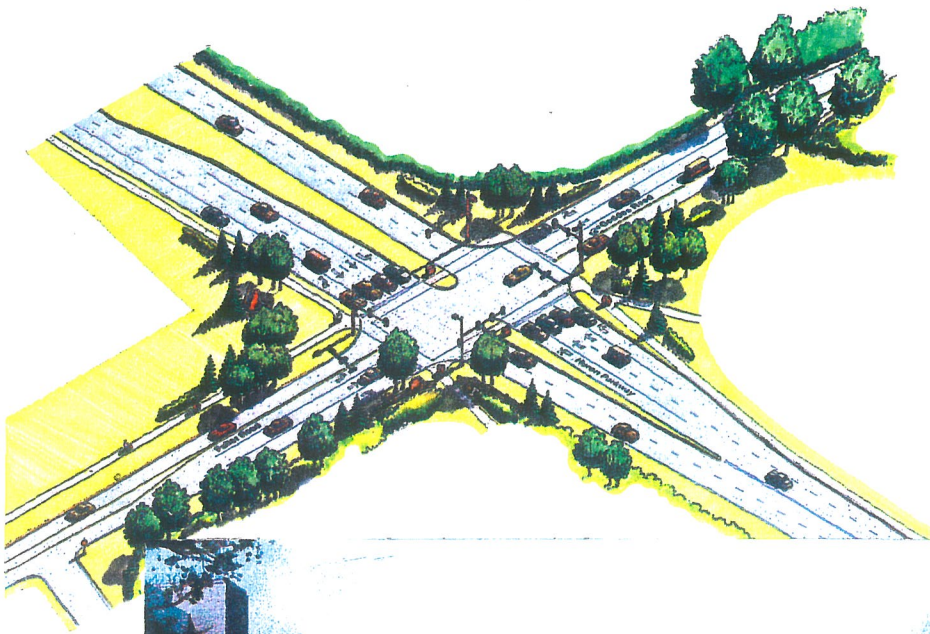


Geddes/Fuller/Conrail

Corridor Study



June 1994



VII. COST-BENEFIT EVALUATION

Recommendations have been presented for individual strategies, as well as potential advantages and disadvantages for each strategy. These recommendations were based primarily on the expected benefits of the strategy without regard to costs. This section considers in greater detail the expected cumulative benefits for each strategy and the associated costs. Results of this evaluation formulate the basis for a final recommendation of the Geddes/Fuller corridor.

Three different analysis methodologies were used to compare relative costs and benefits for each strategy. These methodologies are:

- Cost-Benefit Index
- Cost-Effectiveness Index, and
- Benefit/Cost Ratio.

Each approach uses estimates of costs, benefits, and number of users/beneficiaries to determine a cost-benefit measure. Cost estimates include capital, operating and maintenance costs. Benefits include time and costs savings.

A general definition of benefits varies depending upon the group of people affected by a particular alternative strategy. For example, construction of a new park-and-ride facility might be beneficial to commuters because they save downtown parking costs. On the other hand, residents adjacent to the new facility may have costs inflicted upon them due to increased air pollution, noise, and pedestrian-vehicle interaction. Benefits considered herein refer to both time and cost savings to users/beneficiaries of the proposed strategy. The disutility measure described earlier in this report was used here to quantify these benefits.

Disutility is a comprehensive measure of trip costs and inconveniences for a particular transportation mode such as transit, auto, bicycle, or walking and converted into minutes for simplicity. Variables influencing a trip's disutility include the trip's length, vehicle speed and operating costs, walking times, and out-of-pocket costs. All cost variables are divided by a time value of money for conversion to time units.

