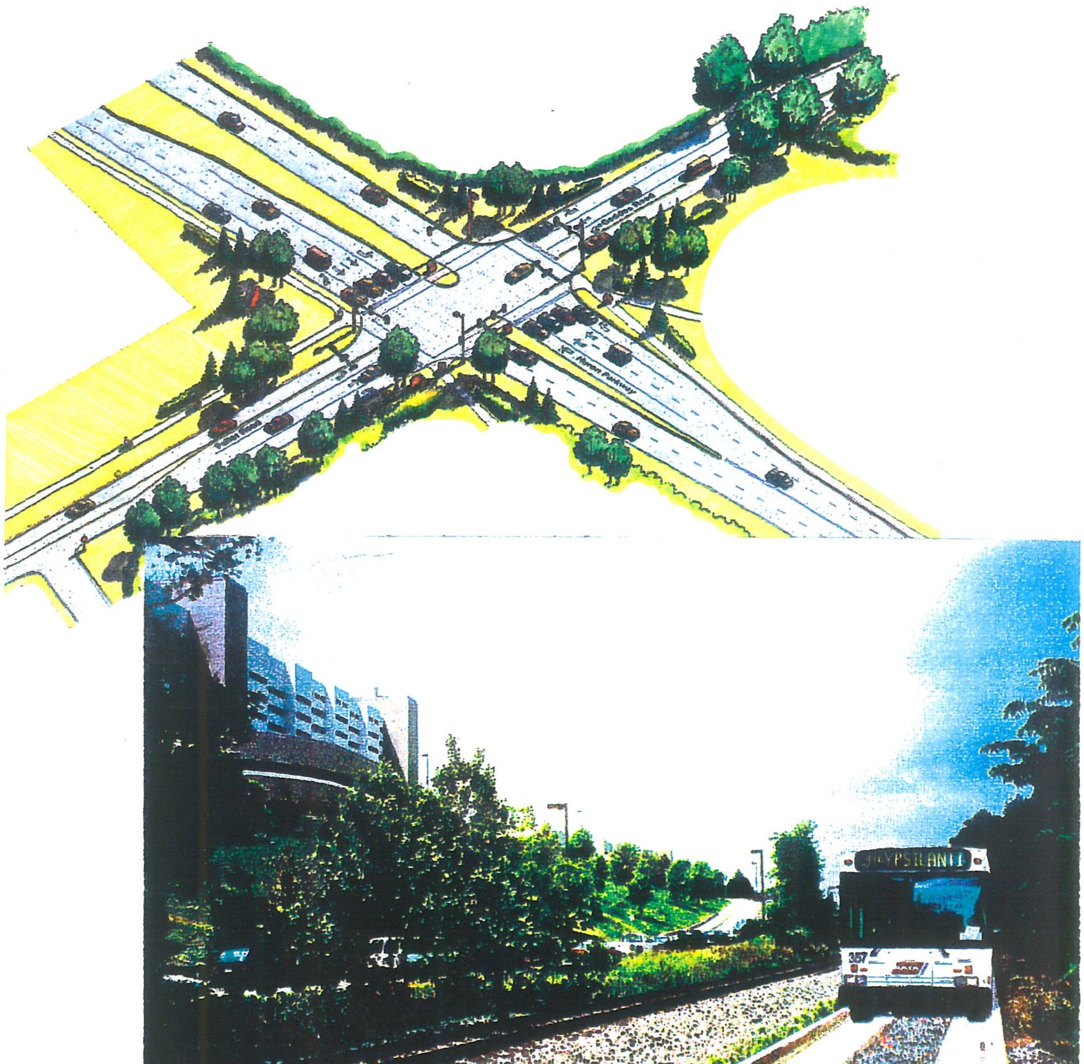
Geddes/Fuller/Conrail

Corridor Study



June 1994

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J. KAHAN

FINAL REPORT

Geddes/Fuller/Conrail

Corridor Study

July 1994

Prepared for:

The City of Ann Arbor
Ann Arbor Transportation Authority
University of Michigan

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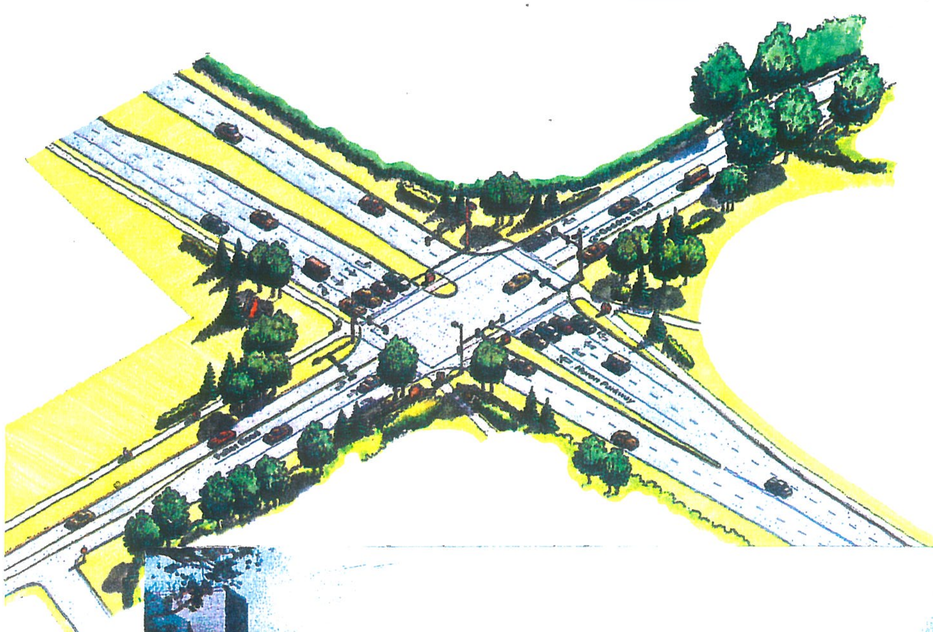
LIST OF ACRONYMS

CAC	Citizens' Advisory Committee
SOV	Single-Occupant Vehicle
HOV	High-Occupancy Vehicle
O&M	Operation & Maintenance
TSM	Transportation System Management
TDM	Travel Demand Management
LOS	Level of Service
VOC	Volatile Organic Components (air quality analysis)
IVHS	Intelligent Vehicle-Highway System
ADT	Average Daily Traffic
ATMS	Advanced Traffic Management Systems
ATIS	Advanced Traveler Information Systems
CVO	Commercial Vehicle Operations
AVI	Automatic Vehicle Identification
APTS	Advanced Public Transportation Systems
AHS	Automatic Highway Systems
ARTS	Advanced Rural Transportation Systems
RRR	Resurfacing, Restoring & Rehabilitation
ROW	Right-of-Way
ISTEA	Intermodal Surface Transportation Efficiency Act
CMAQ	Congestion Mitigation and Air Quality Program
STP	Surface Transportation Program

Geddes/Fuller/Conrail

Corridor Study

EXECUTIVE SUMMARY



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EXECUTIVE SUMMARY

In April of 1993, the City of Ann Arbor, The Ann Arbor Transportation Authority, and the University of Michigan jointly issued a request for proposal for a study of the Geddes/Fuller/Conrail corridor. The study's purpose is to develop and analyze transportation alternatives for the corridor with an emphasis on preferential transit, use of high occupancy vehicle (HOV) lanes (highway lanes designated for vehicles carrying two or more passengers), non-motorized options, and other related improvements.

Socioeconomic forecasts based on Ann Arbor-Ypsilanti Urban Area Transportation Study Committee (UATS) projections predict that between now and the year 2015 significant increases will occur in major demographic indicators in the corridor such as:

- Households 33%
- Retail employment 90%
- Non-retail employment 48%
- Total employment 52%

Although socioeconomic growth is desirable, excessive amounts lead to large increases in trips--trips which cannot be accommodated with the existing roadway network. Presently, existing travel demand is nearing the maximum capacity of Geddes/Fuller Road. Any increase of traffic and vehicle trips may result in:

- Increased congestion and travel time,
- Traffic diversions to other local and residential streets,
- Degradation of air quality,
- Reduced safety,
- Increased noise levels,
- Degradation of the environment, and
- Increased vehicle/pedestrian conflicts.

The challenge facing Ann Arbor is to understand the potential increases in demographics and travel demand, and to improve the traffic-carrying capacity in the corridor without degrading the environment or quality of life.

Ann Arbor planners, transportation professionals, and community citizens recognize the potential for growth and increased congestion in the Geddes/Fuller corridor, and have been organized into committees to address this issue. Two committees were formed to help guide the Geddes/Fuller/Conrail corridor study: a Citizens Advisory Committee (CAC) consisting of 26 members of the community, and a Steering Committee consisting of 14 representatives from the University of

Michigan, Ann Arbor Transportation Authority, the City of Ann Arbor, and other agencies.

The two committees formulated the following set of goals and objectives to help guide the study:

GOAL 1: To efficiently and effectively serve travel needs of the corridor.

OBJECTIVES:

Provide an adequate level of mobility along/within the corridor both today and in the future, and provide connections to the regional transportation system.

- Provide incentives for and encourage use of alternative transportation modes/management techniques of travel.
- Increase persons per vehicle throughout the corridor.
- Provide transportation alternatives in the form of transit, bicycle, and pedestrian facilities and services for persons who cannot or choose not to use automobiles.

GOAL 2: To be compatible with the environmental character and adjacent land uses of the corridor.

OBJECTIVES:

- Implement transportation system improvements that are sensitive to the unique characteristics of the corridor.
- Implement transportation system improvements that are sensitive to adjacent land uses, natural features, and have positive environmental aspects.
- Support land use development patterns consistent with other community and institutional plans.

GOAL 3: To be implemented within the financial constraints of public/private resources.

OBJECTIVES:

- Develop a transportation corridor plan that can be financed within the resources of the public sector.
- Develop policies and programs that encourage private sector participation in serving corridor travel needs.

- Developing a plan to satisfy the requirements of these goals and objectives was the focus of the Geddes/Fuller/Conrail corridor study.

A three-step procedure was used to evaluate potential alternative strategies for the corridor. This procedure starts with a broad range of alternatives and filters or screens the alternatives through a series of tests to identify alternatives that support the goals and objectives. The final result of this evaluation procedure is a recommended alternative that best supports the goals and objectives of the corridor and provides an acceptable cost-benefit measurement.

The first screen of the Geddes/Fuller/Conrail study considered a "universe" of alternatives. This universe included a wide range of alternatives that could have any chance of meeting the objectives for the corridor. These alternatives were subjected to a fatal flaw analysis whereby the alternative either passed or failed the test.

The universe of alternative strategies can be categorized as follows:

- Travel Demand Management (TDM),
- Transportation System Management (TSM),
- Intelligent Vehicle-Highway Systems (IVHS) Applications,
- Environmental and Aesthetic Issues,
- Roadway Widening, and
- No-build.

Travel demand management encompasses strategies that coordinate the use of travel and maximized effectiveness of current transportation facilities. Compared to construction, these strategies are generally low cost. These strategies include carpool/vanpool programs, congestion pricing and flexible work hours. Transportation system management strategies seek to make improvements in transportation facilities to improve the effectiveness of the overall travel environment. These strategies can have a wide range of costs, benefits and impacts. TSM strategies tend to focus primarily on infrastructure improvements and, consequently, are site specific. Intelligent Vehicle-Highway Systems (IVHS) is a national initiative to apply technology-based solutions to make significant increases in safety, mobility, air quality and trip quality. IVHS strategies provide real-time traffic and trip information to travelers to accomplish these improvements.

Any changes made to the infrastructure or operating characteristics of the transportation system within the corridor must be made in accordance with procedures and regulations for environmental and aesthetic issues. These issues include,

- Preserve lands fronting transportation routes,
- Land use decisions relating to transit, and
- Enhance image of frontage roads.

To complete the range of available alternatives considered for this study, a no-build or do-nothing option, and a construction option were considered. This provided a basis to compare the relative impact of considered improvements and an understanding of the impacts of "not-taken" proactive steps in improving the corridor.

As a preliminary screening of strategies, a universe of 128 alternatives was identified and then reduced to 35 candidates. The alternatives not passing this preliminary screening had fatal flaws and had no elements worthy of being considered for combination with other strategies. The remaining 35 strategies were given a more thorough review and analysis for fatal flaws and possible elements for combination in other strategies. Of the 35 strategies reviewed in detail in Screen 1, 20 strategies received a pass rating. Of the 15 strategies that failed, four had elements that were considered desirable and warranted further review. From these twenty passing strategies and four additional elements, nine alternatives were developed for review in the second screening.

The Screen 2 evaluation was a more rigorous review and focused on three categories of macro-level criteria:

- Use and Ridership,
- Environmental Issues, and
- Cost Considerations.

Individual strategies for each of the alternatives were evaluated using a weighted scoring procedure. Six of the nine alternatives were eliminated through this screening.

The final and most rigorous analysis of alternatives occurred in Screen 3. The analysis from the Screen 2 evaluation indicated that there were several key elements throughout the previous alternatives that warranted further review. These key elements were combined into three new alternatives:

- Alternative A: Applications of TDM/TSM,

- Alternative B: One-Lane Bus Guideway in the Conrail Right-of-Way, and

- Alternative C: Extend the Existing HOV-Lane on Fuller Road.

Widening Geddes/Fuller Road and a Do Nothing alternative (Alternatives D and E respectively) were also evaluated.

Seventeen criteria were used to evaluate individual strategies of the final alternatives mentioned above:

1. Desirable person and vehicle throughput,
2. Ridership,

3. Travel time savings,
4. Proximity to congested roadways,
5. Consistency with transportation plan,
6. Safety,
7. Right-of-way requirements,
8. Air quality,
9. Noise Impacts,
10. Wetlands, woodlands, and other natural features,
11. Impact on side slopes,
12. Existing traffic level of service,
13. Reverse commuter trips,
14. Visual and enhancement opportunities,
15. Capital costs,
16. Operating and maintenance costs, and
17. Cost-effectiveness.

The strategies were evaluated individually against each of the first 14 criteria and assigned a score between -5 and 5, depending upon the evaluation result. A negative score indicated that the strategy will likely adversely affect the criterion with respect to the study's goals and objectives. Conversely, positive scores indicated desirable impacts and work toward achieving the goals and objectives. Scores were then summed by alternative to determine that alternative's overall rating. Results of this final screening were ranked according to the ratings. Cost-related criteria 15-17 were also ranked. These rankings are shown in the Ranking Summary for all Screen 3 Criteria table. Rankings are shown for post-implementation and year 2015 time periods.

RANKING* SUMMARY FOR ALL SCREEN 3 CRITERIA

Strategy	Cost-Benefit Criteria (Criteria 15-17 only)		Non-Cost Criteria Screen 3	Final Overall Ranking (Criteria 1-17)	
	P-Imp	Yr. 2015	(Criteria 1-14)	**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 desireable) rank = 1; lowest = 19.*

A potential staging plan for the recommended alternative is presented in the table below. Responsible agencies for implementation of individual strategies are also provided.

POTENTIAL STAGING OF THE RECOMMENDED ALTERNATIVE

Strategy	Capital Cost	Annual O&M Cost	Responsible Agency
SHORT-TERM (0 TO 5 YEARS)			
One-Lane Bus Guideway on Conrail, LeForge Road to the Medical Center			
Environmental Impacts Studies, Preliminary Engineering and Design	$1,400,000	--	AATA
Parking Restrictions and Management			
HOV-Priority Parking	$37,000	$39,000	Employer Specific
Parking Fee	--	$163,000	
Increase to 10% HOV-Priority Parking	$37,000	--	
Transit Service Enhancements			
Increase Transit to 15-Minute Headway	$1,290,000	$727,000	AATA
Purchase and Operate 3 Feeder Buses in Peak Hours	$645,000	$363,000	AATA
Continue Fare Subsidies		$3,000	AATA
Smart Buses, Kiosks, and ATIS Transit Information			
Implement AATA Smart Bus	$645,000	$166,000	AATA
Park and Ride with Bus Transfer			
Use Existing Lots for P&R	--	Negotiable	AATA
Employee RideShare Program			
Market RideShare Public Information Campaign	--	$21,000	AATA
Area Bicycle Circulation Program			
Coordinate Plans with City and Washtenaw County	$1,256,000	$38,000	City of Ann Arbor

Strategy	Capital Cost	Annual O&M Cost	Responsible Agency
Pedestrian Circulation System			
Assure Consistency with Master Plan	--	--	City of Ann Arbor
Site Specific Circulation Plans	$125,000	$2,000	
System Beautification Project		$30,000	
Signal Optimization, Phasing, Progression			
Optimize All Signals in Primary Study Area	$31,000	$4,000	City of Ann Arbor
Set Timing Plans for AM/PM Peaks	--	--	
Coordinate Efforts with Washtenaw County and City	--	--	
Intersection Improvements			
Geddes/Fuller and Huron Parkway	$414,000	TBD	City of Ann Arbor
Add Right Turn Lanes for EB and WB Geddes\Fuller	--	--	
Extend Left Turn Bay on WB Geddes/Fuller	--	--	
Improve Pavement Condi-tions on EB and WB Geddes/Fuller	--	--	
Geddes Road and U.S. 23	$300,000*	TBD	Michigan DOT
Interconnect and Progress Signals	--	--	
Geddes Road and Dixboro Road	$300,000	TBD	Washtenaw County Road Commission
Extend Left Turn Bays	--	--	
Add Right Turn Lanes	-	--	
Dixboro Road and Huron River Drive	$320,000	TBD	
Extend EB Left Turn Bay	--	--	
Lengthen SB Right Turn Lane	--	--	
Huron Parkway and Glazier Way	$300,000	TBD	City of Ann Arbor
Signalize and Optimize Signal	--	--	

Strategy	Capital Cost	Annual O&M Cost	Responsible Agency
Huron Parkway and Huron River Drive	$300,000	TBD	
Signalize and Optimize Signal	--	--	
Washtenaw Avenue and Huron Parkway	$380,000	TBD	City of Ann Arbor
Add Right Turn Lanes on NB and SB Huron Parkway	--	--	
Right Turn Lanes on EB and WB Washtenaw Avenue	--	--	
Huron Parkway and Glazier Way	$300,000	TBD	City of Ann Arbor
Signalize and Optimize Signal	--	--	
Roadway Improvement			
Pave Glazier Way East of Huron Parkway	$1,000,000	$4,000	City of Ann Arbor
INTERMEDIATE FUTURE (6 TO 10 YEARS)			
One Lane Bus Guideway on Conrail	$15,802,000	$1,142,000	AATA
Satellite Park-and-Ride near Guideway	$816,000	$95,000	AATA
Feeder Buses to P&R/Bus Guideway	$3,048,000	$1,635,000	AATA
Pedestrian Traffic Enhancements	$121,000	$2,000	AATA
Intersection Improvements (Intermediate Future - 6 to 10 years)			
Geddes/Fuller and Huron Parkway	TBD	TBD	City of Ann Arbor
Add a Second Left Turn Lane to WB Geddes Road			
Geddes Road and U.S. 23	TBD	TBD	Michigan DOT
Realign SB On-Ramp with SB Off-Ramp			
Widen Existing Bridge			
Provide Right Turn Lanes at Ramp Terminals			

Strategy	Capital Cost	Annual O&M Cost	Responsible Agency
Geddes Road and Dixboro Road	TBD	TBD	Washtenaw County Road Commission
Consider Double Left Turns for NB Dixboro			
Consider EB Channelized Right Turn with Yield			
LONG-TERM (11 + YEARS)			
ATMS-Traffic Surveillance			
Video Surveillance and Signal Control	$1,924,000	$200,000	TBD
CMS Parking and Traffic Information			
Sites Along U.S. 23	$386,000	$50,000	TBD
Intersection Improvements			
Geddes Road and Dixboro Road	TBD	TBD	City of Ann Arbor
Consider Double Left Turns for NB Dixboro			
Consider EB Channelized Right Turn with Yield			

TBD = To Be Determined

* Not including bridge reconstruction

Of all the strategies evaluated, the bus guideway most comprehensively satisfies the study's goals and objectives. However, the bus guideway is not the most cost-effective of these strategies. The bus guideway will incur an additional annual operating cost of approximately $800,000 over and above the cost of operating the current route in the corridor (Route 3). Ridership on the guideway is forecasted at about 4,900 riders per day for the forecast year 2015. Accompanying the bus guideway are park-and-ride lots, feeder buses to these lots, and pedestrian traffic enhancements. Individually, these features provide marginal benefits. Feeder buses to park-and-ride lots, like the bus guideway, support the goals and objectives well, but at a high cost. The total estimated cost to implement the entire recommendation is approximately $30 million dollars and $3 million annual O&M costs. Right-of-way and additional insurance costs are not included.

