes	252	8 units	1	1	1	1	24	24
2022	Airgas Plant	110	17,000 SF	20	3	4	17	57	57
2022	Ryan Companies	110	147,000 SF	100	15	18	85	302	302
2025	Up North Plastics Expansion	140	430,000 SF	224	83	133	184	912	912
2025	Settlers Bluff	220	155 detached townhomes	17	54	55	32	535	535
2028	25 Acre Industrial	110	325,000 SF	210	32	42	189	636	636
2030	19 Acre Industrial	110	248,000 SF	163	24	30	136	492	492
			Total:	2209	735	960	2054	10010	10011

No Build

For the No Build forecast, the growth rate along the corridor was 2.5 percent per year based on the AADTs.

Build

The Build scenario keeps the traffic flow the same, therefore the forecast the growth rate along the corridor is also 2.5 percent per year based on the AADT's.

Analysis

Synchro/SimTraffic was used to analyze the various traffic scenarios and configurations. The values obtained using the modeling software provide travel distance (vehicle miles traveled - VMT) and travel time (vehicle-hours traveled - VHT) for the corridor. See **Table 4.** Yearly VMT and VHT for VMT and VHT during 2025 and 2044 build and no-build scenarios.

Table 4. Yearly VMT and VHT

	Year	Type	No Build		Build	
VMT	2025	Cars	8,573,218	11,430,957	5,618,053	7,490,738
		Trucks	2,857,739		1,872,684	
	2044	Cars	8,932,235	11,909,647	7,367,630	9,845,681
		Trucks	2,977,412		2,478,051	
VHT	2025	Cars	452,393	603,190	183,403	244,538
		Trucks	150,798		61,134	
	2044	Cars	709,875	946,500	260,764	347,685
		Trucks	236,625		86,921	

Calculation of Benefits

Economic values for VHT, VMT, and emissions were obtained from the US Department of Transportation (USDOT) guidance: "Benefit Cost Analysis Guidance for Discretionary Grant Programs (2022)". See **Table 5** for a summary of economic values that were used for this analysis. A 20-year analysis period beginning in 2025 and ending in 2044 was chosen for the benefit-cost evaluation with all values discounted to 2020 dollars.

Table 5. BCA Recommended Standard Values

Occupancy Rates in Seven-County Metro Area	
Auto	1.3
Truck	1.0
Value of Travel Time Savings (per person-hour)	
Auto	$22.50
Truck	$33.60
Operating Costs (per mile)	
Auto	$0.27
Truck	$0.66
Emissions Costs (per mile)	
Auto	$2,384.30
Truck	$15,800.00

Travel Time Benefit

Delay benefit was calculated in terms of delay per person. Using MnDOT's guidance of 1.3 persons per car and 1.0 persons per truck, delay was calculated by using these multipliers and the travel time reported in vehicle hours by SimTraffic. The economic costs of this delay were then quantified by using USDOT's suggested values for auto and truck travel time savings. The benefits derived from the build scenario for travel time are estimated at **$131,455,000** for a 7 percent discount rate. 2025 and 2044 delay benefits can be seen in **Table A4** and a yearly breakdown of the benefit-cost analysis pertaining to delay can be found in **Table A5.**

Vehicle Operation and Emissions Benefits

Vehicle operations and emissions benefit were determined by using USDOT's suggested values based on a cost per mile traveled. With the expected reduction of stops for rail crossings and in reduction total linear feet of roadway, the benefits derived from the build scenario for vehicle operations are estimated at **$10,749,000** for a 7 percent discount rate. The benefits derived from the build scenario for vehicle emissions are estimated at **$8,558,000** for a 7 percent discount rate. 2025 and 2044 delay benefits can be seen in **Table A6** and **Table A8**. A yearly breakdown of the benefit-cost analysis pertaining to vehicle operation and emissions can be found in **Table A7** and **Table A9**.

Operation and Maintenance Benefits

Roadway and utilities maintenance along the existing corridor would be needed if the project does not happen; a mill and overlay is anticipated to be completed in 2025. The city will need to maintain the existing rail crossing on an estimated 8-year cycle. More frequent maintenance activities, such as crack

sealing, was taken to be equal between build and no-build scenarios and therefore not taken into consideration when monetizing maintenance operations.

The expenditure cost for the lifetime cycle cost of the project is expected to be **$1,648,778.** Total discounted maintenance benefits are **$709,885** at a 7 percent rate. **Table A10** shows a yearly breakdown of the benefit-cost analysis for maintenance activities.

Safety Benefits

The methodology used to complete the crash analysis and corresponding benefit-cost ratio is described in the following paragraphs. Crash reduction within the project area was determined by separating intersections and segments so that factors and state averages could be applied appropriately. Crashes were obtained from the MnDOT Crash database for a ten-year period from 2012-2021. These collisions were then annualized, and reductions and additions of crashes were added appropriately relative to geometry reconfigurations.