As an example, assume the disutility of a home-to-work trip on an AATA bus is estimated at 225 minutes. (Recall that disutility represents the costs and inconveniences of a trip, not that it takes over three hours to complete the home-to-work trip.) Then assume that the bus guideway is constructed and made fully operational to service the same home-to-work trip. Because the bus guideway provides its users reduced trip travel times, savings in daily parking fees, and possibly reduced walking distances, the disutility measure for the same home-to-work trip on the

bus guideway is reduced to say, 142 minutes. Use of the bus guideway has made the taking of trips more convenient for both transit riders on the guideway, and for vehicular traffic on Geddes/Fuller Road. Therefore, the disutility for all vehicle trips taken in the corridor is also reduced.

By comparing the benefits (reduction in disutility) to the estimated costs with respect to the number of users/beneficiaries, cost-benefit evaluations can be completed. Because of the somewhat subjective nature of disutility, three cost-benefit measures were calculated and averaged to minimize inherent biasing of the results. Quantitative results of these three measures is presented in Table 17. Table 17 summarizes the cost-benefit evaluations for post-improvement implementation as well as for the Year 2015. These two time periods are considered here because the expected number of users/beneficiaries increases over time, allowing a comparison between present, post-implementation conditions and the forecast year 2015. Procedures and results for each measure is discussed below.

COST-BENEFIT INDEX ANALYSIS

Benefits for each strategy were determined by observing likely reductions in mode disutility before and after a strategy was implemented. The costs to implement and operate that strategy were then divided by the product of the number of benefiting users and savings of disutility minutes. A cost-benefit index was established as the ratio of costs to benefit as follows:

Cost-Benefit Index =

$$\frac{\text{Costs (Capital, O\&M) to Implement Strategy}}{(\text{Savings in Disutility Minutes}) * (\text{Number of Benefiting Users})}$$

Low C-B index values indicate the greatest benefit given the estimated cost for individual strategies. Low cost strategies that provide benefits to many users result in the best or lowest C-B indices.

The most effective strategies, or those with the lowest index values, were as follows

- HOV-Priority parking
- Employee RideShare programs
- Traffic signal optimization
- Pedestrian circulation systems.

For all but intersection improvements, as travel demand increases the C-B index decreases (becomes better).

**TABLE 17
COST-BENEFIT ANALYSES SUMMARY**

Strategy	BENEFIT COST MEASURES							
	Cost-Benefit Index				Cost-Effectiveness Index		B/C Ratio	
	Capital Cost Index		O&M Cost Index		Post-Improvement	Year 2015	Post-Improvements	Year 2015
	Post-Improvement	Year 2015	Post-Improvement	Year 2015				
Parking Restriction and Mgmt (HOV Parking)	0.9	0.9	1.0	0.5	13	4	0.21	0.33
Additions to Transit Service	173	29.5	97.7	16.6	1,865	313	0.0011	0.0099
Smart Buses and Kiosks *	693	118	35.9	6.1	1,118	187	0.0003	0.0025
Park-and-Ride with Bus Transfer	137	137	18.6	18.6	265	265	0.0014	0.0021
Employee Rideshare Programs	0.0	0.0	60.6	4.8	- 1	- 2	6.7	127
Area Bicycle Circulation Program	58.6	31.5	1.8	1.0	208	106	0.0033	0.0093
Pedestrian Circulation System	6.0	3.2	0.1	0.1	25	2	0.0321	0.0904
ATMS - Traffic Surveillance *	278	127	28.9	13.2	414	188	0.0007	0.0023
ATIS - Transit Information *	509	86.5	216	36.7	2,719	460	0.0004	0.0034
CMS Parking and Traffic Information	39.0	17.9	5.1	2.3	91	40	0.0049	0.0163
Signal Optimization, Phasing, Progression	0.15	0.07	0.02	0.01	- 2	- 3	1.3	3.6
Intersection Improvements	14.7	> 500	0.02	> 100	11	3	0.018	3.6
One Lane Bus Guideway on Conrail	146	43.6	8.9	2.7	149	63	0.0013	0.058
Satellite P&R near Guideway Stations	567	567	65.8	65.8	445	445	0.0003	0.0067
Feeder Buses to P&R Guideway Stations	166	32.6	89.0	40.3	115	47	0.0012	0.0089
Pedestrian Traffic Enhancements near Guideway Stations	44.3	11.8	0.9	0.2	13	3	0.0043	0.025
Extend Existing HOV on Geddes/Fuller	85.6	47.0	1.2	0.7	37	16	0.0022	0.0062
Widen Geddes/Fuller to Four Lanes	61.4	28.0	0.5	0.2	63	28	0.0090	0.010
Do Nothing	NA	NA	NA	NA	NA	NA	NA	NA

* Benefits uncertain due to new technologies.