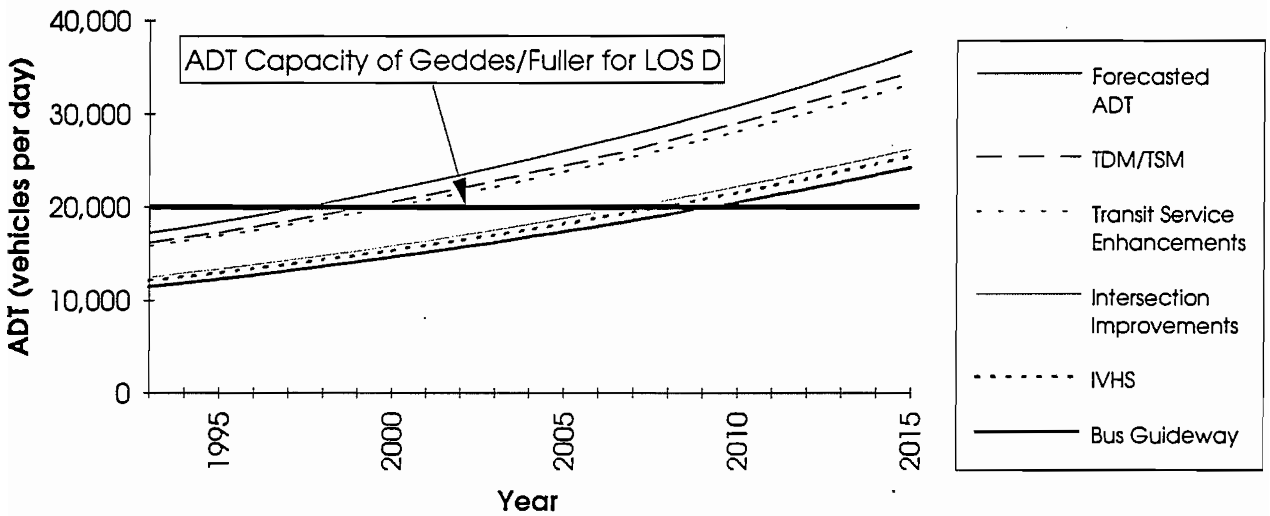
The recommendation's overall potential impact on the Geddes/Fuller corridor is illustrated in the Comparison of Capacity Improvements figure. This figure shows the average daily traffic capacity of Geddes/Fuller for LOS D (level of service D indicates high-density, but stable traffic flow, restricted speeds and vehicle movement, and poor pedestrian levels of comfort) as a solid horizontal line crossing the ordinate at 20,000 vehicles per day. Traffic conditions in the peak hours already exceed LOS D. Forecasted average daily traffic volumes are represented by the top curve. The intersection of these two lines indicates that traffic conditions will meet LOS D conditions sometime in 1997. Based upon the Screen 3 evaluation, the ability of each strategy to reduce vehicles per day extends the intersection point between the LOS D horizontal line and the traffic volumes over time. Assuming all strategies of the recommended alternative were implemented, LOS D conditions or better can be extended approximately 13 years. Intersection improvements provide the greatest improvement to roadway capacity, but these benefits may diminish after five to seven years. These final observations indicate that other means of satisfying travel demand must accompany the bus guideway in order to maintain LOS D traffic conditions or better up to the year 2015.

The recommendations represent a family of improvements which all need to be implemented to provide necessary relief to projected congestion through the twenty-year planning period. Some of the recommendations will be difficult to achieve. The implementation of the bus guideway faces significant challenges in right-of-way issues and negotiations. Other recommendations must face competition for funding from other important community needs.

Failure to implement all of the recommendations is likely to lead to unacceptable levels of traffic congestion. The most important immediate recommendation is to improve the operation of the intersections. The biggest positive impact to the corridor will result from extended turning lanes, signal timing and progression improvements. The second most important combination of recommendations are those dealing with transit. Additions to transit service in the corridor -- increased frequency, feeder buses, advanced technologies (underway), and preferential treatments -- should occur soon. Preliminary engineering, design and right-of-way negotiations for the bus guideway should also begin immediately. Actual construction of the guideway is not likely to occur within the first five years of the plan's implementation, but will be important.

Many of the improvements are not scheduled for implementation until after the first five years of the plan (such as construction of the bus guideway). Thus, a comprehensive reassessment of the corridor should be undertaken at the end of the five-year period. This reassessment needs to include a new look at traffic, forecasts and congestion in the corridor. It needs to assess the ability of improvements undertaken during the first five years to accommodate travel demand in the corridor. Finally, it needs to assess the likelihood of continued implementation of recommendations scheduled beyond the first five years of the plan. If traffic projections continue to be realized and some of the improvements are not able to be implemented as planned, a new assessment of alternatives (including roadway widening) will need to take place.

Comparison of Reduction in Average Daily Traffic (ADT) from Recommended Improvements



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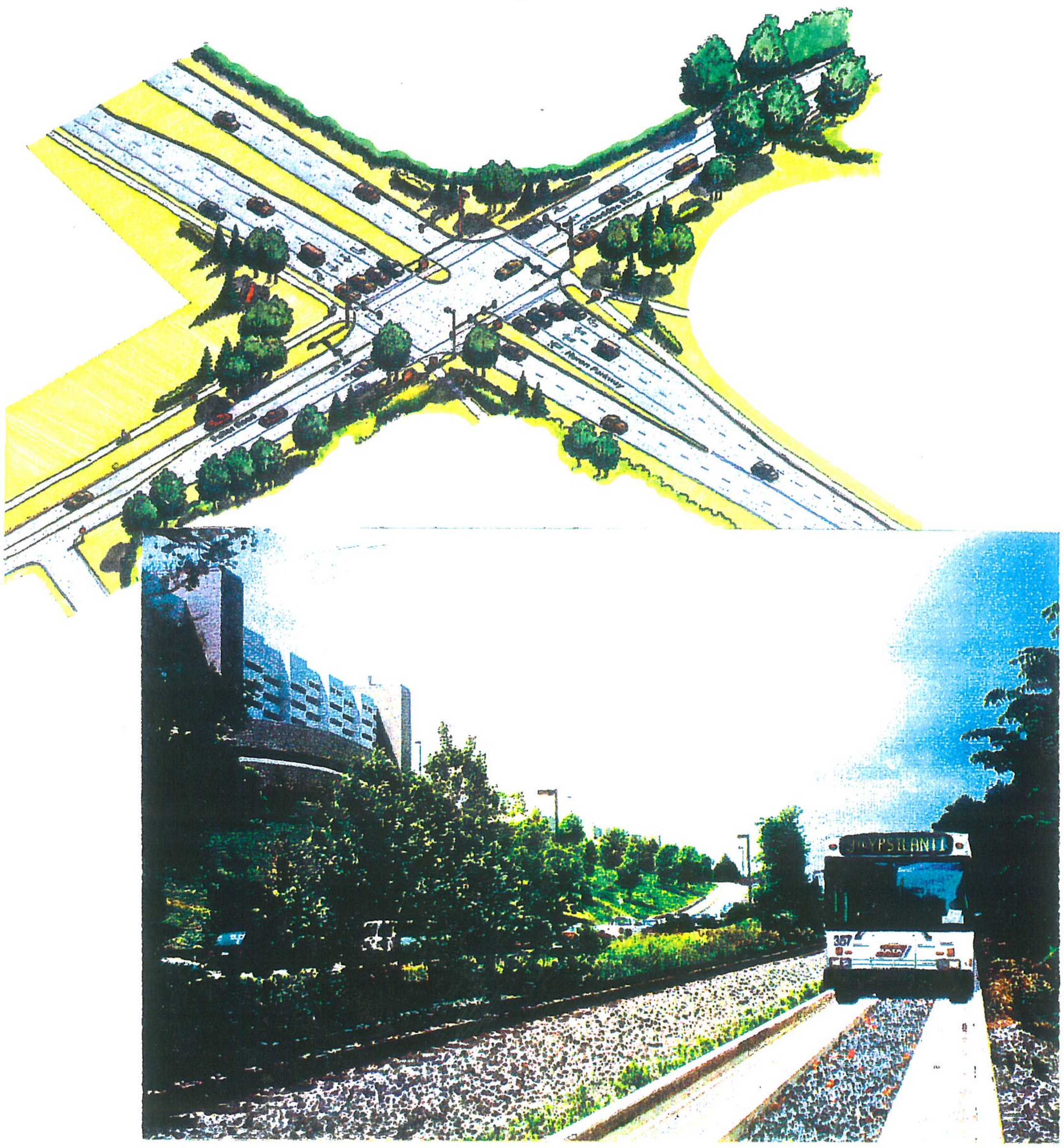

June 1994

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INTRODUCTION

I. INTRODUCTION

In April of 1993, the City of Ann Arbor, the Ann Arbor Transportation Authority, and the University of Michigan jointly issued a request for proposal for a study of the Geddes/Fuller/Conrail corridor. These organizations, in coordination with the Ann Arbor Ypsilanti Urban Area Transportation Study Committee (UATS), are responsible for the transportation system in this corridor and are concerned with its growing traffic congestion and related impacts. To address the current and future transportation concerns in the corridor, these organizations requested a comprehensive corridor study. The study's purpose is to develop and analyze transportation alternatives to roadway widening or to simply doing nothing, with an emphasis on preferential transit, use of high occupancy vehicle (HOV) lanes (highway lanes designated for vehicles carrying two or more passengers), non-motorized options, and other related improvements.

The need for a detailed study of the corridor was cited in a number of studies, most recently the November 1990, Ann Arbor Transportation Plan Update. The Plan Update identified the Geddes/Fuller corridor as environmentally unique in character and deficient in capacity. Year 2010 travel forecasts indicated that travel demand in the corridor would exceed available capacity by over 100 percent. Consequently, this study was instigated to identify alternative transportation management strategies that would control the growth of congestion in the Geddes/Fuller corridor without degrading the environment.

BACKGROUND

The primary and secondary focus areas of the study are shown in Figure 1. The primary study area is the Geddes/Fuller/Conrail corridor extending from approximately Superior Road on the east to the University of Michigan medical campus on the west. The primary focus area parallels the Huron River and is characterized by unique and sensitive environmental areas. Consequently, the primary study area has the potential to become a green zone, i.e., an environmentally-protected area where land use policy preserves the openness and aesthetic beauty of the environment. The primary area also has significant institutional land use including the University of Michigan Medical Center, the Veterans Administration Hospital and Huron High School. Both the Medical Center and the Veterans Hospital are scheduled for expansion in the near future. These expansion activities will add to the roadway congestion.

The secondary area is an expansion of the primary area and includes downtown Ypsilanti on the east, downtown Ann Arbor on the west,

Primary and Secondary Study Areas

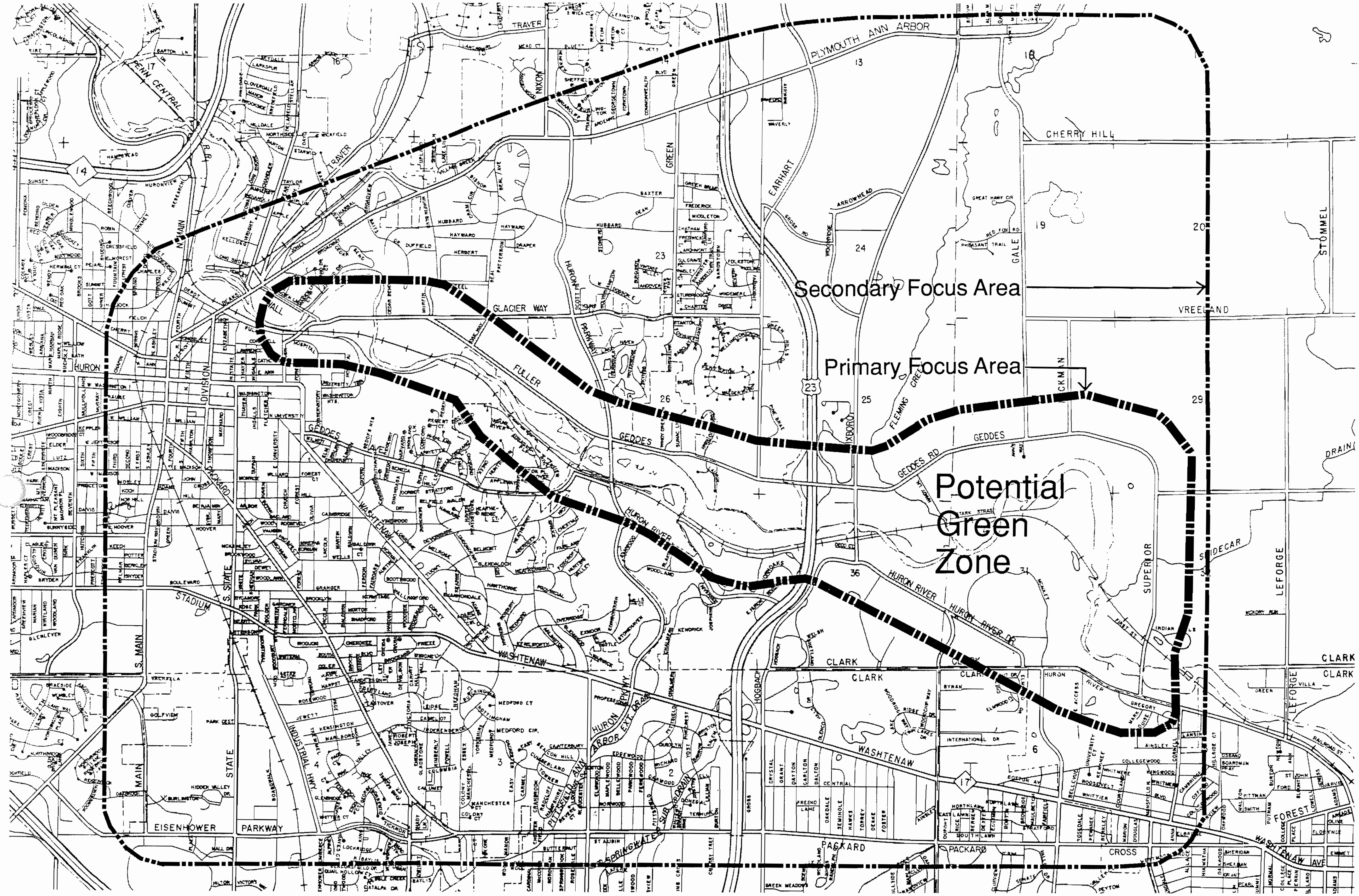

Figure 1

Geddes/Fuller/CONRAIL Corridor Study

North

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Plymouth Road on the north and Packard Road on the south. The secondary focus area is characterized by a mix of land uses. Some of the more significant travel destinations within the secondary study area which impact traffic conditions in the primary study area include the University of Michigan, Eastern Michigan University, McAuley Health Center, Washtenaw Community College and the numerous commercial uses located in the downtown areas and along Washtenaw Avenue, Packard Road and Plymouth Road. Congested roadways in the secondary focus area include: Washtenaw Avenue, Huron River Drive, Clark Road, Dixboro Road, and Packard Road.

PROBLEM DEFINITION

Socioeconomic forecasts based on UATS projections predict that between now and the year 2015 significant increases will occur in major demographic indicators in the corridor relative to the corridor such as:

Households	33%
Retail employment	90%
Non-retail employment	48%
Total employment	52%

Full details of the socioeconomic trends can be found in Table 1. Traffic analysis districts that influence the primary study area are shown in Figure 2. Although socioeconomic growth is desirable, it leads to increases in trips--trips which cannot be accommodated with the existing roadway network.

The Geddes/Fuller corridor currently operates at a level of service (LOS) E during AM and PM peak hours. A LOS E indicates that average traffic flows between 25 and 30 miles per hour and motorists experience delays of two minutes or more at each signalized intersection. At some intersections in the Geddes/Fuller corridor, standing vehicle queues as long as 40 vehicles occur regularly in the peak hours. During the rest of the day, traffic operates at LOS D. LOS D means that traffic flows at about 30 to 35 miles per hour, and vehicles attempting to enter the traffic stream may face long strings of cars which do not provide sufficient separation to enter the traffic stream safely. These measures indicate that existing travel demand is approaching the maximum capacity of the roadway. Any increase of traffic and vehicle trips may result in:

- Increased congestion and travel time,
- Traffic diversions to other local and residential streets,
- Degradation of air quality,
- Reduced safety,
- Increased noise levels,
- Degradation of the environment, and
- Increased vehicle/pedestrian conflicts.

TABLE 1 SOCIOECONOMIC DATA FOR PRIMARY STUDY AREA TRAFFIC ANALYSIS DISTRICTS

District	Socioeconomic Descriptor											
	Households			Retail Employment			Non-Retail Employment			Total Employment		
	1990	2015	% Change	1990	2015	% Change	1990	2015	% Change	1990	2015	% Change
1	1,853	4,075	119.9%	31	29	-6.5%	19,317	21,227	9.9%	19,348	21,256	9.9%
2	644	975	51.4%	213	199	-6.6%	6,464	10,626	64.4%	6,677	10,825	62.1%
3	6,709	9,667	44.1%	1,720	4,894	184.5%	3,195	8,527	166.9%	4,915	13,421	173.1%
4	5,390	5,568	3.3%	1,147	1,746	52.2%	5,450	8,423	54.6%	6,597	10,169	54.1%
5	1,372	1,485	8.2%	529	551	4.2%	1,880	2,652	41.1%	2,409	3,203	33.0%
6	1,821	1,948	7.0%	733	885	20.7%	3,378	7,271	115.2%	4,111	8,156	98.4%
Totals	17,789	23,718	33.3%	4,373	8,304	89.9%	39,684	58,726	48.0%	44,057	67,030	52.1%

Source: Ann Arbor-Ypsilanti Urban Area Transportation Study Committee (UATS), 1993

Trips per Household* =	10.0	Source: * ITE Trip Generation Manual (5th Ed., Washington, D.C., 1991)
Trips per Retail Employee* =	29.0	
Trips per Non-Retail Employee* =	3.5	
New Household Trips =	59,290	
New Retail Employment Trips =	113,999	
New Non-Retail Employment Trips =	66,647	
	239,936	= Total Estimated New Trips from Household and Employment Growth