The existing corridor is 11,100 feet in length, rural two-lane highway, speed limits ranging between 50 miles-per-hour (mph) and 55 mph, and includes two at-grade rail crossing. The new corridor will be an urban four-lane section with turn-lanes and a speed limit of 45 mph. The projected volume increase along the corridor from 3,000 ADT to 22,000 ADT justifies the added lanes.

Crash modification factors were reviewed from the Highway Safety Manual (HSM) and the Crash Modification Factors (CMFs) Clearinghouse. Crash modification factors were used to determine the anticipated number of crashes after an improvement is made to an intersection or roadway. The CMF is as follows:

- Install Curb and Gutter (CMF ID: 2375)
    - Install AASHTO Type B curb along the outside (right) shoulder of four-lane suburban roadways.
        - CMF = 0.89

After establishing no-build and build crashes for 2021 using the CMFs, forecasted 2025 and 2044 collisions were obtained by inflating numbers according to the expected AADT growth along the corridor for the no-build and build scenarios.

Table 6. KABCO Collision Values

Severity	Description	2025		2044	
		No-Build	Build	No-Build	Build
K	Fatal	0.1	0.1	0.2	0.2
A	suspected Major Injury	0.0	0.0	0.0	0.0
B	Suspected Minor Injury	0.1	0.1	0.2	0.2
C	Possible Injury	0.3	0.3	0.5	0.5
O	Property Damage Only	2.2	2.0	3.5	3.1
Sum		**2.8**	**2.5**	**4.4**	**3.9**

The USDOT's value of a statistical life (VSL) provided in the Benefit-Cost Analysis Guidance for Discretionary Grant Programs were used for the values of the crashes. A resulting benefit of **$1,689,000** was obtained for a 7 percent discount rate over the 20-year analysis period. A yearly breakdown of the benefit-cost analysis pertaining to this decrease in collisions can be seen in **Table A12**.

An additional safety benefit was evaluated but not derived within quantitative portion of the BCA. GradeDec.Net, a web-based application and decision support tool for the identification and evaluation of highway-rail grade crossing upgrades, separations and closures, was used to evaluate the improvement of a grade separated crossing for the corridor. The results found from GradeDec.Net indicated that the closing of the rail crossing and addition of a grade separated crossing will have the potential to reduce 1.5 property damage only crashes, 1 injury crash, and 0.5 fatal crashes over the span of 20 years.

Public Health Benefit

Improved public health is another benefit of the proposed project. This benefit was not quantified, but the new pedestrian and bicycle facilities will improve public health. The project will make the corridor and the community of Cottage Grove more pedestrian and bicycle friendly through the following improvements:

- Reduced travel distances
- New sidewalks and trails
- Wider boulevard providing greater separation between pedestrians and vehicles
- ADA compliant facilities
- New multi-use trail connecting a highly used community facility

Stormwater Runoff Mitigation

The project will also improve stormwater runoff management through the addition of stormwater BMPs that will include native plantings to improve water quality and promote infiltration and other green street elements where practical to reduce stormwater runoff and improve water quality. This benefit was not quantified.

Benefit-Cost Analysis Results

Table A13 shows a yearly breakdown of design and construction costs for the project. See **Table 7** for a results summary of the benefit-cost analysis for the SW Arterial Roadway Project.

Table 7. Benefit-Cost Analysis Summary

Item	Build
	PV (7% Discount Rate)
Travel Time Benefit	$131,455,000.00
Collision Reduction Benefit	$1,689,000.00
Operation and Maintenance Benefit	$710,000.00
Emissions Benefit	$8,558,000.00
Vehicle Operating Benefit	$10,749,000.00
PV Total Benefit	**$153,161,000.00**
PV Total Cost	**$30,187,000.00**
PV Salvage Value	$2,275,000.00
(PV Total Cost - Salvage Value)	**$27,912,000.00**
Benefit-Cost Ratio	**5.487**

The analysis indicates that the build option has a benefit-cost ratio greater than 1.0, meaning that it is an economically beneficial project. The benefits of the project are estimated to be higher than the costs associated with the construction of the project. A more complete breakdown of both the project costs and benefits can be found in **Table A14.**

Resources Used

"Benefit-Cost Analysis Guidance for Discretionary Grant Programs." Office of the Secretary. U.S. Department of Transportation, https://www.transportation.gov/sites/dot.gov/files/2022-03/Benefit%20Cost%20Analysis%20Guidance%202022%20%28Revised%29.pdf

"Highway Safety Manual" Washington D.C. American Association of State Highway and Transportation Officials. 2010. Book

"Crash Modification Factors Clearinghouse." Safety Research Center*, U.S. Department of Transportation Federal Highway Administration, http://www.cmfclearinghouse.org/*

"GradeDec.Net – System for Highway-Rail Grade Crossing Investment Analysis" Federal Railroad Administration, https://gradedec.fra.dot.gov/default.aspx

APPENDIX