The least effective strategies, or those with the highest index values were as follows:

- Satellite Park and Ride
- ATMS - Traffic surveillance

Use of the C-B index is useful only for cross-comparison of strategies because estimations of disutility were made using the same set of assumptions. Because of the subjective nature of this procedure, direct application of the C-B index values is not appropriate. For example, it is appropriate to conclude that HOV-priority parking (C-B Index = 0.9) is more cost-beneficial than widening Geddes/Fuller (C-B Index = 61.4). However, it is not necessarily correct to say that HOV-priority parking is over 68 times ($61.4 \div 0.9$) more cost-beneficial than widening the roadway.

COST-EFFECTIVENESS INDEX ANALYSIS

The second cost-benefit measure considered the cost per user to determine a cost-effectiveness index. The cost-effectiveness index is defined as follows:

Cost-Effectiveness Index =

$$\frac{(\text{Annual Capital Cost}) + (\text{Annual O\&M Cost}) - \text{Savings in Disutility}}{\text{Number of Users}}$$

Low cost-effectiveness index values are desired. From this analysis, the most effective strategies, or those with the lowest index values, were as follows

- Employee RideShare programs
- Traffic signal optimization
- Intersection improvements
- Pedestrian circulation systems
- Parking restrictions.

The least effective strategies, or those with the highest index values were as follows:

- ATIS - Transit information
- Smart buses with kiosks
- Additions to transit

BENEFIT-COST RATIO ANALYSIS

The third cost-benefit measure is the benefit to cost ratio. This ratio was calculated as follows:

$$\text{B/C Ratio} = \frac{\text{Change in Disutility}}{\text{Incurred Cost for the Strategy}}$$

The B/C ratios are only useful for comparisons of the alternative strategies, not individually. Typically, a B/C ratio greater than 1.0 indicates that the benefits gained from the strategy outweigh the costs. The same indication may not be true with those found in Table 17 because of the way in which disutility was estimated. Unlike both previous indices, the highest B/C ratio indicates the most benefit for the money spent. Both the Cost-Effectiveness Index and the B/C Ratio require that disutility be converted from time to dollar units. The value of time was assumed equal within each mode and for all trip purposes.

Similar results were observed for both the cost-effectiveness index and the B/C ratio. The highest (most favorable) B/C ratios were observed with RideShare, signal optimization, and intersection improvements.

COMBINED ANALYSIS

In order to compare each of the three measures, the strategies were ranked (lower rankings are the most beneficial) for each analysis method. These rankings are presented in Table 18 for a post-improvement time period and for the forecast year 2015.

An overall ranking of strategies based on the combination of cost-benefit analysis methods is presented in Table 19 as well as the overall rankings of strategies from the Screen 3 analysis. The Screen 3 rankings were derived from benefits identified during Screen evaluations. Table 19 demonstrates how priorities change when costs are considered.

The top five strategies for both time periods considered with respect to cost-benefit only are:

- Employee RideShare,
- Signal Optimization and Progression,
- Intersection Improvements,
- Pedestrian Circulation Systems, and
- Parking Restrictions and Management.