Traffic Analysis Districts for the Primary Study Area

Note: District 5 represents downtown Ypsilanti

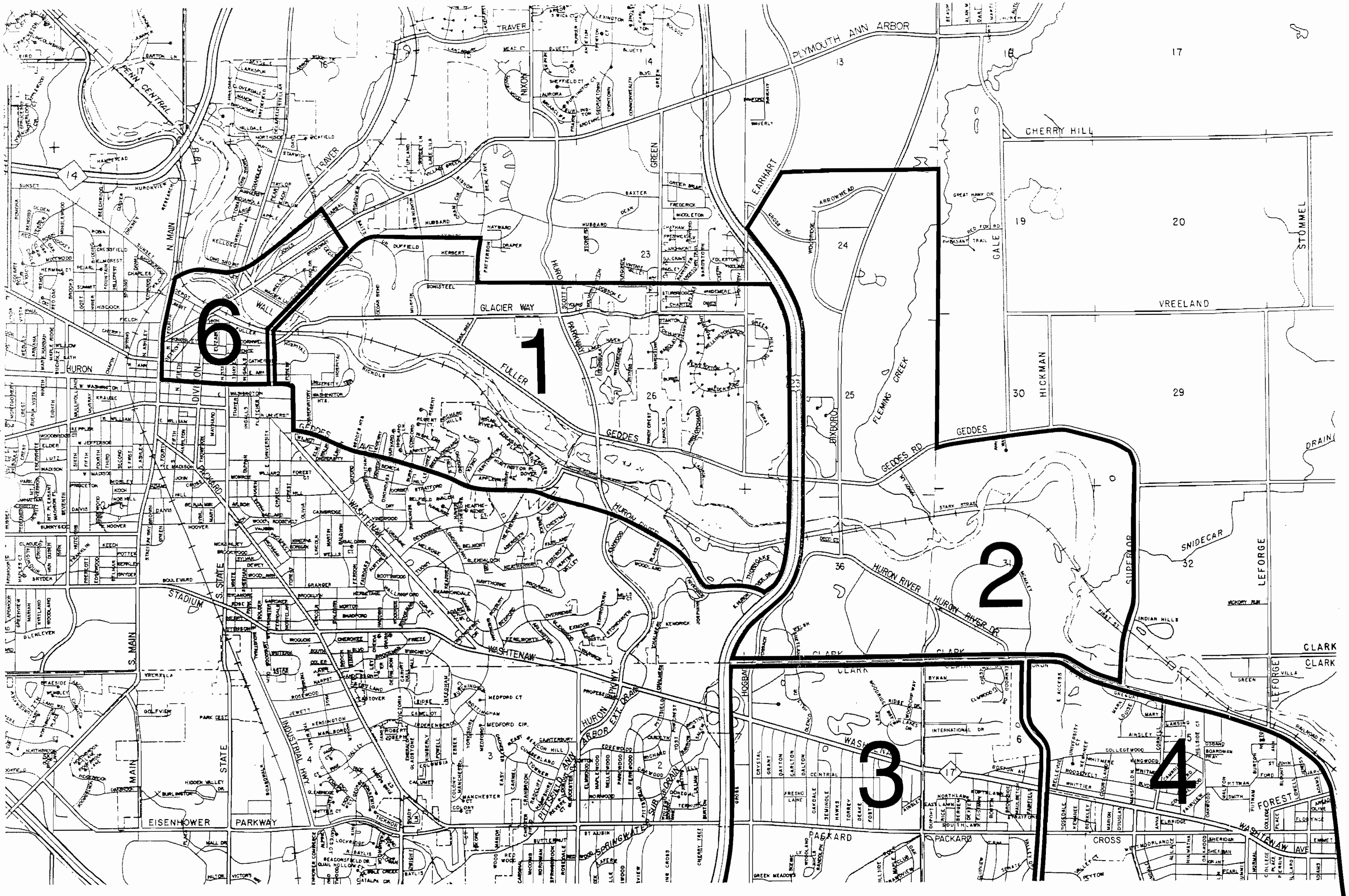

Figure 2

Geddes/Fuller/CONRAIL Corridor Study

North

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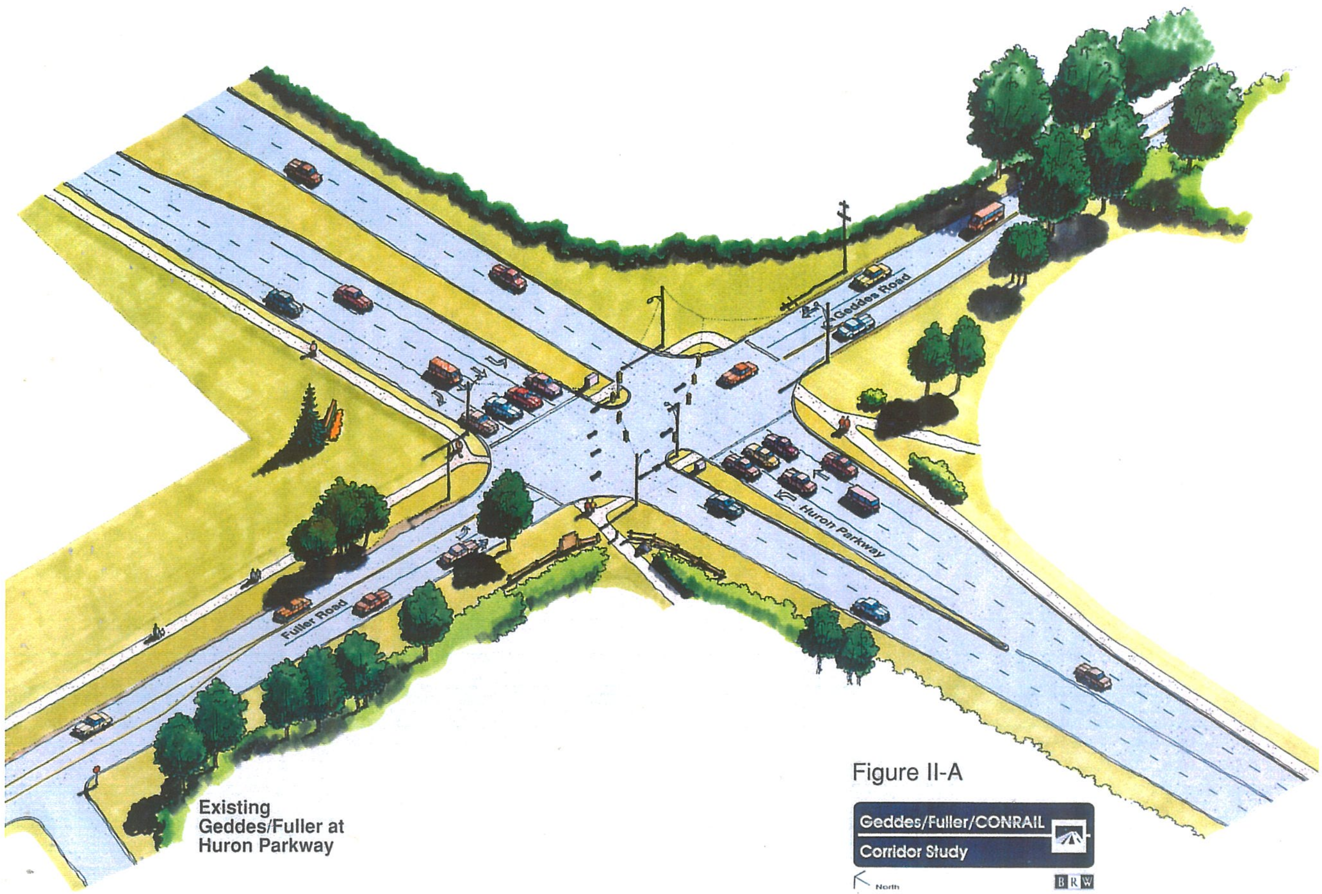

Figure II-A

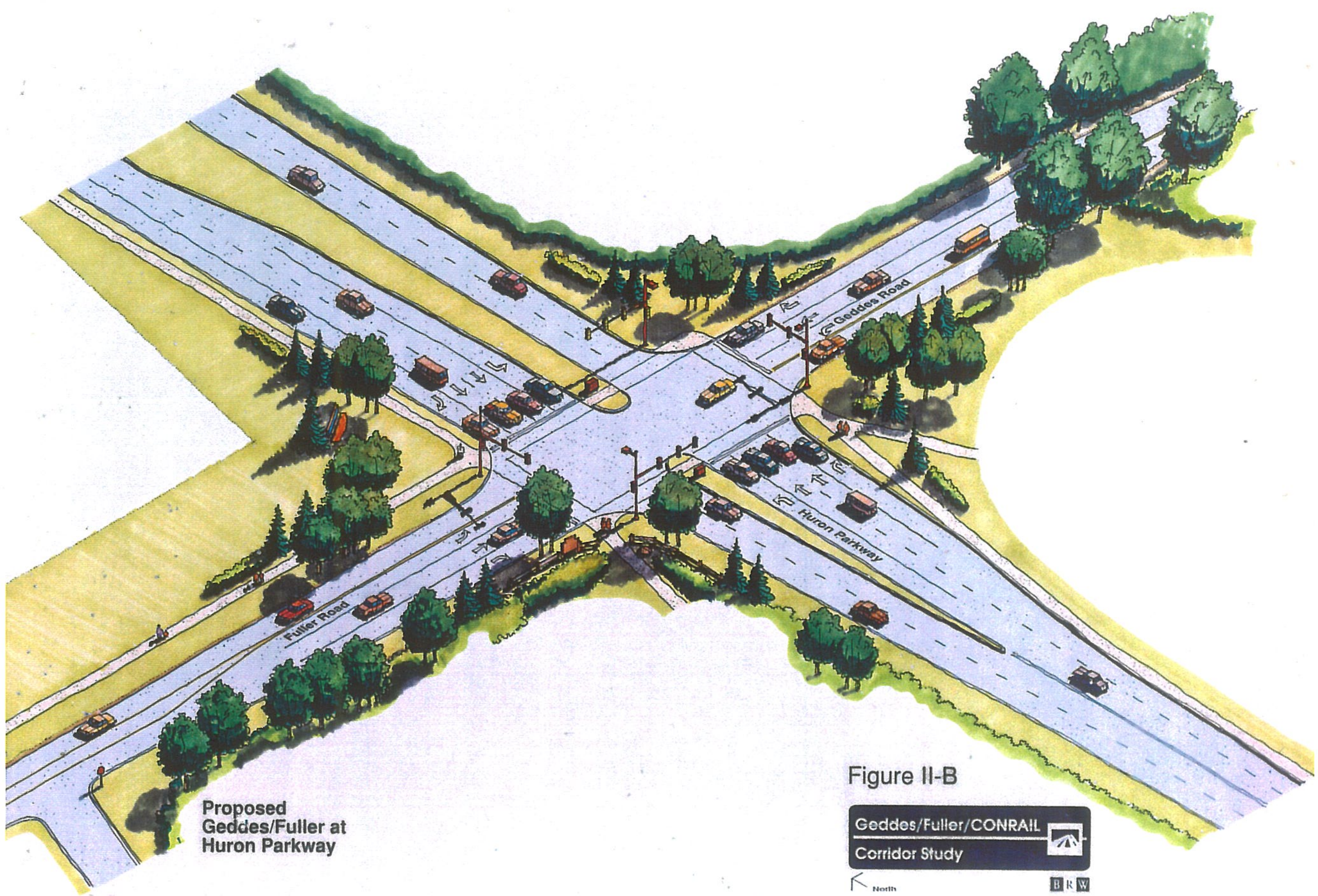

Figure II-B

Geddes/Fuller/Conrail
Corridor Study

Figure II-C

Visual Representation of the Proposed Bus Guideway

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The challenge facing Ann Arbor is to understand the potential increases in demographics and travel demand, and to improve the traffic-carrying capacity in the corridor without degrading the environment or quality of life.

Existing Traffic Conditions

Figure 3 illustrates average daily traffic (ADT) counts for major roadways in the primary and secondary study areas. Where available, counts are provided for the years 1985, 1988, and 1993. Observation of each count reveals that ADT has increased over time. Because the roadways are already near capacity, it appears inevitable that an increase in travel demand will cause traffic conditions to deteriorate.

Forecasted Traffic Conditions

A travel forecast model of the study area was developed for this study. Figure 4 shows the results of this model for the year 2015. The forecast indicates that existing ADT values will more than double by 2015. It should be noted that this forecast accounts for the Fuller Road alignment change at Oak Way.

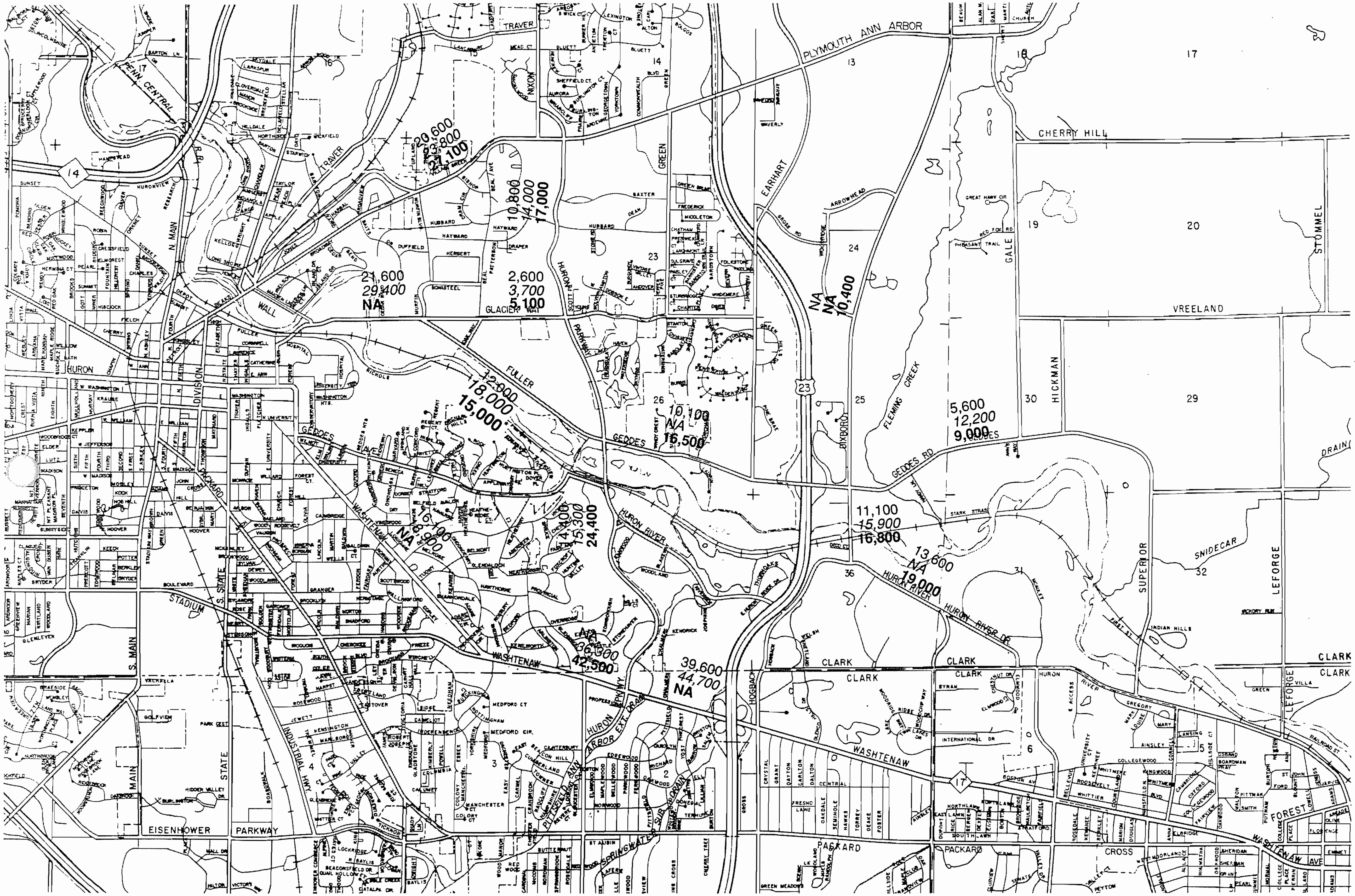
Forecast Methodology

The methodology used to generate travel forecasts relied upon both computer-generated (model) data and actual field data. With the model data, average annual rates of travel increase were calculated using actual 1985 and 1993 traffic counts on key roadways within the study areas. Key roadways included:

- Plymouth Road,
- Glazier Way,
- Huron Parkway,
- Geddes/Fuller Road,
- Huron River Parkway,
- Dixboro Road, and
- Washtenaw Avenue.

Significant differences between adjacent roadway segments were resolved through review of changes on other segments which contributed traffic to the corridor segment in question. Where necessary, qualitative assessments were made and factored into the annual percentage increases. These percentages were then projected to the forecast year of 2015 using a straight-line projection.

Actual traffic counts collected in 1985 and 1993 were used in a cutline approach to develop the annual increases in travel. The cutline was established through Washtenaw Avenue, Huron River Drive, Geddes



Average Daily Traffic For 1985, 1988, and 1993

xxx	–	1985
xxx	–	*1988*
xxx	–	**1993**
NA	–	**Not Available**

Sources:
1. *November 1990, Ann Arbor Transportation Plan Update (1985 and 1988 counts)*
2. *BRW, Inc. (1993 counts)*

• Bridge under construction during this count

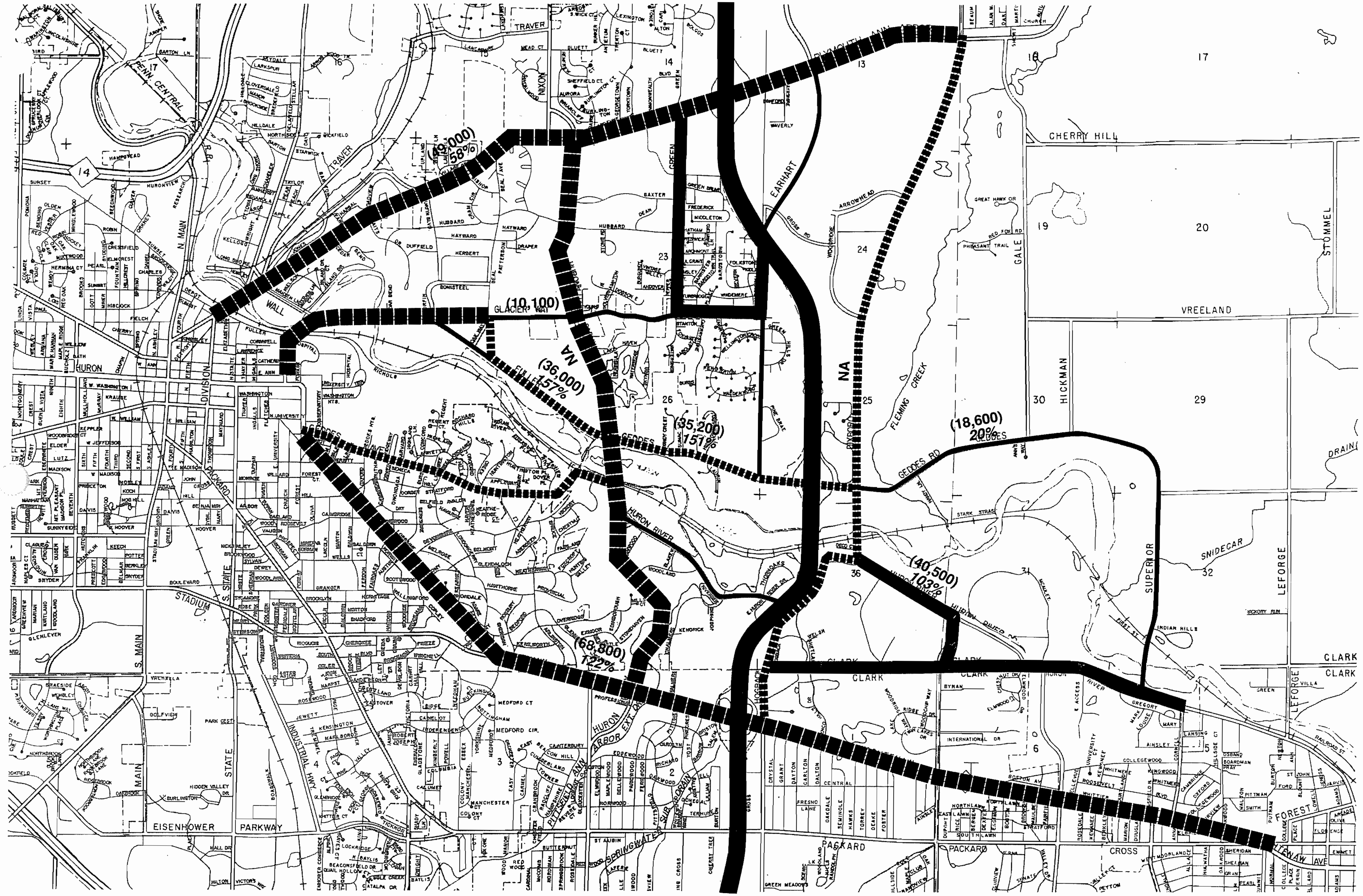
Figure 3

Geddes/Fuller/CONRAIL Corridor Study

North

0 500 1000 2000

BRW



Roadway Capacities (ADT)

(heavy solid line)	> 36,001
(heavy hatched line)	21,001-36,000
(solid line)	18,001-21,000
(hatched line)	15,001-18,000
(thin line)	< 15,000
(xxx)	2015 ADT
xxx%	Forecasted Capacity Deficiency Yr. 2015

Source: November 1990, Ann Arbor Transportation Plan Update

Figure 4

Geddes/Fuller/CONRAIL Corridor Study

North 0 500 1000 2000

BRW

Road, Glazier Way, and Plymouth Road east of Huron Parkway. Using the count data collected along the cutline, annual average change percentages were developed for links including Geddes Road to the north, and links including Geddes Road to the south. These percentages were then factored to the forecasted year. Actual data were collected from only five locations, which statistically lessens the reliability of results generated by this procedure.

Results from the computer model and the cutline procedure were then combined and weighted to produce the Year 2015 vehicle forecast. Socioeconomic data such as percentage increases in households, retail employment, and non-retail employment were used as a test of reasonableness for the combined results. This test assumes that change in traffic in the corridor is similar in scale to the change in socioeconomic descriptors for the given study area.

Transportation System Deficiencies within the Study Areas

Figure 4 also illustrates deficiencies in the existing roadway network based upon the forecasted traffic volumes for the year 2015. The deficiencies assume that no roadway improvements, other than those which are presently committed, will occur. The capacity deficiencies reflect a significant overall increase in traffic in the study areas, with only minor increases in capacity from committed projects.

It should be noted that as congestion increases, with deficiency exceeding 50 percent capacity for example, some drivers alter their chosen routes to local and residential streets. Consequently, capacity deficiencies on major roadways may not actually reach the levels predicted. Nevertheless, the trend toward significant deficiencies is justified.

As shown in Figure 4, the greatest deficiency lies along Washtenaw Avenue where the travel demand is forecasted to be 122 percent above capacity. Travel demand on Huron River Drive is also forecasted above 100 percent capacity. Travel demand in the Geddes/Fuller corridor also exceeds available capacity. Travel demand is greater than available capacity by 75 percent between Dixboro Road and Glazier Way. Demand on Plymouth Road is also forecasted to exceed its capacity by 58 percent.

STUDY GOALS AND OBJECTIVES

Ann Arbor planners, transportation professionals, and community citizens recognize the potential for growth and increased congestion in the Geddes/Fuller corridor, and have been organized into committees to address this issue. Two committees were formed to help guide the Geddes/Fuller/Conrail corridor study: a Citizens Advisory Committee (CAC) consisting of 26 members of the community, and a Steering

Committee consisting of 14 representatives from the University of Michigan, Ann Arbor Transportation Authority, the City of Ann Arbor, and other agencies.

The two committees formulated the following set of goals and objectives to help guide the study:

GOAL 1: To efficiently and effectively serve travel needs of the corridor.

OBJECTIVES:

- Provide an adequate level of mobility along/within the corridor both today and in the future, and provide connections to the regional transportation system.
- Provide incentives for and encourage use of alternative transportation modes/management techniques of travel.
- Increase persons per vehicle throughout the corridor.
- Provide transportation alternatives in the form of transit, bicycle, and pedestrian facilities and services for persons who cannot or choose not to use automobiles.

GOAL 2: To be compatible with the environmental character and adjacent land uses of the corridor.

OBJECTIVES:

- Implement transportation system improvements that are sensitive to the unique characteristics of the corridor.
- Implement transportation system improvements that are sensitive to adjacent land uses, natural features, and have positive environmental aspects.
- Support land use development patterns consistent with other community and institutional plans.

GOAL 3: To be implemented within the financial constraints of public/private resources.

OBJECTIVES:

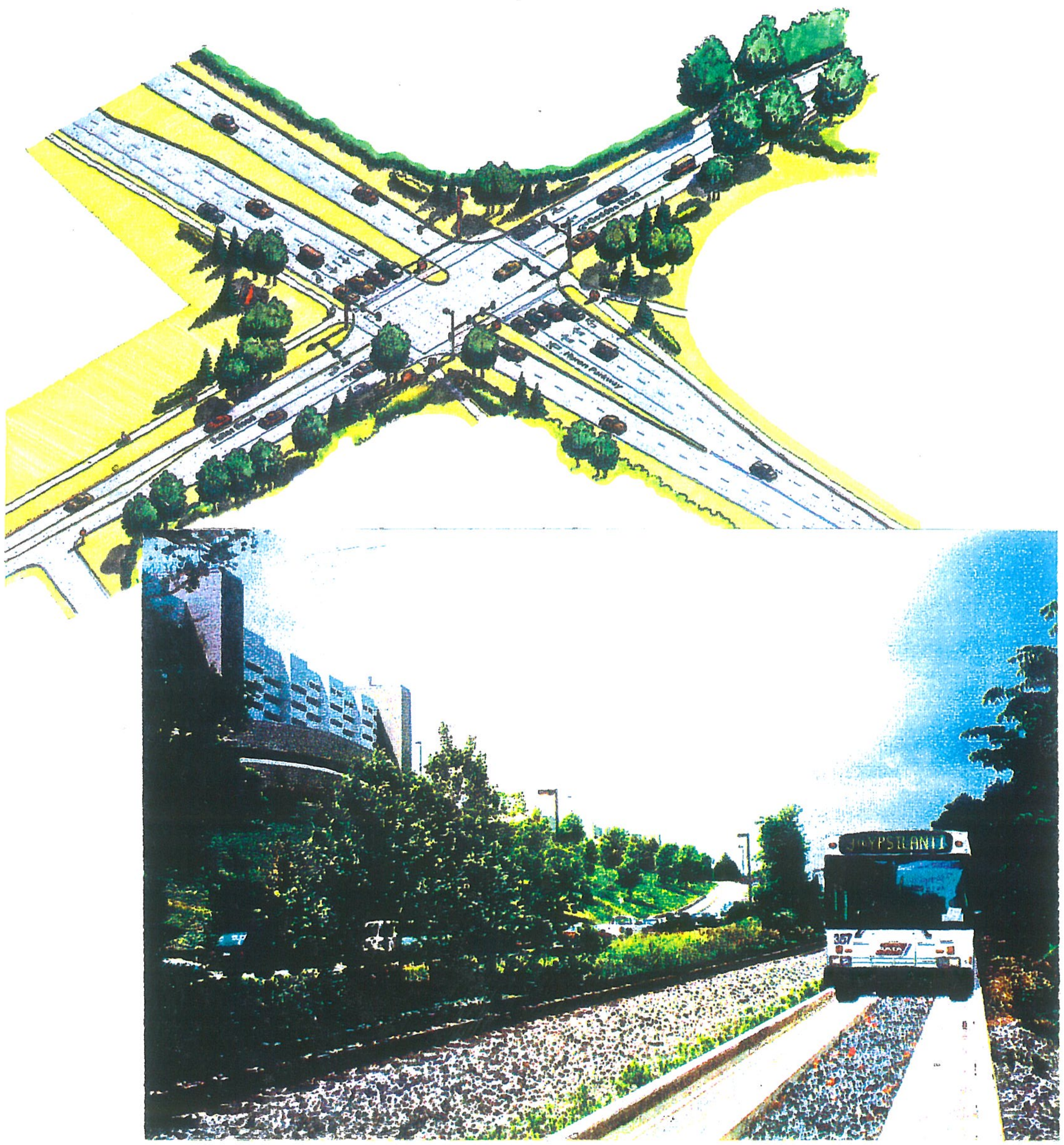
- Develop a transportation corridor plan that can be financed within the resources of the public sector.

- Develop policies and programs that encourage private sector participation in serving corridor travel needs.

- Developing a plan to satisfy the requirements of these goals and objectives was the focus of the Geddes/Fuller/Conrail corridor study.

Geddes/Fuller/Conrail

Corridor Study



June 1994

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RECOMMENDATION

II. RECOMMENDATION

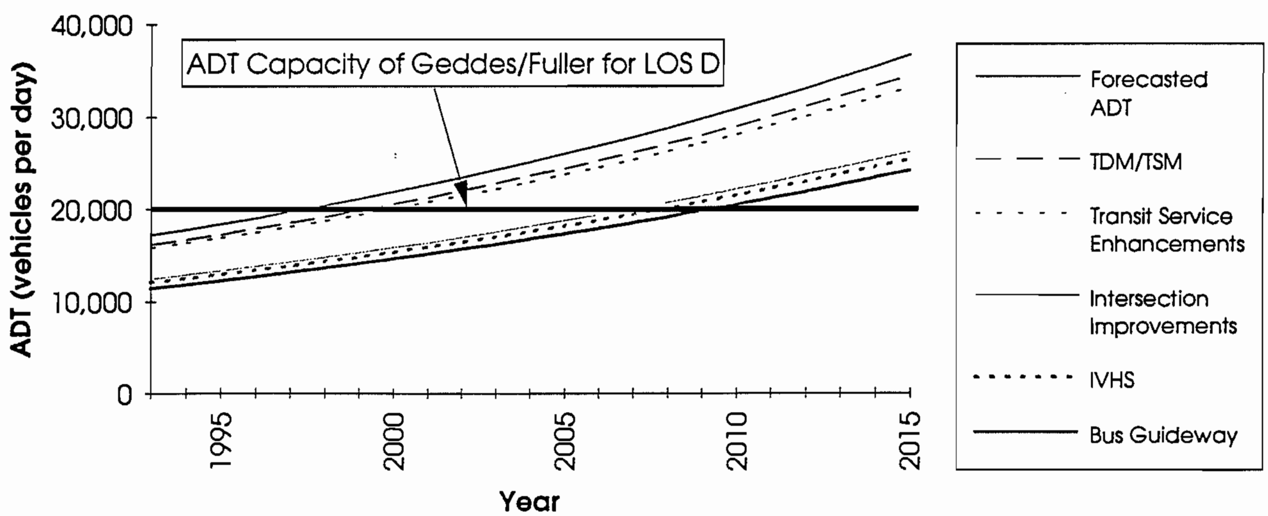
The recommendation for the Geddes/Fuller/Conrail corridor is a combination of the following:

- Intersection Improvements, Signal Optimization and Progression
- One Lane Bus Guideway on Conrail
- Transit Service Enhancements
- Travel Demand Management/Transportation System Management
- Intelligent Vehicle-Highway System Technologies (Long Term)

The bus guideway received the highest ranking of all strategies in the Screen 3 analysis. The TDM/TSM strategies received the highest rankings in the cost-benefit analysis. Each recommendation is described in detail in the following sections.

This recommendation's overall potential impact on the Geddes/Fuller corridor is illustrated in Figure 5. This figure shows the average daily traffic capacity of Geddes/Fuller for LOS D as a solid horizontal line crossing the ordinate at 20,000 vehicles per day. (Los D indicates high-density, but stable traffic flow, restricted speeds and vehicle movement, and poor pedestrian levels of comfort.) Forecasted traffic volumes are represented by the top curve. The intersection of these two lines indicates that traffic conditions will meet LOS D conditions sometime in 1995. Based upon the Screen 3 evaluation, the ability of each strategy to reduce vehicles per day extends the intersection point between the LOS D horizontal line and the traffic volumes over time. Assuming all strategies of the recommended alternative were implemented, LOS D conditions can be extended at least 13 years and not met until the year 2008. These final observations indicate that other means of satisfying travel demand must accompany the bus guideway in order to maintain LOS D traffic conditions or better.

Figure 5
Comparison of Reduction in Average Daily Traffic (ADT) from Recommended Improvements



INTERSECTION IMPROVEMENTS, SIGNAL OPTIMIZATION AND PROGRESSION

- Optimize all signalized intersections within the primary study area.
- Set timing plans differently for morning and evening peak hours.
- Coordinate efforts with Washtenaw Road Commission and the City of Ann Arbor to coordinate traffic signal progression within the Geddes/Fuller corridor.

Specific recommendations are provided in Table 2. Figures II-A and II-B illustrate potential intersection improvements at Geddes/Fuller and Huron Parkway.

TABLE 2
SIGNALIZED INTERSECTION RECOMMENDATIONS

Intersection	Recommendation
Geddes/Fuller and Huron Parkway	• Optimize existing phasing for peak a.m. and peak p.m. • Add right turn lanes for EB and WB Geddes/Fuller. • Extend left turn bay on WB Geddes Road. • Improve pavement conditions on EB and WB approach legs. • (Future) Add an additional left turn lane to WB Geddes Road.
Geddes Road and U.S. 23	• Realign SB on-ramp with existing signal at SB off-ramp. • Widen existing bridge to provide for left turn lanes at both intersections. If widening bridge is not possible, provide short left turn bays off ends of existing bridge. • Provide right turn lanes at ramp terminals. • Interconnect traffic signals and optimize timing to improve progression.
Geddes Road and Dixboro Road	• Extend left turn lanes. • If possible, add right turn lanes. • Consider double left turn bay for NB Dixboro Road. • Consider provision of EB channelized right turn lane with yield sign.
Dixboro Road and Huron River Drive	• Extend EB left turn bay. • Lengthen SB right turn lane.
Washtenaw Avenue and Huron Parkway	• Optimize existing signal. • Add right turn lanes on NB and SB Huron Parkway. • Designate exclusive right turn lanes on EB and WB Washtenaw Avenue.
Huron Parkway and Glazier Way	• Signalize and optimize signal. • Stripe pavement to aid turning movements. • If possible, pave Glazier Way east of Huron Pkwy.
Huron Parkway and Huron River Drive	• Signalize and optimize signal.

Figure II-A and II-B
Visual Representation of Potential Geddes/Fuller and Huron Parkway Intersection Improvements

ONE LANE BUSWAY ON CONRAIL

- Plan, design, and construct a single-lane bus guideway on Conrail right-of-way from LeForge Road to the University of Michigan Medical Center including:

  - Satellite Park-and-Ride near Guideway Stations
  - Feeder Buses to Park-and-Ride and Stations
  - Pedestrian Traffic Enhancements

  Buses using the guideway will provide direct transit service from downtown Ypsilanti to downtown Ann Arbor. Figure II-C is a visual representation of the proposed bus guideway. The bus guideway should be completed as soon as possible. In Table 3, however, the Bus Guideway is listed as an intermediate recommendation only because implementing this size of a system typically requires more than five years.

TRANSIT SERVICE ENHANCEMENTS

- Increase transit frequency to 15-minute headways (7½ minutes in peak hours) for Route 3 regular fixed-route buses.

- Operate three feeder buses in the peak hours.

- Continue with AATA fare subsidies for non-SOV commuters.

TRAVEL DEMAND MANAGEMENT/ TRANSPORTATION SYSTEM MANAGEMENT (TDM/TSM)

Parking Restrictions and Management

- Allocate (as necessary) HOV-reserved parking stalls near building entrances at the University of Michigan, Medical Center, and VA Hospital.

- HOVs receive free parking.

- Pending utilization of the reserved stalls, increase the number of HOV-reserved parking stalls accordingly over time.

Park-and-Ride with Bus Transfer

- Continue negotiations for park-and-ride at existing, underutilized parking lots for weekday use only.

- Provide signing of these sites.

Figure II-C
Visual Representation of the Proposed Bus Guideway

Employee Rideshare

- Continue with existing RideShare program.
- Market RideShare with the proposed transportation enhancements.
- Direct efforts toward a public information campaign.

Area Bicycle Circulation System

- Coordinate future bicycle circulation plans with existing plans as established by the City of Ann Arbor and Washtenaw County.

Pedestrian Circulation System

- Coordinate efforts with the City of Ann Arbor to assure consistency with the Ann Arbor Master Plan.

- Facilitate site-specific, pedestrian circulation plans as alternative strategies are adopted.

- Begin a pedestrian system beautification program where existing sidewalks and pathways are cleared of weeds, overgrown shrubbery, and debris. Procurement of a funding mechanism should also begin for this effort.

- Consider grade-separated crossings of Conrail right-of-way.

- Develop an area-wide plan that links pedestrian and bicycle circulation plans together.

INTELLIGENT VEHICLE-HIGHWAY SYSTEM TECHNOLOGIES (LONG-TERM)

Smart Buses, Kiosks, and ATIS Transit Information

- Implement Ann Arbor Transportation Authority's planned Intelligent Transportation System (ITS), incorporating buses, kiosks and ATIS Transit Information.

Traffic Surveillance and Changeable Message Signs

- Traffic surveillance equipment on major roadways and intersections.

    - Fuller road (Oak Way to Glen)
    - Huron Parkway and Geddes/Fuller intersection
    - Washtenaw and Huron Parkway
    - Plymouth Road (Nixon Road to Huron Parkway)

- Changeable message items along U.S. 23 that display real-time parking and traffic information.

DISCUSSION OF RECOMMENDED STRATEGIES

Traffic signal optimization and progression will provide immediate and noticeable improvements to motorists in the corridor. Intersection improvements such as adding and lengthening turning lanes will improve travel conditions even more. Increased traffic flow, reduced delay and emissions, and reduced accident potential all result from intersection improvements. However, many of these benefits may only be short-term. Long-term benefits associated with these two strategies may diminish after 5 to 7 years because of increasing travel demand. Figure II-A and II-B illustrates potential improvements to the Geddes/Fuller and Huron Parkway intersection—a key intersection in the Geddes/Fuller corridor.

Transit enhancements include the increased frequency of buses plus the addition of smart bus technology and information kiosks. These enhancements have the potential of reducing congestion. Development of the smart bus technology is currently funded under an existing grant to AATA.

The TDM/TSM strategies provide a cost-effective alternative for the corridor. These strategies promote the use of multi-occupancy modes of transportation. Given the increasing travel demand for the forecast years, transit enhancements will be needed just to maintain existing service conditions. The enhancements may also attract new riders who are currently single-occupant drivers.

HOV-priority parking scored highly in both cost effectiveness and in meeting the goals and objectives. Success of this strategy depends upon coordinated efforts with the University of Michigan, Medical Center, and the VA Hospital. Officials within these institutions must come to understand the potential future congestion problems and the significant influence they can make in the Geddes/Fuller corridor. Priority parking for HOVs may also be complemented with other RideShare programs at these facilities.

Park-and-ride lots should be pursued for those sites not requiring new construction. Use of existing, underutilized lots will provide a low-cost means of utilizing existing facilities and promote multi-occupant modes of travel.

Of all the strategies evaluated, the bus guideway most comprehensively satisfies the study's goals and objectives. (A visual representation of the bus guideway is presented in Figure II-B.) However, the bus guideway is not the most cost effective strategy. Cost is a relative measure and can be highly subjective at this level of analysis. For this study, costs were measured as direct expenses for a strategy plus a measure of disutility.

(Disutility is explained in detail under the Ridership section of this report.) Other costs not considered were factors such as quality of life, economic development and environmental preservation. These are important factors and weighed heavily in the selection of the study's goals and objectives and in the selection of a recommended alternative.

The bus guideway will have a current annual cost of approximately $2.5 million over a 30 year life. This includes capital, operating and maintenance costs. Right-of-way costs are not included with this figure. Actual costs will increase above the $2.5 million figure as inflation affects operating costs. Ridership on the guideway is forecasted at about 5500 riders per day in the year 2015 assuming 7½-minute headway operation.

Accompanying the bus guideway are park-and-ride lots, feeder buses to these lots, and pedestrian traffic enhancements. Individually, these features provide marginal benefits. Feeder buses to park-and-ride lots, like the bus guideway, support the goals and objectives well, but at a high cost. On the other hand, the cost effectiveness of pedestrian enhancements is good, but alone does not provide significant support of the goals and objectives. Park-and-ride lots near bus guideway stations did not fare well in either respect because of the high cost to construct them, and the fixed number of spaces they provide. However, each of these strategies are necessary to complement ridership on the guideway.

Bicycle and pedestrian circulation systems are also recommended. These strategies not only provide mobility without negatively affecting the environment, but also add to the quality of life. These non-motorized facilities have long useful lives, require little maintenance, and can be enjoyed by many people virtually year-round.

Finally, for the long-term future, IVHS technologies may be considered. Presently, costs for traffic surveillance equipment, changeable message signs, and all accompanying hardware and software are very high. Given these high costs and the unknown benefits gained from such technology, immediate procurement is not warranted. As technology improves and costs drop, IVHS technologies may prove to be a viable option in the future.

The recommendations represent a family of improvements which all need to be implemented to provide necessary relief to projected congestion through the twenty-year planning period. Some of the recommendations will be difficult to achieve. The implementation of the bus guideway faces significant challenges in right-of-way issues and negotiations. Other recommendations must face competition for funding from other important community needs.