**Table 18
Cost Benefit Ranking**

Strategy	C-B Index				C-E Index		B/C Ratio		Summary (Criteria 15-17 only)	
	Capital		O&M		P-Imp	Yr. 2015	P-Imp	Yr. 2015	P-Imp	Yr. 2015
	P-Imp	Yr. 2015	P-Imp	Yr. 2015						
Parking Restrictions & Mgmt.	3	3	7	7	5	6	3	3	4	5
Additions to Transit Services	14	9	17	14	17	16	14	9	15	12
Smart Buses and Kiosks	18	15	14	12	16	13	18	15	17	14
Park & Ride w/ Bus Transfer	11	17	12	15	13	15	11	17	12	17
Employee Rideshare Programs	1	1	3	1	2	2	1	1	1	1
Area Bicycle Circulation Program	8	10	9	9	12	12	9	10	10	9
Pedestrian Circulation System	4	4	4	4	6	3	4	4	5	3
ATMS-Traffic Surveillance	15	16	13	13	14	14	15	16	14	15
ATIS-Transit Info.	16	14	18	16	18	18	16	14	18	16
CMS Prkg & Traffic Information	6	7	10	10	9	9	7	7	8	8
Signal Optimization, Phasing, Prgssn	2	2	2	3	1	1	2	2	2	2
Intersection Improvements	5	5	1	2	3	5	5	5	3	4
1-Lane Guided Busway on CONRAIL	12	12	11	11	11	11	12	12	11	11
Satellite P&R near Busway Stations	17	18	15	18	15	17	17	18	16	18
Feeder Buses to P&R / Busway Stns	13	11	16	17	10	10	13	11	13	13
Pedestrian Traffic Enhancements	7	6	6	6	4	4	8	6	6	6
Extend Existing HOV on G/F	10	13	8	8	7	7	10	13	9	10
Widen G/F to 4-lanes	9	8	5	5	8	8	6	8	7	7
Do Nothing	19	19	19	19	19	19	19	19	19	19

* Highest (most desirable) rank = 1; lowest = 19.

Table 19
Overall Strategy Rankings

Strategy	Cost-Benefit Criteria (Criteria 15-17 only)		Non-Cost Criteria Screen 3 (Criteria 1-14)	Final Overall Ranking (Criteria 1-17)	
	P-Imp	Yr. 2015		P-Imp	Yr. 2015
Parking Restrictions & Mgmt.	4	5	5	3	4
Additions to Transit Services	15	12	3	4	3
Smart Buses and Kiosks	17	14	9	10	9
Park & Ride w/ Bus Transfer	12	17	11	11	13
Employee Rideshare Programs	1	1	14	13	12
Area Bicycle Circulation Program	10	9	6	6	6
Pedestrian Circulation System	5	3	8	7	7
ATMS-Traffic Surveillance	14	15	11	12	12
ATIS-Transit Info.	18	16	8	8	8
CMS Prkg & Traffic Information	8	8	16	15	15
Signal Optimization, Phasing, Prgssn	2	2	3	2	2
Intersection Improvements	3	4	12	10	10
1-Lane Guided Busway on CONRAIL	11	11	1	1	1
Satellite P&R near Busway Stations	16	18	15	16	16
Feeder Buses to P&R / Busway Stns	13	13	5	5	5
Pedestrian Traffic Enhancements	6	6	14	14	14
Extend Existing HOV on G/F	9	10	17	17	17
Widen G/F to 4-lanes	7	7	18	18	18
Do Nothing	19	19	19	19	19

* Highest (most desirable) rank = 1; lowest = 19.

According to the analyses, these strategies provide the greatest benefit to users for the dollars spent. With respect to the five alternatives evaluated in Screen 3 based upon these cost rankings only, the following hierarchy results:

- TDM/TSM
- Widen Geddes/Fuller
- Extend Existing HOV on Geddes/Fuller
- One-Lane Bus Guideway on Conrail
- Do Nothing

As noted in Table 19, considering all criteria equally, the bus guideway received the highest ranking. Intersection improvements, signal optimization, and transit enhancements also received favorable rankings. Each of these strategies best serve to satisfy Ann Arbor goals and objectives, although some more cost-effectively than others. Recommendations were made based upon these results which directly reflect the interests and desires of both resident citizens and officials of Ann Arbor, Michigan. Their charge now is to help promote implementation of the recommended strategies.