Failure to implement all of the recommendations is likely to lead to unacceptable levels of traffic congestion. The most important immediate recommendation is to improve the operation of the intersections. The biggest positive impact to the corridor will result from extended turning lanes, signal timing and progression improvements. The second most important combination of recommendations are those dealing with transit. Additions to transit service in the corridor -- increased frequency, feeder buses, advanced technologies (underway), and preferential treatments -- should occur soon. Preliminary engineering, design and right-of-way negotiations for the bus guideway should also begin immediately. Actual construction of the guideway is not likely to occur within the first five years of the plan's implementation, but will be important.

Many of the improvements are not scheduled for implementation until after the first five years of the plan (such as construction of the bus guideway). Thus, a comprehensive reassessment of the corridor should be undertaken at the end of the five-year period. This reassessment needs to include a new look at traffic, forecasts and congestion in the corridor. It needs to assess the ability of improvements undertaken during the first five years to accommodate travel demand in the corridor. Finally, it needs to assess the likelihood of continued implementation of recommendations scheduled beyond the first five years of the plan. If traffic projections continue to be realized and some of the improvements are not able to be implemented as planned, a new assessment of alternatives (including roadway widening) will need to take place.

POTENTIAL STAGING AND FUNDING OF THE RECOMMENDED ALTERNATIVE

Funding and implementation of each of the recommended strategies was considered and a possible staging plan was developed. Potential sources of funding are described below.

FEDERAL FUNDING SOURCES: ISTEA

The Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) serves to develop a National Intermodal Transportation System that is economically efficient, environmentally sound, provides the foundation for the Nation to compete in the global economy, and will move people and goods in an energy efficient manner. ISTEA proposes broad changes to the way transportation decisions are made by emphasizing diversity and balance of modes and preservation of existing systems over construction of new facilities, especially roads, and by proposing a series of social, environmental and energy factors which must be considered in transportation planning, programming and project selection. ISTEA is designed to assist identification of solutions to transportation problems. Programs exist within ISTEA that serve to allocate funding; ISTEA merely defines the procedure to acquire such funding.

- *Section 3 (New Starts)*: Funds allocated through the Federal Transit Administration (FTA) and distributed to transit agencies on a discretionary basis for "New Starts." Various agencies desiring use of these funds must compete for them; the FTA distributes the funds based upon evaluations of competing agencies' needs and feasibility of the request. The statutory maximum matching rate for Section 3 is 80 percent federal and 20 percent state and local.

- *Section 9*: Funds allocated through the FTA to transit agencies where agencies need not compete for the funding. The amount of funding allocated is determined using a formula which considers the population, population density, and service provided.

- *Surface Transportation Program (STP)*: A principal capital funding program under ISTEA for roadway and intersection improvements. A portion of these funds can be used by the State.

- *Transportation Enhancements:* Funding for non-motorized, landscaping, etc. enhancements. These enhancements serve to broaden the definition of eligible transportation activities to include pedestrian and bicycle facilities and to enhance community and environmental quality. Funding for transportation enhancements can be issued as grants.

STATE FUNDING SOURCES

- *Act of the (State of Michigan) Legislature, No. 51 (also called the Michigan Transportation Fund)*: Allocates a gasoline and vehicle weight tax to public street enhancements. If these street enhancements complement pedestrian and bicycle movement, such funding can also be used for those pedestrian and bicycle improvements adjacent to the street. Ten percent of the fund, designated as Comprehensive Transportation Fund (CTF), may be used to fund transit.

LOCAL FUNDING SOURCES

- *City of Ann Arbor Streets Millage*: Millage utilized to acquire necessary local matching fund allocations for public street improvements within Ann Arbor. Intersection improvements are eligible for these funds.

- *City of Ann Arbor Parks Millage*: Millage utilized to acquire necessary local matching fund allocations for parks development and enhancements, and to operate and maintain parks within Ann Arbor. Intersection improvements adjacent to or within parks may be eligible for this funding.

- *City of Ann Arbor Special Assessment Districts*: Property developments and adjacent property owners can be required to provide funding for street improvements and pedestrian enhancements.

- *City of Ann Arbor Transit Millage:* Millage used to supplement federal transit operations funding.

- *City of Ann Arbor General Fund Revenues*

TRANSIT AGENCIES

- *Ann Arbor Transportation Authority*: AATA is the primary transit agency in Ann Arbor. Potential opportunity for AATA to supply funding is dependent upon ridership (transit demand), fare structure, and service provisions. Specific details of funding potential for AATA have not been determined.

- *Other Agencies*: Other transit and paratransit agencies may provide funding for enhancements if such enhancements benefit their agencies directly as well. For example, a paratransit agency may contribute if allowed use on the bus guideway.

OTHER FUNDING SOURCES

- *University of Michigan*: Transportation enhancements conducive to safe and efficient movement of people and goods relative to the University of Michigan may receive funding by the University. Opportunity may exist to receive such funding for transit service, park-and-ride lots and bicycle facilities, given that many students ride bicycles to campus.

- *Large Employers*: Large employment centers may contribute funding for pedestrian and bicycle enhancements on and around their facilities. Such site enhancements could be incorporated into an area-wide pedestrian and bicycle circulation plan.

- *Public/Private Partnerships:* Funding from private sources may be combined with public funding in partnerships to fund projects or portions of projects such as the bus guideway.

Given the complexity of the recommended alternative, funding will not come from a single source, but from many sources. In general, available funding sources may be classified as:

- Federal,
- State,
- Local,
- Transit Agencies, and
- Other.

Funding for larger projects typically are covered by a combination of these sources. Because of the national demand for funding, acquiring funds from any one of these sources can be an arduous and competitive task.

Consequently, city officials have identified sometimes creative means to acquire funds. Brief descriptions of funding sources as mentioned in the table follow.

Table 3 shows this plan as well as responsible agencies and potential funding sources of capital and operating costs. Most of the recommended strategies can be implemented within 5 years.

TABLE 3
POTENTIAL STAGING OF THE RECOMMENDED ALTERNATIVE

	Capital Cost	Annual O&M Cost	Responsible Agency	Potential Source of Funding
SHORT-TERM (0 TO 5 YEARS)				
One-Lane Bus Guideway on Conrail				
Environmental Impacts Studies, Preliminary Engineering and Design	$1,400,000	--	AATA	Section 9 Act 51
Parking Restrictions and Management				
HOV-Priority Parking	$37,000	$38,000	Employer Specific	
Parking Fee	--	$163,000		
Increase to 10% HOV-Priority Parking	$37,000	--		
Transit Service Enhancements				
Increase Transit to 15-Minute Headway	$1,290,000	$727,000	AATA	Local
Purchase and Operate 3 Feeder Buses in Peak Hours	$645,000	$363,000	AATA	Section 9 or Local
Continue Fare Subsidies		$3,000	AATA	U of MI
Smart Buses, Kiosks, and ATIS Transit Information				
Implement AATA Smart Bus	$645,000	$166,000	AATA	Section 3 Local
Park and Ride with Bus Transfer				
Use Existing Lots for P&R	--	Negotiable	AATA	STP
Employee RideShare Program				
Market RideShare Public Information Campaign	--	$21,000	AATA	Act 51

	Capital Cost	Annual O&M Cost	Responsible Agency	Potential Source of Funding
Area Bicycle Circulation Program				
Coordinate Plans with City and Washtenaw County	$1,256,000	$38,000	City of Ann Arbor	Act 51 Local
Pedestrian Circulation System				
Assure Consistency with Master Plan	--	--	City of Ann Arbor	Local STP
Site Specific Circulation Plans	$125,000	$2,000		
System Beautification Project		$30,000		
Signal Optimization, Phasing, Progression				
Optimize All Signals in Primary Study Area	$31,000	$4,000	City of Ann Arbor	Act 51 Local
Set Timing Plans for AM/PM Peaks	--	--		
Coordinate Efforts with Washtenaw County and City	--	--		
Intersection Improvements				
Geddes/Fuller and Huron Parkway	$414,000	TBD	City of Ann Arbor	STP Act 51 Local
Add Right Turn Lanes for EB and WB Geddes\Fuller	--	--		
Extend Left Turn Bay on WB Geddes/Fuller	--	--		
Improve Pavement Conditions on EB and WB Geddes/ Fuller	--	--		
Geddes Road and U.S. 23	$300,000*	TBD	Michigan DOT	STP Act 51 Local
Interconnect and Progress Signals	--	--		
Geddes Road and Dixboro Road	$300,000	TBD	Washtenaw County Road Commission	STP Act 51 Local
Extend Left Turn Bays	--	--		
Add Right Turn Lanes	--	--		

	Capital Cost	Annual O&M Cost	Responsible Agency	Potential Source of Funding
Dixboro Road and Huron River Drive	$320,000	TBD		
Extend EB Left Turn Bay	--	--		
Lengthen SB Right Turn Lane	--	--		
Huron Parkway and Glazier Way	$1,000,000	$4,000		
Signalize and Optimize Signal	—	—	City of Ann Arbor	STP Act 51 Local
Huron Parkway and Huron River Drive	$300,000	TBD		
Signalize and Optimize Signal	--	--		
Washtenaw Avenue and Huron Parkway	$380,000	TBD		
Add Right Turn Lanes on NB and SB Huron Parkway	--	--		
Right Turn Lanes on EB and WB Washtenaw Avenue	--	--		
Roadway Improvement				
Pave Glazier Way East of Huron Parkway	$1,000,000	$4,000	City of Ann Arbor	STP Act 51 Local Special Assess-ment
INTERMEDIATE FUTURE (6 TO 10 YEARS)				
One Lane Bus Guideway on Conrail				
Construct Guideway, LeForge Road to Medical Center	$15,802,000	$1,142,000	AATA	Section 3 Act 51
Satellite Park-and-Ride near Guideway	$816,000	$95,000	AATA	Section 3 Act 51
Feeder Buses to P&R/Bus Guideway	$3,048,000	$1,635,000	AATA	Section 3 Act 51

	Capital Cost	Annual O&M Cost	Responsible Agency	Potential Source of Funding
Pedestrian Traffic Enhancements	$121,000	$2,000	AATA	Section 3 Enhancements
Intersection Improvements				
Geddes/Fuller and Huron Parkway	TBD	TBD	City of Ann Arbor	STP Local Act 51
Add A Second Left Turn Lane to WB Geddes Road				
Geddes Road and U.S. 23	TBD	TBD	Michigan DOT	STP Act 51
Realign SB On-Ramp with SB Off-Ramp				
Widen Existing Bridge				
Provide Right Turn Lanes at Ramp Terminals				
Geddes Road and Dixboro Road	TBD	TBD	Washtenaw County Road Commission	STP Act 51
Consider Double Left Turns for NB Dixboro				
Consider EB Channelized Right Turn with Yield				
LONG-TERM (11 + YEARS)				
ATMS-Traffic Surveillance				
Video Surveillance and Signal Control	$1,924,000	$200,000	TBD	TBD
CMS Parking and Traffic Information				
Sites Along U.S. 23	$386,000	$50,000	Michigan DOT	TBD
Intersection Improvements				
Geddes Road and Dixboro Road	TBD	TBD	Washtenaw County Road Commission	STP Act 51 Local
Consider Double Left Turns for NB Dixboro				
Consider EB Channelized Right Turn with Yield				

TBD = To Be Determined
* Not including bridge reconstruction

NEXT STEPS

Implementation of the recommended alternative requires the following steps:

1. Communicate results of this study with other city, county, state, and federal officials. Coordinate with the appropriate officials to initiate implementation of recommended strategies, in particular intersection improvements, traffic signal optimization and progression, bicycle and pedestrian facilities, etc. Incorporate short-term plan recommendations into Ann Arbor's Capital Improvement Program.

2. Continue working with Conrail officials and undertake detailed design of the bus guideway. Investigate further potential placement of a bus guideway in Conrail's right-of-way.

3. Begin discussions with the University of Michigan, Medical Center, and VA Hospital regarding conversion of existing parking stalls to HOV-priority parking. Consideration may be given to executing a pilot study of this strategy to further refine its application for possible future use.

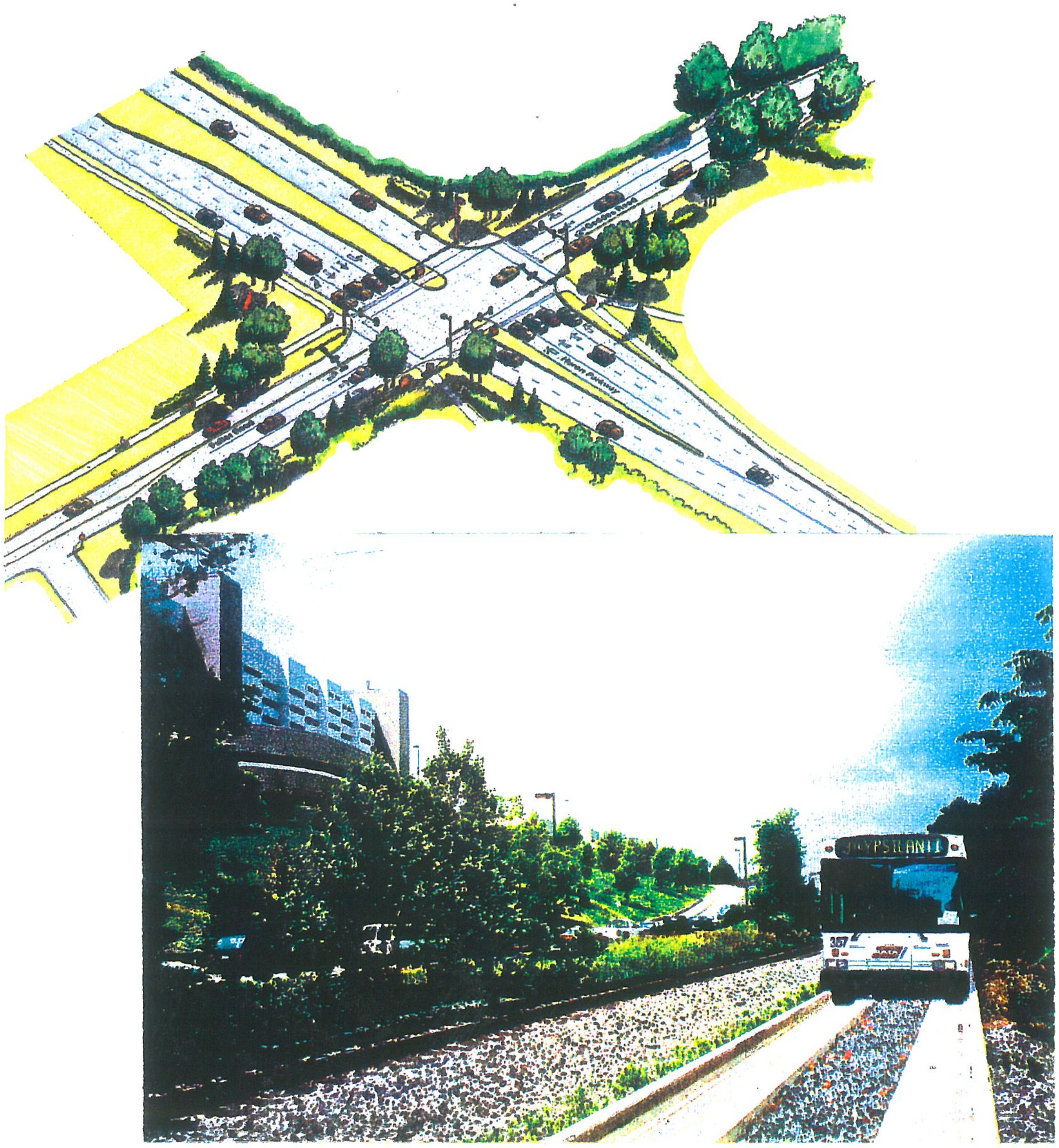
4. Watch for preliminary results of the AATA smart bus program. Identify potential applications of such technologies as they might apply with the bus guideway.

5. Procure additional funding for transit operational enhancements and for the purchase of additional buses.

Complete implementation requires direct, frequent, and open communication among city, county, state and federal officials. It is imperative that efforts are coordinated among all of these officials if recommendations are to be implemented. Progress of the implementation process should be monitored periodically by the Steering Committee.and Citizens' Advisory Committee. The Steering Committee should also continue to guide the transportation plan.

Geddes/Fuller/Conrail

Corridor Study



June 1994

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EVALUATION OVERVIEW

III. EVALUATION OVERVIEW

A three-step procedure was used to evaluate potential alternative strategies for the corridor. This procedure starts with a broad range of alternatives and filters or screens the alternatives through a series of tests to identify alternatives that support the goals and objectives for the corridor. The final result of this evaluation procedure is the recommended alternative (described in the previous section) that best supports the goals and objectives of the corridor and provides an acceptable cost-effective value.

The three steps of the procedure are given the term screens, because they filter alternatives to a finer level for each succeeding step. Screen 1 of this procedure identified and assessed a broad range of possible alternative strategies. This "universe" of strategies was evaluated at a macro-level using a fatal flaw analysis. A set of fatal flaw criteria is applied to the strategies and the strategy can pass or fail the test. Strategies passing the test are advanced to the second screen.

The second screen uses a macro level evaluation to determine successful strategies. The macro categories are use/ridership, environmental impacts, and costs. The strategies are given ratings in each of these categories using a weighted rating structure. At this stage, it is important to identify good and bad elements of each strategy so that these elements might be later combined into more effective strategies. Strategies which have successful overall or individual elements are forwarded or recombined into new strategies for evaluation in the third screening.

The third screen uses a micro level evaluation to finally identify in detail which strategy is the preferred alternative. This screening uses 17 different criteria with specific measures of success. This rigorous evaluation procedure insures that all effective alternatives are identified and provides confidence that the selected alternative best meets the goals and objectives of the corridor.

Geddes/Fuller/Conrail
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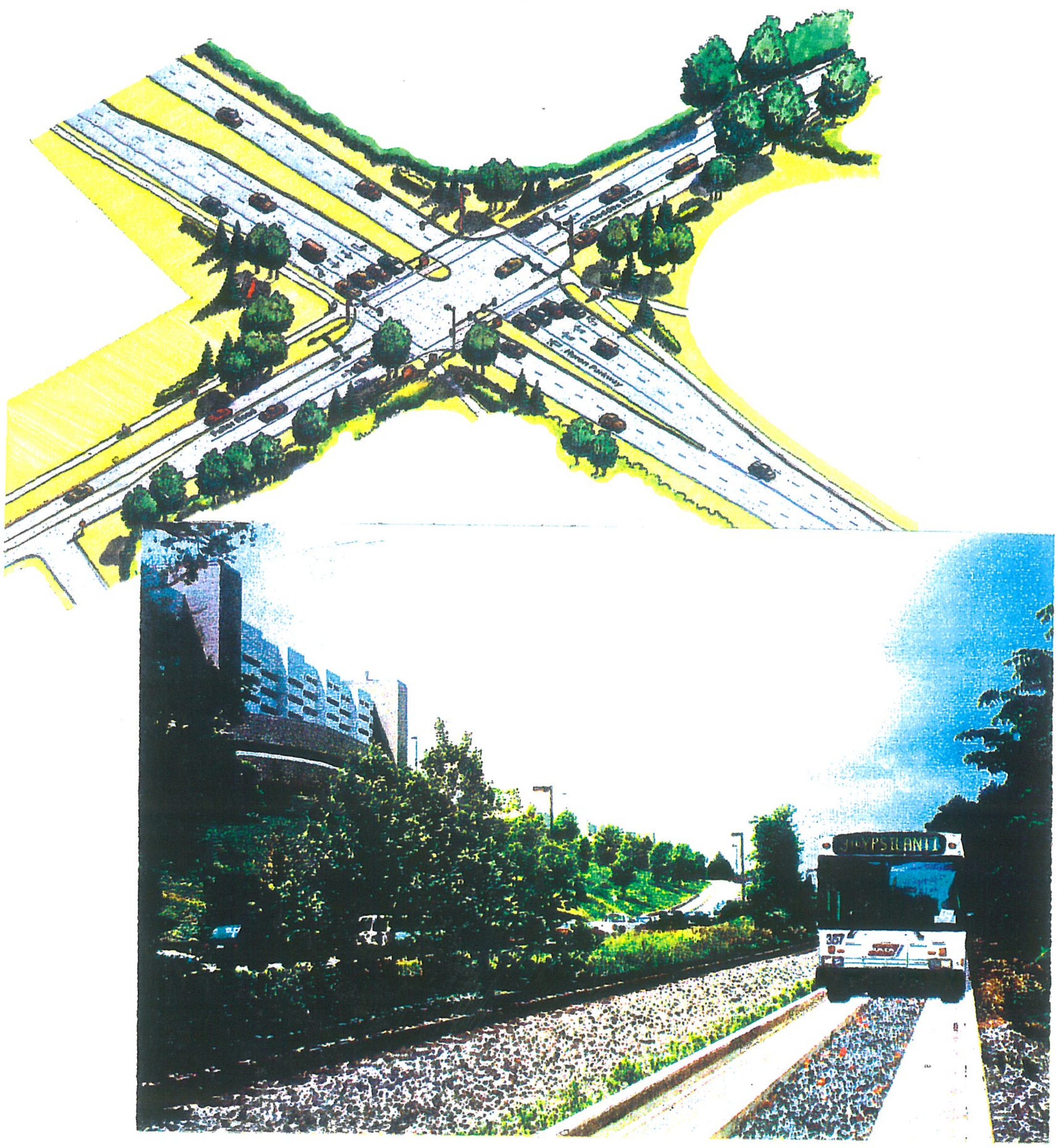

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IV. SCREEN 1 - FATAL FLAW ANALYSIS

The first screen of the Geddes/Fuller/Conrail study considered a "universe" of alternatives. This universe included a wide range of alternatives that could have any chance of meeting the objectives for the corridor. These alternatives were subjected to a fatal flaw analysis whereby the alternative either passed or failed the test.

SCREEN 1: ALTERNATIVES

A universe of alternative strategies was identified to address the problems facing the Geddes/Fuller/Conrail corridor. These strategies can be classified into five major categories:

- Travel Demand Management (TDM),
- Transportation System Management,
- Intelligent Vehicle-Highway Systems (IVHS) Applications,
- Environmental and Aesthetic Issues,
- Roadway Widening,
- No-build.

A listing of the alternative strategies available within each of these categories is presented below.

Travel Demand Management Strategies

Travel demand management encompasses strategies that coordinate the use of travel and maximize the effectiveness of current facilities. These strategies include carpools, congestion pricing and flexible work hours. By increasing the occupancy of vehicles, staggering the use of facilities and restricting the availability of facilities, travel demand management strategies are a low cost, low impact and effective manner to reduce congestion. The travel demand management strategies considered for this study were:

Trip Reduction Ordinances

- Special use permits,
- Negotiated agreements,
- Trip reduction goals,
- Mandated ridesharing programs, and
- Transportation management funds and districts.

Employer-Based Transportation Management

- Employee financial incentives,
- On-site employer transportation coordinator,

- Transit/RideShare services,
- Vanpools,
- Carpool matching efforts,
- Telecommunication systems,
- Staggered work hours,
- Flex time,
- Four-day work week, and
- Telecommuting.

Driving Restrictions

- Voluntary No-Drive Days,
- Route diversion, and
- Control of truck movement.

Parking Management Programs

- Off-street parking restrictions,
- On-street parking controls,
- Control of parking supply,
- Commercial vehicle restrictions/priorities, and
- Residential Parking Permit Programs (RPPPs).

Road Pricing

- Toll collection,
- Taxes and/or fees, and
- Congestion pricing.

Area-Wide RideShare Incentives

- Area-wide programs,
- Transportation management organizations, and
- Tax incentives.

Traffic Management Plans

- Special events (e.g., athletic events, concerts, assemblies), and
- Adverse weather conditions.

Transportation System Management Strategies

Transportation system management strategies seek to make improvements in transportation facilities to improve the effectiveness of the overall travel environment. These strategies can have a wide range of costs, benefits and impacts. Because they are based on infrastructure improvements, they are very site specific and need to be evaluated against the available options, needs and constraints of the site. The specific transportation system management strategies considered for this study were:

Improved Public Transportation

- Increased bus service

  - → Express with feeder,
  - → Higher frequency (shorter headways),
  - → Charter bus services,
  - → Subscription bus,
  - → Dial-a-ride,
  - → Provide bus loading facilities with shelters.

- Pricing programs to promote increased ridership,

  - → Free ride days,
  - → Employer subsidies.

- Exclusive busway/guideway on Conrail,

  - → 1 lane,
  - → 2 lanes,
  - → Combination 1 and 2 lanes.

- Bus Rapid Transit/Preferential Treatment,

  - → Reserved freeway/highway/arterial lane(s),
  - → Contraflow/Curb bus lane,
  - → Normal flow/Curb bus lane,
  - → Metered freeway/highway/arterial,
  - → Preference in street signing,
  - → Preference in traffic signals,
  - → Normal-flow curb bus lane,
  - → Median bus lane,
  - → Bus only streets.

- Street Improvements

  - → Pavement surface improvements and drainage features,
  - → Increased curb return radii,
  - → Parking restrictions,
  - → One-way streets.

Park-and-Ride/Fringe Parking

- Satellite (Distant) Park and Ride,
- Fringe/periphery parking,

- Shuttle service,
- Carpool services.

Traffic Flow Improvements

- Build new roadways,
- Expand/widen existing roadways,
- Alter speed limits,
- Improve efficiency of existing roadways,

  → Replace/refurbish traffic control devices (e.g., signing, striping, painted islands, etc.),
  → Resurfacing, restoration, and rehabilitation (RRR) projects,
  → Improve sight distance (e.g., provide lighting, clearing ROW),
  → Mid-block improvements (modifications to property access).

- Intersection Improvements,

  → Provide additional turning lanes,
  → Correct offsets,
  → Widening,
  → Eliminate approach sight distance obstacles,
  → Replace/refurbish traffic control devices (e.g., signing, striping, painted islands, signal heads, etc.),
  → Provide new traffic control devices,
  → Optimize signal phasing of single intersections,
  → Establish a progressive system of signalized intersections,
  → Signalize existing non-signalized intersections.

- High-Occupancy Vehicle Facilities,

  → Contra-flow lanes (1 or 2),
  → Normal-flow lanes (1 or 2).

Creation and Preservation of Pedestrian Facilities

- Integrated System Spot Improvements

  → Provide/refurbish pedestrian signal displays,
  → Improve signal timing to accommodate pedestrian movement,
  → Remove obstacles to pedestrian movement (e.g., mailboxes, newspaper racks, sign posts, etc.),
  → Widen crosswalks,
  → Improve/provide sidewalk lighting,
  → Curb radii modifications for pedestrian movement.

- Integrated System Concordance with Design Standards

    - → Provide (new) sidewalks where standards indicate sidewalks are required,
    - → Provide pedestrian easements,
    - → Pedestrian access to shopping centers, etc.,
    - → Neighborhood intersection design improvements,
    - → Provide refuge islands,
    - → Provide system continuity throughout Ann Arbor for pedestrian movement and facilities.

- Sidewalk Widening

    - → Reduce street widths in high-pedestrian movement areas,
    - → Create arcade setbacks with new and reconstruction of buildings.

- Provide Partial Pedestrian Malls,
- Provide Full Pedestrian Malls,
- Auto-Free Zones,
- Convert existing alleys/streets to sidewalks,
- Central Park concept,
- Vertical Separation Systems,

    - → Underground (tunnels) walkways,
    - → Elevated walkways,
    - → Skyway access across streets.

Creation and Preservation of Bicycle Facilities

- Provide Bicycle Facilities

    - → Exclusive ROW with Protected Lane (Class I),
    - → Restricted ROW with no through vehicles allowed (Class II),
    - → Shared ROW with vehicular traffic (Class III).

- Integrate bicycle facilities into corridor circulation plan,
- Marketing strategies to promote bicycle use,
- Geometric design consistent with existing topography and human physical capabilities (i.e., flat grades, grade separation at busy intersections, etc.),
- Path delineation.

Traffic Calming

- Close/Eliminate roadway links,
- Eliminate access,

- Placement of physical barriers,
  - → Rumble strips,
  - → Raised pavement delineators (dots).

Intelligent Vehicle-Highway Systems

Intelligent Vehicle Highway Systems (IVHS) is a national initiative to apply technology-based solutions to make significant increases in safety, mobility, air quality and trip quality. The specific technologies considered for this study were:

- Advanced Traffic Management Systems (ATMS)
  - → Traffic surveillance,
  - → Dynamic signal control,
  - → Changeable message signs,
  - → Parking information,
  - → Police/Emergency Incident Response,
  - → Traffic advisory radio,
  - → Traffic advisory television.
- Advanced Traveler Information Systems (ATIS),
  - → On-board computers,
  - → Palmtop computers,
  - → Paging devices,
  - → Cellular telephone.
- Commercial Vehicles Operations (CVO),
  - → Automatic vehicle identification (AVI),
  - → Weigh in motion monitors (WIMs).
- Advanced Public Transportation Systems (APTS),
  - → Smart Bus,
  - → Smart Cards,
  - → Global Positioning System applications,
  - → Computer-aided scheduling and dispatching,
  - → Real-time trip information.
- Automated Highway Systems (AHS),
  - → Collision avoidance systems,
  - → Vehicle platooning.

- Advanced Rural Transportation Systems (ARTS),
  - → Hazard avoidance,
  - → Weather information.

Environmental and Aesthetic Issues

Any changes made to the infrastructure or operating characteristics of the transportation system within the corridor must be made in accordance with procedures and regulations for environmental and aesthetic issues. These issues include:

- Preserve lands fronting transportation routes,
- Land use decisions relating to transit,
- Enhance image of frontage roads.

No Build/Do Nothing

To complete the range of available alternatives considered for this study, a no-build or do-nothing option, and a construction option was considered. This provided a basis to compare the relative impact of considered improvements and an understanding of the impacts of not taken proactive steps in improving the corridor.

SCREEN 1: FATAL FLAW CRITERIA

Four major criteria were used to determine if a strategy could be passed on to subsequent evaluations. A strategy was evaluated against these criteria and the strategy either passed or failed. The criteria used to determine whether a strategy passed or failed Screen 1 were:

Appropriateness

Will application of the strategy attain goals and objectives specific to the Geddes/Fuller/Conrail corridor?

Effectiveness

Is the strategy likely to generate the desired results?

Is the strategy consistent with community goals and objectives specific to Ann Arbor?

Adequacy

Does the strategy correspond to the scale of the problem?

Does the strategy correspond to level of expectation of the problem solution?

Feasibility

Can legal or administrative barriers that could preclude implementation be overcome?

SCREEN 1: RESULTS

As a preliminary screening of strategies, the universe of 128 alternatives was first reduced to 35 candidates. The alternatives not passing this preliminary screening had fatal flaws and had no elements worthy of being considered for combination with other strategies.

The remaining 35 strategies were given a more thorough review and analysis for fatal flaws and possible elements for combination in other strategies. These 35 strategies and their Screen 1 results are presented in Table 4.

Of the 35 strategies reviewed in detail in Screen 1, 20 strategies received a pass rating. Of the 15 strategies that failed, four had elements that were considered desirable and warranted further review. From these twenty passing strategies and four additional elements, nine alternatives were developed for review in the second screening. Table 5 presents a summary of this analysis and how the first group of strategies are represented in the succeeding nine alternatives. The initial strategies that failed are indicated by a shaded row. The unshaded rows are the passing strategies. The columns list the nine new alternatives with a dot in the row of the initial passing strategy that has been included in the new alternative.

TABLE 4
SCREEN 1 ANALYSIS RESULTS

No.	Alternative Strategy	Pass/Fail 1st Screening	Reason for Failure or Comment
I. TRAVEL DEMAND MANAGEMENT			
1	One reversible HOV lane, toll SOV, no toll HOV in Conrail right-of-way.	Pass	Included in Alternative 3B; refer to Table 5.
2	Two HOV lanes, 2-directional toll SOV, no toll HOV in Conrail right-of-way.	Fail	• Not sensitive to the environment; • Does not correspond to scale of the problem.
3	Parking management and/or restrictions at: Area schools, Colleges, universities, high activity centers, major employers.	Pass	Included in Alternative 1; refer to Table 5.
4	Route diversions that direct traffic away from Geddes/Fuller.	Fail	• Does not encourage use of or provide alternative modes of transportation; • Private participation not likely.
5	RideShare programs/employer.	Pass	Included in Alternative 1; refer to Table 5.
II. TRANSPORTATION SYSTEM IMPROVEMENTS			
HOV FACILITY OPTIONS			
6	One reversible median HOV lane on Geddes/Fuller/Glen (U.S. 23 to Huron Street) NOTE: This alternative may be further segmented.	Fail, segments may pass	• Does not support other community goals and objectives; • Lacks sensitivity to existing land use and environmental concerns; • Private participation not likely. However, used in Alternative 5 for comparative purposes.

TABLE 4
SCREEN 1 ANALYSIS RESULTS (Continued)

No.	Alternative Strategy	Pass/Fail 1st Screening	Reason for Failure or Comment
7	Extend current HOV lanes on Geddes/Fuller/Glen to U.S. 23	Fail	• Does not correspond to scale of problem; • Does not support other community goals and objectives; • Lacks sensitivity to existing land use and environmental concerns; • Private participation not likely; • Legal barriers difficult to overcome.
8	Designate one HOV lane per direction on Huron Parkway. (Plymouth to Washtenaw) with one median HOV lane on Glazier/Fuller (Huron Parkway to Glen).	Fail	• Private participation not facilitated; • Does not correspond to scale of the problem; • Lacks sensitivity to existing land use and environmental concerns.
9	One reversible HOV lane on Washtenaw (Ypsilanti to Downtown Ann Arbor).	Fail	• Does not correspond to scale of the problem; • Not likely to generate the desired results; • Private participation not likely; • Lacks sensitivity to existing land use and environmental concerns.
10A 10B	One HOV lane per direction on Plymouth (U.S. 23 to Main Street) Designate 1 existing lane as HOV on Plymouth (U.S. 23 to Main Street)	Fail	• Does not correspond to scale of the problem; • Not likely to generate the desired results; • Private participation not likely; • Lacks sensitivity to existing land use and environmental concerns.
11	One HOV lane on Huron River Drive (Clark to Geddes/Fuller)	Fail	• Not sensitive to environment and land use; • Private participation not likely; • Potential for legal barriers-not easily overcome.

TABLE 4
SCREEN 1 ANALYSIS RESULTS (Continued)

No.	Alternative Strategy	Pass/Fail 1st Screening	Reason for Failure or Comment
12	One reversible HOV lane on Conrail Corridor.	Pass	Used in Alternative 3A; refer to Table 3.
13	Two HOV lanes on Conrail Corridor.	Fail	• Not sensitive to the environment; • Does not correspond to scale of the problem.
	IMPROVE PUBLIC TRANSPORTATION		
14	Higher frequency of buses at: Washtenaw Corridor (Ypsilanti to U. of Michigan) Huron River Drive (Ypsilanti to Geddes Geddes/Fuller (Huron River Drive to U. of Michigan) Plymouth (Cherry Hill Road to U. of Michigan)	Pass	Used in Alternative 1; refer to Table 5.
15	Express bus and feeder bus system: Geddes/Fuller (Huron River Drive to U. of Michigan) Washtenaw Corridor (Ypsilanti to U. of Michigan) Plymouth (Cherry Hill Road to U. of Michigan)	Pass	Used in Alternatives 1 and 2; refer to Table 5.
16	Provide bus shelters in corridor and on other bus routes.	Pass	Used in Alternative 1; refer to Table 5.
STREET IMPROVEMENTS ON GEDDES/FULLER			
17	Widen roadway.	Fail	• Not sensitive to existing land use and environmental issues; • Would not generate desired results; • Does not encourage use of or provide alternate modes of transportation. However, used in Alternatives 5 and 7.

TABLE 4
SCREEN 1 ANALYSIS RESULTS (Continued)

No.	Alternative Strategy	Pass/Fail 1st Screening	Reason for Failure or Comment
18	One-way pair (Glazier/Fuller/ Geddes)	Fail	• Does not increase corridor throughput; • Does not promote use of or provide alternate modes of transportation; • Not likely to generate the desired results.
19	Provide park-and-ride lots with bus transfer	Pass	Used in Alternatives 1 and 2; refer to Table 5.
	GUIDED BUSWAY / BUSWAY ON Conrail		
20	One lane reversible bus only.	Bus	Used in Alternative 2; refer to Table 5.
21	Two lane, 2-direction bus only.	Fail	• Does not correspond to scale of the problem.
	TRAFFIC CALMING ON GEDDES/FULLER		
22	Close Geddes/Fuller or feeder streets to Geddes/Fuller.	Fail	• Does not increase corridor throughput; • Does not promote the use of or provide alternative modes of transportation; • Does not correspond to scale of the problem.
23	Geometric alterations (e.g., traffic circles, curved alignments).	Fail	• Does not increase corridor throughput; • Does not promote the use of or provide alternative modes of transportation; • Does not correspond to scale of the problem.
	INTERSECTION IMPROVEMENTS		
24	Signal optimization at Huron Parkway/Fuller, and any along Geddes/Fuller Corridor; potential progression along Geddes/Fuller, Dixboro, and Huron River Drive.	Pass	Used for Alternatives 3A, 3B, 5, and 6; refer to Table 5.

TABLE 4
SCREEN 1 ANALYSIS RESULTS (Continued)

No.	Alternative Strategy	Pass/Fail 1st Screening	Reason for Failure or Comment
25	Signalize existing non-signalized intersections at Glazier/Fuller, Huron Parkway/Glazier, and any required on Dixboro and Huron River Drive.	Pass	Used for Alternatives 3A, 3B, 5, and 6; refer to Table 5.
26	Lengthen or increase number of turn lanes (widening at intersections).	Pass	Used in combination with other strategies for Alternatives 3A, 3B, 5 and 6.
	BICYCLE FACILITIES		
27	Area-wide bicycle promotional program.	Pass	Used in Alternative 1; refer to Table 5.
28	Bicycle path identification, development, and implementation of bicycle plan.	Pass	Used in Alternative 1; refer to Table 5.
	PEDESTRIAN FACILITIES		
29	Area-wide pedestrian paths along Glazier/Fuller.	Pass	Used in Alternative 1; refer to Table 5.
30	Site-specific pedestrian movement strategies (e.g., shuttle bus, people mover, grade separations, covered walkways, etc.) for specific site.	Pass	Used in Alternative 2; refer to Table 5.
	III. INTELLIGENT VEHICLE-HIGHWAY SYSTEMS		
31	Traffic surveillance on Geddes/Fuller, Washtenaw, Plymouth, Dixboro, etc., with information dissemination.	Pass	Used in Alternative 4; refer to Table 5.
32	Use of changeable message signs with parking information, delays (to be placed along U.S. 23 and other specific sites).	Pass	Used in Alternative 4; refer to Table 5.
33	Use of Smart kiosks at U. of Michigan, VA Hospital, and at park-and-ride lots.	Pass	Used in Alternative 1 and 4; refer to Table 5.

TABLE 4
SCREEN 1 ANALYSIS RESULTS (Continued)

No.	Alternative Strategy	Pass/Fail 1st Screening	Reason for Failure or Comment
34	Use of Smart buses on Geddes/ Fuller, Washtenaw, Plymouth, and Conrail right-of-way.	Pass	Used in Alternative 1; refer to Table 5.
IV. DO NOTHING / NO BUILD			
35	Do nothing/no-build.	Fail	• Does not promote the use of or provide alternate modes of transportation; • Does not increase corridor throughput; • Not consistent with community goals and objectives.

Table 5
Universe of Strategies for Ann Arbor Alternatives

No.	STRATEGY	Alt.1 TDM/TSM	Alt. 2 1-Lane Busway	Alt.3A 1 HOV - CONRAIL	Alt.3B Toll SOV CONRAIL	Alt. 4 IVHS	Alt. 5 1-Lane HOV on G/F	Alt. 6 Improve G/F	Alt. 7 Widen G/F	Alt. 8 Do NOthing
(1)	1 Lane HOV, Toll SOVs				O					
(2)	2 Lane HOV, Toll SOVs									
(3)	Parking Mgmt. & Restrictions	O								
(4)	Route Diversions									
(5)	Rideshare	O								
(6)	1 Rev. HOV Lane in Med. on G/F						O			
(7)	1 HOV Lane per Dir. on G/F									
(8)	1 HOV Lane per Dir. on Huron Pkwy. w/ 1 Rev. HOV Lane in Med. on Glacier									
(9)	1 HOV Lane Rev. on Washtenaw					O				
(10A)	1 HOV Lane per Dir. on Plymouth					O				
(10B)	1 HOV Lane Rev. on Plymouth									
(11)	1 HOV Lane Rev. on Huron R. Dr.									
(12)	One Rev. HOV Lane on CONRAIL			O						
(13)	2 HOV Lanes on CONRAIL									
(14)	Increased Bus Freq. & Service	O								
(15)	Express Bus with Feeder Buses	O	O							
(16)	Bus Shelters	O								
(17)	Widen Roadway						O		O	
(18)	One-Way Pair (G/F/G)									
(19)	Park & Ride w/ Bus Transfer	O	O							
(20)	1 Lane Rev. Guided Busway		O							
(21)	2 Lane, 2-Dir. Guided Busway									
(22)	Turning Restrictions									
(23)	Geometric Alterations									
(24)	Signal Optimization / Progression			O	O		O	O		
(25)	Signalize Non-Sig. Intersections			O	O		O	O		
(26)	Turn Lanes, Channelize, Widen Intrsctns			O	O		O	O		
(27)	Bicycle Promotional Program	O								
(28)	Bicycle Path Delineation	O								
(29)	Ped. Sidewalks with Easment	O								
(30)	Ped. Movement Strategies		O							
(31)	Traffic Surveillance on G/F					O				
(32)	CMS with Parking Info along G/F					O				
(33)	Smart Kiosks	O				O				
(34)	Smart Buses on G/F	O								
(35)	Do Nothing									O

[unshaded box] = Passed First Screening
[shaded box] = Failed First Screening

O Indicates that the strategy is included with the alternative

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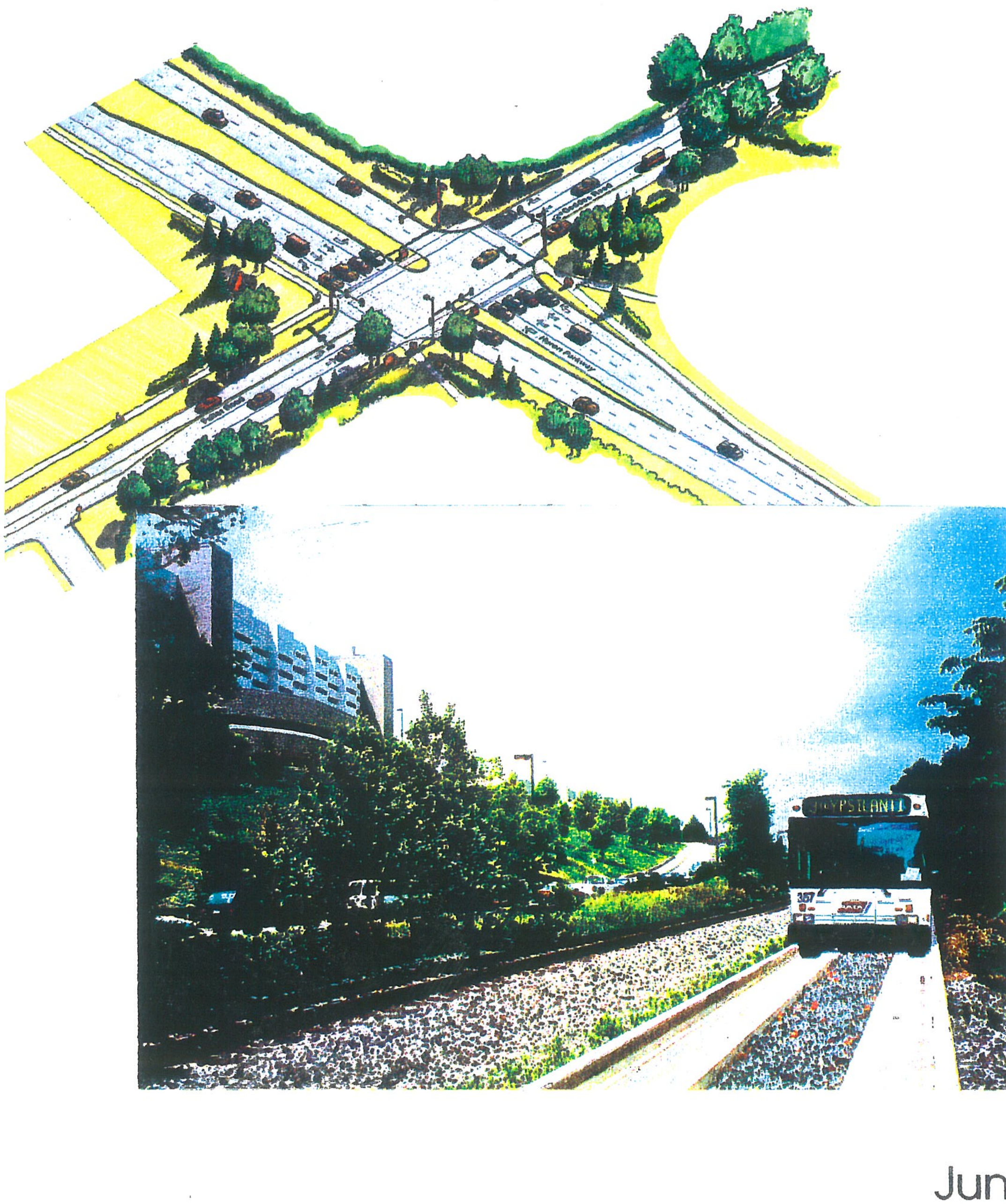

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SCREEN 2
MACRO LEVEL ANALYSIS

V. SCREEN 2 - MACRO LEVEL ANALYSIS

The surviving strategies of Screen 1 were combined into nine alternatives for evaluation in Screen 2. The Screen 2 evaluation is a more rigorous review where the alternatives are scored on their ability to meet the objectives of 11 macro level criteria. The nine alternatives, the 11 criteria and the surviving strategies are presented in this section.

SCREEN 2: ALTERNATIVES

The nine new alternatives to be reviewed in the second screening are as follows:

Alternative 1: TDM/TSM/Bus Applications

1.1 Potential for parking restrictions/management and increased parking costs at:

- University of Michigan (Central and North Campuses),
- VA Hospital, and
- Huron High School.

1.2 Preferential parking for HOV and flexible fuel vehicles

1.3 Increased bus frequency, express buses, feeder buses, redesign of bus schedules, and use of Smart Buses along the following corridors:

- Plymouth Road (Cherry Hill Road to Main Street),
- Washtenaw Avenue (Ypsilanti to Main Street), and
- Huron River Drive/Geddes/Fuller (Washtenaw Avenue to Huron Street).

1.4 Smart Buses, Smart Kiosks at bus shelters on Smart Bus corridors.

1.5 Park-and-Ride lots with bus transfer.

1.6 Employee RideShare Programs

1.7 Area-wide bicycle circulation system:

Bicycle promotion program, and
Bicycle path identification and development.

1.8 Area-wide and site specific pedestrian circulation system

Alternative 2: One-Lane Bus Guideway in Conrail Right-of-Way

NOTE: This alternative may be segmented.

2.1 One-lane reversible guided busway on Conrail right-of-way from Le Forge Road or U.S. 23 to Downtown.

2.2 Satellite park-and-ride lots near busway stations:

- Dixboro Road,
- McAuley Health Center, and
- Le Forge Road, Ypsilanti.

2.3 Feeder bus systems serving neighborhoods and park-and-ride lots, and using guideway for line-haul.

2.4 Pedestrian traffic enhancements that promote use of busway at University of Michigan, VA Hospital, McAuley, Washtenaw Community College, and E.M.U.

Note that the two-lane busway was not included in the Screen 2 analysis due to a fatal flaw in Screen 1.

Alternative 3A: One HOV-Lane in Conrail Right-of-Way

3A.1 One reversible HOV-lane on Conrail right-of-way from Dixboro Road to Fuller Road

3A.2 Traffic signal optimization at:

- Huron River Drive and Dixboro Road, and
- Geddes Road & Dixboro Road.

3A.3 Intersection improvements for the above intersections including:

- Lengthening turning lanes,
- Channelization, and
- Widening.

3A.4 Potential for additional traffic signals and progression along:

- Dixboro Road, and
- Huron River Drive.

Alternative 3B: One Lane, Toll SOVs; No Toll HOVs in Conrail Right-of-Way

3B.1 One lane, toll for single occupant vehicles (SOVs), no toll for high occupancy vehicles (HOVs) in Conrail right-of-way from Dixboro Road to Fuller Road

3B.2 Traffic signal improvements/optimization and intersection improvements at:

- Huron River Drive and Dixboro Road, and
- Geddes Road and Dixboro Road.

3B.3 Intersection improvements for the above intersections including:

- Lengthening turning lanes,
- Channelization, and
- Widening.

3B.4 Potential for additional traffic signals and progression along:

- Dixboro Road, and
- Huron River Drive.

Alternative 4: IVHS Applications

4.1 Traffic surveillance and information dissemination for:

- Geddes/Fuller,
- Huron Parkway,
- Washtenaw Avenue,
- Plymouth Road,
- University of Michigan (Central and North Campuses), and
- VA Hospital.

4.2 Smart Kiosks at:

- University of Michigan (Central and North Campuses),
- VA Hospital, and
- Other.

4.3 HOV lanes:

- One lane per direction on Plymouth Road, and
- One reversible lane in median on Washtenaw.

4.4 Changeable Message Signs (CMS) for traffic condition information at:

- U.S. 23,
- Geddes Road and Dixboro,
- Geddes Road and Huron Parkway, and
- University of Michigan.

4.5 CMS for parking conditions information at:

- University of Michigan (Central and North Campuses), and
- VA Hospital.

Alternative 5: One HOV-Lane on Geddes/Fuller

5.1 One reversible HOV lane in median of Geddes/Fuller between Dixboro Road and Downtown.

5.2 Roadway improvements to accommodate bus and carpool passenger loading and unloading along Geddes/Fuller.

5.3 Potential for additional traffic signals, optimization and progression at the following intersections to accommodate HOV movement:

- Geddes Road and Earhart Road,
- Fuller Road and Huron Parkway,
- Fuller Road and Oak Way,
- Fuller Road and Glazier, and
- Fuller Road and Medical Center Drive

5.4 Intersection improvements including:

- Lengthening turning lanes,
- Channelization, and
- Widening.

Alternative 6: Improvements of Geddes/Fuller

6.1 Potential for additional traffic signal optimization, phasing plans, and progression.

6.2 Potential for additional traffic signals, optimization and progression at the following intersections to accommodate traffic movement:

- Geddes Road and Earhart Road,
- Fuller Road and Huron Parkway,

- Fuller Road and Glazier,
- Fuller Road and Medical Center Drive,
- Huron Parkway and Huron River Drive, and
- Other.

6.3 Intersection improvements including:

- Lengthening turning lanes,
- Channelization, and
- Widening.

Alternative 7: Roadway Widening of Geddes/Fuller

7.1 Add one lane per direction along Geddes/Fuller between Dixboro Road and Main Street.

Alternative 8: Do Nothing

8.1 Do nothing. Leave the transportation system as it exists.

SCREEN 2: MACRO LEVEL CRITERIA

The second screening of alternatives focused on three categories of macro-level criteria. These categories were further divided into 11 subcategories in order to include the committee's established goals and objectives:

Use and Ridership:

1. Minimize residential accessibility impacts,
2. Maximize accessibility to commercial, office and industrial areas,
3. Maximize accessibility to universities, schools, and medical centers,
4. Complement existing and future parks and recreational areas,
5. Promote use of carpools and vanpools,
6. Promote use of bus and transit systems;

Environmental Issues:

7. Minimize adjacent land use impacts,
8. Minimize wetland impacts, and
9. Minimize visual impacts;

Cost Considerations:

10. Keep costs within available public funds, and
11. Promote private sector participation.

The nine alternatives were evaluated against the 11 criteria using a weighted approach. Alternatives were given a rating of High, Moderate, or Low for each criterion. The ratings carried a point value as follows:

High	=	5 points,
Moderate	=	3 points, and
Low	=	1 point.

For every alternative, the sum scores of the criteria were then divided by the highest possible score (5 points x 11 criteria = 55 possible points) and multiplied by 100. This measure provides an indication of the percentage of the highest possible score provided by each alternative. Thus, a score of 100 indicates that an evaluation of each criterion resulted in a "High" weighted score, i.e., 5 points. Scores less than 100 indicate that one or more weighted scores were less than the desired ("High") score for the given alternative. Brief descriptions of each criterion are presented below.

Use/Ridership

Minimize Residential Accessibility Impacts: An acceptable alternative must maintain existing access to residential areas without promoting potentially unsafe vehicle/pedestrian exposure. This criterion focuses on maintaining safe residential areas with acceptable access from these areas to roadway thoroughfares, while limiting the number of vehicles that operate unnecessarily on local streets.

Maximize Accessibility to Commercial, Office and Industrial Areas: Commercial, office and industrial areas need an efficient and effective transportation system to enhance their profitability. Access to these facilities must be easily understood and safely executable by both familiar and unfamiliar drivers. An acceptable alternative must complement a street network which allows the greatest mobility and appropriate access to commercial, office and industrial properties.

Maximize Accessibility to Universities, Schools, and Medical Centers: Perhaps the greatest portion of trips taken in Ann Arbor are trips to public and semi-public institutions. Due to the "peaking" nature of trips servicing these areas, the roadway network may occasionally be unable to accommodate the travel demand, resulting in traffic congestion. An acceptable alternative must be able to accommodate peak levels of travel demand.

Complement Parks and Recreational Areas: The proximity of parks and recreational areas to primary activity and residential areas is important to the Ann Arbor community. The chosen alternative should complement and enhance the accessibility of these areas without adversely impacting park and recreational purposes.

Promote Use of Alternative Transportation Modes: This criterion measures the potential to increase ridership on alternative modes of transportation. This criterion is further subdivided into transit use and participation in carpools and vanpools.

Environmental Issues

Minimize Adjacent Land Use Impacts: Some land uses are more sensitive to traffic than others. For example, single-family residential neighborhoods and parks are more severely impacted by vehicular traffic than are commercial districts or industrial developments. The recommended alternative should minimize impacts on sensitive land uses.

Minimize Impacts on Wetlands and Wooded Areas: The study area includes extensive wetlands and wooded areas. The wetlands and wooded areas should be preserved and protected because they contribute significantly to Ann Arbor's high quality of life and provide habitat for wildlife.

Minimize Visual Impacts: The Huron River valley is a key natural and visual amenity in Ann Arbor. The river, the ponds, the parks, and the adjacent wooded slopes offer an environment for relaxation and recreation, and provide many excellent views and vistas along the river corridor. The recommended alternative should avoid negative visual impacts and, if possible, provide opportunities for enhancing the visual environment.

Cost Considerations

Minimize Costs: Costs must be kept within limits of available public funds. Although an alternative may be more attractive because of public perception or other reasons, available funding is also an important factor.

Promote Private Participation: This criterion parallels the objective to provide opportunities for private investment into the chosen alternative.

SCREEN 2: RESULTS

The Screen 2 evaluation produced scores ranging from 63.6 percent to 34.5 percent with an average score of 51.9 percent. Alternative 1, Travel Demand Management, scored highest with 63.6 percent. Alternative 8, Do Nothing, received the lowest score of 34.5 percent. Table 6 presents the details of this compilation.

It is clear from the results of Screen 2 that no alternative alone can remedy the rising congestion levels in the Geddes/Fuller Corridor. However, a combination of two or more of these alternatives into a single option may provide acceptable results. Additional bus service is recommended for every alternative--even with the Do Nothing alternative in order to accommodate a "status quo" proportion of transit trips given forecasted trips. Results indicate that the existing transit system is reaching capacity, particularly in the peak periods. Discussions of each alternative with respect to the evaluation criteria follow.

Alternative 1: Travel Demand Management (TDM)/ Transportation System Management (TSM)

Alternative 1 received the highest score of all alternatives considered (63.6 percent). Only one "Low" rating was found under the criterion, Promote Private Funding Participation. This rating occurred because it promotes multiple-occupancy modes of transportation and most of the elements of these actions are publicly funded.

This alternative is attractive for several reasons. First, Travel Demand Management (TDM) strategies focus on reducing and limiting the demand of travelers to utilize transportation facilities within the same time period. Consequently, TDM strategies do not include construction of new roadways or widening of existing streets, but rather attempt to spread the travel demand over time. In this way, the existing roadway network can accommodate the travel demand placed upon it, rather than experiencing periods of severe congestion or "grid lock" which harm air quality and add to traffic delay. This aspect of TDM also protects adjacent land uses because efforts focus on optimizing the existing transportation system instead of expanding it.

Second, a fundamental principle of TDM is to promote use of multi-occupancy transportation modes. By increasing the number of travelers per vehicle, vehicle demand decreases while passenger throughput increases. This precept is completely in harmony with the goals and objectives set by both committees. Use of other non-SOV travel modes, such as bicycling and walking, can also complement local park and recreational areas.

Table 6
Screen 2 Analysis Results

Alternative	EVALUATION CRITERIA: Minimize Residential Accessibility Impacts	Maximize Accessibility to Commercial, Office, & Industrial Areas	Maximize Accessibility to Universities, Schools, & Med. Cntrs.	Complement Park & Recreational Areas	Promote Use of Alternative Transportation Modes: Carpools & Vanpools	Promote Use of Alternative Transportation Modes: Bus/Transit	Minimize Adjacent Land Use Impacts	Minimize Impacts on on Wetlands & Wooded Areas	Minimize Visual Impacts	Minimize Capital Costs	Promote Private Funding Participation	Unresolved Issues	Score 100 Max.
1 TDM/TSM	**Moderate** Impacts likely adjacent to parking management areas	**Moderate** Increased flow, but potential to walk farther	**Moderate** Better for multi-occ. modes, same or worse for SOV	**High** Promotes non-SOV transportation modes	**Moderate** Carpool incentives, but no travel time savings	**Moderate** Additional transit service, but no travel time savings	**Moderate** Adds bus traffic on Geddes/ Fuller	**High** No Impacts	**Moderate** No impacts, but also no enhancement opportunities	**Moderate** $ 3.8 M	**Low** Mostly publicly funded strategies	Type of P&R Facilities	**63.6**
2 1-Lane Busway on CONRAIL	**High** No impacts	**Low** Limited to partial corridor access only	**Moderate** Better for multi-occupancy transportation modes	**Moderate** Additional bus traffic may have an impact	**Low** No incentives	**High** Additional transit service & significant time savings	**Low** Has greatest impact on residential uses	**High** No Impacts	**Low** Low, if barrier is required	**Low** $ 15.1 M	**Moderate** Potential for advertising and private investment	CONRAIL ROW, Barrier Req'mts	**52.7**
3A 1 HOV Lane on CONRAIL	**High** Better intersections and signalization keeps traffic off res. strts.	**Low** Limited to partial corridor access only	**Moderate** Service of HOV limited by CONRAIL r.o.w.	**Moderate** Additional traffic may have an impact	**High** Carpool incentives and some travel time savings	**Moderate** Additional transit service and some travel time savings	**Low** Has greatest impact on residential uses	**High** No Impacts	**Low** Low, if barrier is required	**Low** $ 8.6 M	**Low** Typically strictly publicly funded strategies	CONRAIL ROW, Barrier Req'mts	**52.7**
3B Toll SOV on CONRAIL	**High** Better intersections and signalization keeps traffic off res. strts.	**Low** Limited to partial corridor access only	**Moderate** Service of HOV limited by CONRAIL r.o.w.	**Moderate** Additional traffic may have an impact	**High** Carpool incentives and some travel time savings	**Moderate** Additional transit service and some travel time savings	**Low** Has greatest impact on residential uses	**High** No Impacts	**Low** Low, if barrier is required	**Low** $ 8.7 M	**Moderate** Tolls may generate private interest	CONRAIL ROW, Barrier Req'mts	**56.4**
4 IVHS Technology	**High** Improved trip quality focuses on primary corridors only	**Moderate** Potential to coordinate IVHS with these areas	**High** IVHS targeted at these areas	**High** Traffic directed away from G/F corridor	**Low** No incentives	**Low** No incentives or additional service	**Low** Widening of Washtenaw Avenue	**High** No Impacts	**Moderate** Provides opportunities to enhance Washtenaw corridor	**Low** $ 10.1 M HOV Lanes increase cost	**Moderate** IVHS vendors likely to offer promotional products	ROW Req'mts	**60.0**
5 1-HOV Lane on G / F	**Moderate** Added difficulty accessing area across HOV lane	**High** Downtown areas benefit most	**High** Locations serviced by HOV lanes benefit most	**Low** Widening G/F for HOV requires acquisition of adjacent land	**High** Carpool incentives and some travel time savings	**Moderate** Additional transit service and some travel time savings	**Low** Impacts some residential areas along Geddes/ Fuller	**Moderate** Some impacts	**Moderate** Potential to enhance the Geddes/Fuller corridor	**Low** $ 6.8 M	**Low** Typically strictly publicly funded strategies	ROW Req'mts	**56.4**
6 Intersection Improvemnts on G / F	**Moderate** Impacts on adjacent properties likely due to higher volumes	**Moderate** Areas adjacent to improved areas benefit most	**Moderate** Areas adjacent to improved areas benefit most	**Moderate** Potential for "smoother" traffic flow in G/F corridor	**Low** No incentives	**Low** No incentives or additional service	**Moderate** Traffic impacts on Geddes/ Fuller	**High** Minimal impacts	**Moderate** Potential to enhance the Geddes/Fuller corridor	**High** $ 2.6 M	**Low** Typically strictly publicly funded strategies	ROW Req'mts	**56.4**
7 Widen G / F Roadway	**Moderate** Impacts to residents upon accessing wider roadway	**Moderate** Areas adjacent to improved areas benefit most	**High** Many of these areas lie on Geddes/Fuller	**Low** Widening G/F requires acquisition of adjacent land	**Low** No incentives	**Low** No incentives or additional service	**Low** Considerable impacts on residential and institutional uses	**Low** Considerable impacts	**Low** Wider pavement	**Low** $ 7.7 M	**Low** Typically strictly publicly funded strategies	ROW Req'mts	**34.5**
8 Do Nothing	**Low** People likely to find short cuts thru res. areas due to traffic	**Low** Congestion likely to make accessibility worse	**Low** Congestion likely to make accessibility worse	**Low** Congestion likely to worsten	**Low** No incentives	**Low** No incentives or additional service	**Low** Traffic impacts on Geddes/Fuller	**High** No impacts	**Low** Increased congestion	**High** $ 1.9 M (Increased transit service as pop. growth mitigation)	**Low** Does not apply		**34.5**

Finally, TDM increases accessibility to key trip generator areas system-wide. An effective TDM program implemented in the Geddes/Fuller Corridor can lessen congestion on Dixboro Road, Huron River Drive, and at large employment centers such as the University of Michigan and VA Hospital.

Transportation System Management (TSM) strategies focus on providing additional capacity to the existing transportation network. For this alternative, additional bus service, improving traffic operations, and widening and providing new bicycle and pedestrian facilities are examples of TSM. TSM may also include parking management, particularly at key trip generators such as the University of Michigan and VA Hospital. Combined, TDM and TSM can provide relatively low cost alternatives for alleviating traffic congestion.

Alternative 2:
One-Lane Busway on Conrail

This alternative received a score of 52.7 percent. The primary advantages of a one-lane bus guideway on Conrail are:

- No impacts on residential accessibility,
- Promotes use of transit,
- Provides a significant time savings for its users,
- Will not impact existing wetlands and wooded areas, and
- Has a potential for private funding participation.

This alternative provides an attractive means to draw single-occupant drivers away from their vehicles. The bus guideway will enhance the image of Ann Arbor and become a trademark of the city. Reduced vehicle demand in the Geddes/Fuller corridor is also expected.

Two shortcomings of the bus guideway idea include:

- Direct access to commercial, office, and industrial lands is somewhat limited to the Conrail corridor; and
- The bus guideway does not promote carpooling or vanpooling, therefore, the reduced vehicle travel is limited to the capacity of the buses operating on the bus guideway.

Alternative 3A:
One-HOV Lane on Conrail

This alternative also received a score of 52.7 percent. Reasons for this score are as follows:

- Direct access to commercial, office, and industrial lands is limited

to the Conrail corridor;
- Residential areas would be affected negatively by increased traffic in the Conrail corridor;
- A physical barrier would be required which detracts from the natural beauty of the corridor;
- There is little or no opportunity for private funding participation.

Safety issues in the Conrail corridor are also of major concern. Conrail has indicated that they support use of passenger rail operations on their lines provided that their rail freight operations remain unchanged in terms of safety, liability, or service to their customers. Conrail is very strict with this policy. Use of a HOV facility in the Conrail right-of-way is perhaps a separate (and unaddressed) issue at this time, because HOVs are definitely not considered passenger rail.

There are several advantages to this alternative:

- Traffic is deferred from the local (residential) street network in areas not surrounding Conrail corridor, producing fewer vehicle/pedestrian conflicts;
- HOV lanes provide high incentive to carpool and vanpool, and commonly support improved transit operations; and
- Reduced vehicles on the roadway improve environmental quality of the area.

These advantages support the goals and objectives set by the committees.

Alternative 3B:
One HOV Lane, Toll SOVs on Conrail

This alternative received a score of 56.4 percent, slightly higher than Alternatives 2 and 3A. The evaluation of this alternative led to identical results for all but one of the evaluation criteria--Promote Private Funding Opportunities. Therefore, the discussion under Alternative 3A also applies here. The difference between these two alternatives is that toll roads provide additional revenues that can be used for roadway maintenance and transit subsidies. Under favorable circumstances, private contractors will construct and manage this type of facility, and may provide portions of funding to get the project moving.

Alternative 4:
IVHS Technology

Use of IVHS technology received a score of 60.0 percent. The major advantages of IVHS technology are as follows:

- Travel enhancements are focused predominantly on primary travel

corridors, thus, traffic is led to roadways most capable of handling the travel demand. Likewise, traffic can be diverted from one corridor to another using this technology; and
- High trip generating facilities can be integrated into an area wide IVHS plan, which reduces severity of peak period travel for those sites and the transportation network as a whole.

A disadvantage of many IVHS technologies is that they provide SOVs with real-time information which can make their trips more convenient and faster. Consequently, there is little or no incentive to carpool, vanpool, or use transit, especially if the single-occupant driver purchased the means to receive that information. Other IVHS technologies focus only on improving transit ridership and other multi-occupancy travel modes. Use of these types of technologies are better suited to Ann Arbor's community goals.

Presently, cost is the greatest drawback for IVHS technologies. Real-time traffic data collection, reduction, analysis, and transfer to the user requires an extensive infrastructure and communications system. To date, the most reliable means of data collection and transfer utilize buried cable that connect traffic monitoring devices in the field to a central traffic management center. Implementation of both is costly (estimated as just under $4 million in this screening) for the Geddes/Fuller corridor, Plymouth Road, and Washtenaw Avenue.

Alternative 5:
One HOV Lane on Geddes/Fuller

This alternative received a score of 56.4 percent. The major advantages of this alternative are:

- Passengers of high-occupancy vehicles (including transit) receive a significant travel time savings, particularly in the peak hours;
- Potential for carpools, vanpools and transit use is high; and
- Areas connected by the HOV facility benefit with better access.

This alternative requires that a HOV-lane be constructed, which mandates widening of the Geddes/Fuller roadway. Right-of-way costs not included in this analysis also would likely be high. The potential for private funding participation is unlikely for this type of facility.

Alternative 6:
Intersection Improvements on Geddes/Fuller

This alternative received a score of 56.4 percent. The alternative alone does little to promote use of multi-occupancy modes of transportation, but can significantly improve the vehicle carrying capacity of the corridor.

Intersection improvements include changing signal timing, widening streets by providing additional turning lanes, lengthening turning bays and improving signing and striping. This alternative may be best utilized in conjunction with other alternatives in the Geddes/Fuller corridor.

Alternative 7:
Widen Geddes/Fuller Roadway

This alternative received a low score of 34.5 percent. Widening the roadway from two lanes to four lanes definitely provides sufficient capacity to accommodate present and some (not all) forecasted travel demand and would lessen congestion in the corridor. However, this alternative violates several community goals and objectives. On this premise, widening the roadway is not acceptable because widening:

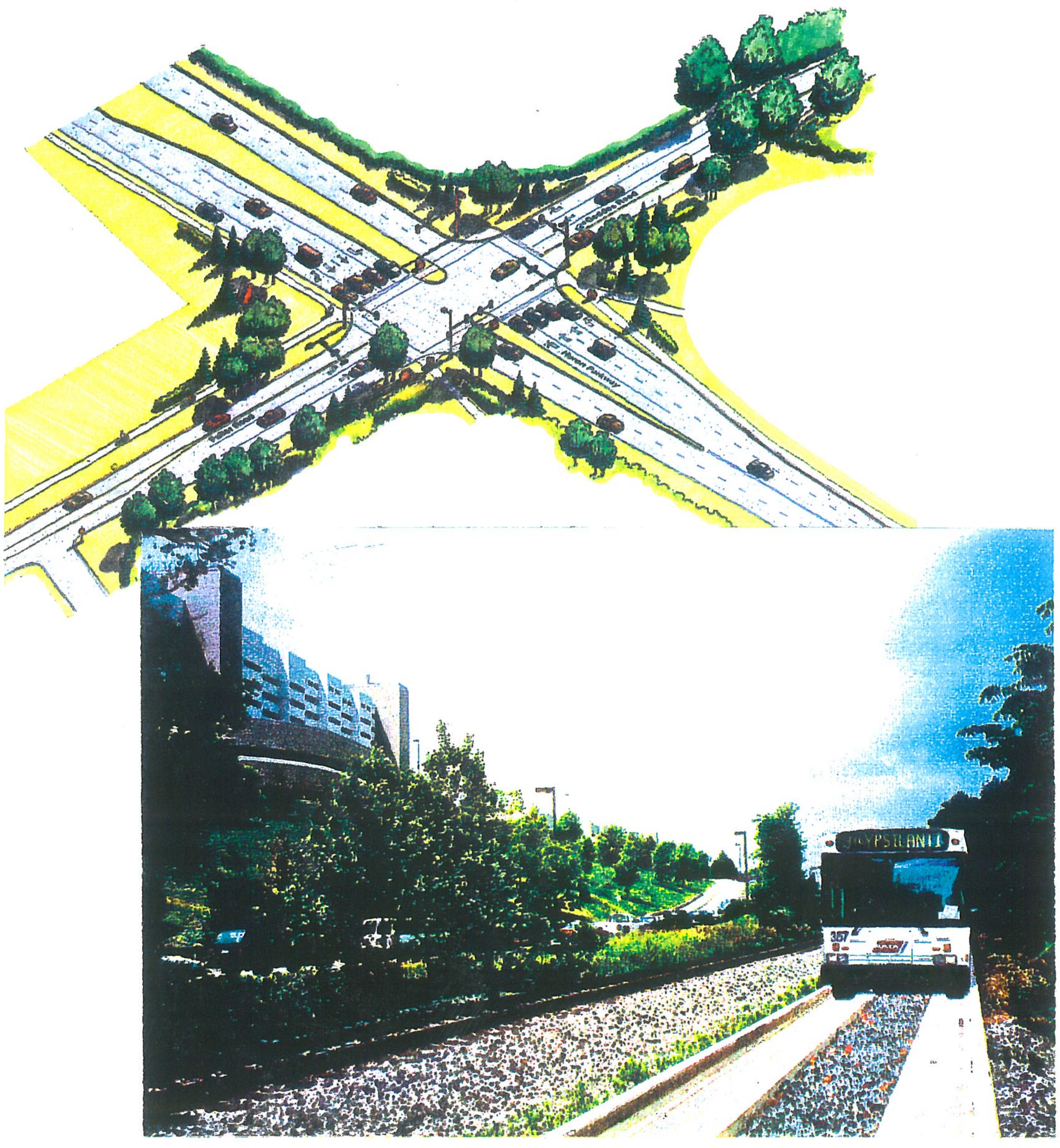
- Does not complement park and recreational areas,
- Does not provide incentives to carpool, vanpool, or use transit,
- Negatively impacts adjacent land uses (particularly residential areas),
- Has the greatest impacts on wetlands and wooded areas,
- Does not provide opportunity for private funding, and
- Right-of-way issues further complicate possible implementation of this alternative.

Alternative 8:
Do Nothing

This alternative also received a low score of 34.5 percent. Evaluation of this alternative confirms that something must be done to remedy increasing congestion in the Geddes/Fuller Corridor.

Geddes/Fuller/Conrail

Corridor Study



June 1994

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Screen 3
Micro Level Analysis

VI. SCREEN 3 - MICRO LEVEL ANALYSIS

The final and most rigorous analysis of alternatives occurs in Screen 3. The nine alternatives considered in Screen 2 were reviewed and the most promising strategies combined into three new alternatives. The alternatives of widening Geddes/Fuller and doing nothing are carried through for comparative purposes. These alternatives are subjected to 17 micro level criteria that consider costs and benefits. The results of this analysis are presented for each strategy and alternative grouping.

SCREEN 3: ALTERNATIVES

The analysis from the Screen 2 evaluation indicated that there were several key elements throughout the first seven alternatives that warranted further review. These key elements were combined into three new alternatives, named Alternatives A, B and C for clarity and distinction from the previous alternatives. These three new alternatives formed a progression whereby Alternative A formed the basis for Alternative B, and Alternative B formed the basis for Alternative C.

The core of this progression, Alternative A, includes elements from the previous Alternative 1 which uses Travel Demand Management and Transportation System Management strategies. Alternatives 7 and 8 which were a widening of Geddes/Fuller and Do-Nothing respectively, were carried over as Alternatives D and E for comparison purposes only. A representation of these alternatives is shown in Figure 6. A description of these surviving alternatives is presented below.

Alternative A:
Travel Demand Management, Transportation System Management, and Bus Improvements

TDM strategies attempt to either reduce travel demand by spreading the peak travel out over time and/or promote multiple-occupancy modes of transportation. TSM focuses on affecting system capacity by either constructing new facilities, or by eliminating facilities to deter unnecessary travel. Bus improvements include increased frequency, more express service, and feeder buses to park-and-ride lots.

The specific strategies used in Alternative A and previously reviewed in Screens 1 and 2 are:

- Parking management at key locations along the Geddes/Fuller corridor,
- Increased transit service frequency,
- Smart buses and kiosks,
- Park & Ride with bus transfer,
- Employee RideShare incentive programs,
- Area bicycle circulation program,
- Pedestrian circulation system,
- IVHS - Advanced Traffic Management System with traffic surveillance,
- IVHS - Advanced Traveler Information System with transit information,
- IVHS - Changeable Message Signs with traffic and parking information,
- Traffic signal optimization, phasing, and progression,
- Intersection improvements

Alternative B:
Bus Guideway on Conrail

The second alternative includes all of the strategies of Alternative A plus the following:

- One-lane bus guideway in Conrail right-of-way
- Satellite park-and-ride near stations
- Feeder buses to park-and-rides and stations
- Pedestrian traffic enhancements

The Conrail right-of-way is an excellent resource for placement of a guided busway because acquisition of additional land is not likely--the bus guideway can coexist along side the existing railroad track.

Satellite park-and-ride lots near the proposed busway stations are also included in this alternative. Additional "feeder" buses that serve neighborhoods would join the guideway at the station locations. Pedestrian enhancements would also be made around station sites. Potential station locations include the McAuley Health Center, Dixboro Road, U.S. 23, and the University of Michigan.

Alternative C:
Extend HOV-Lane on Fuller to Huron Parkway

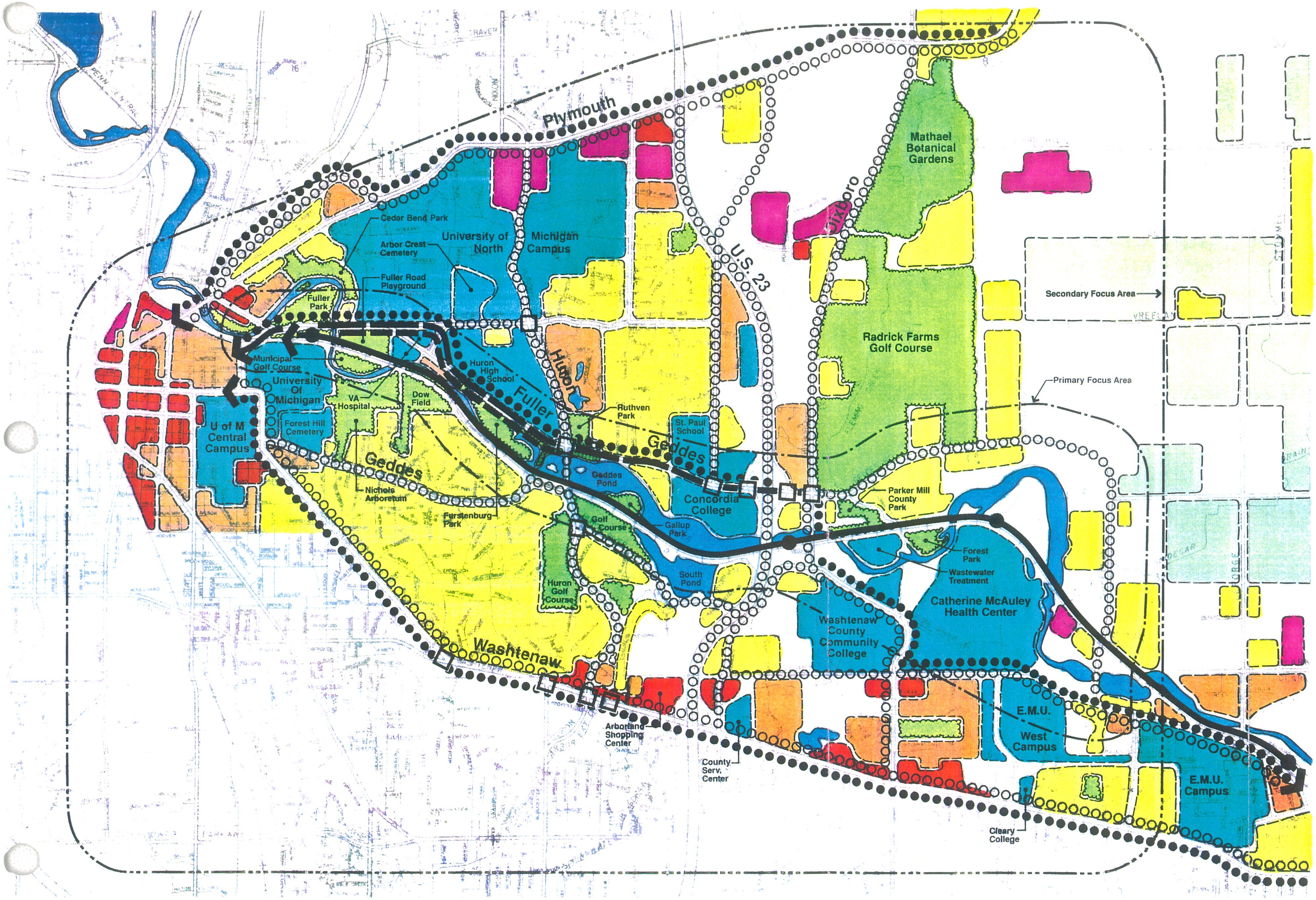
Alternative C includes all of Alternatives A and B, and adds an extension of the existing HOV lane to Huron Parkway. This alternative serves to further promote use of high-occupancy vehicles by providing a reserved lane for such vehicles during the peak hours.

Alternative D:
Widen Geddes/Fuller to Four Lanes

This alternative is independent of the other alternatives.

Alternative E:
Do Nothing

This alternative is independent of the other alternatives.



Existing Land Use

- Residential Low-Density
- Residential High-Density
- Commercial/Office
- Industrial
- Public/Semi-Public
- Parks/Recreational Open Space
- Agricultural

Alternatives Resulting From Screen 2

Alternative A	TDM/TSM	
	IVHS	
	Intersection Improvements on Geddes, Fuller, Huron Parkway and Washtenaw	
Alternative B	Above Items Plus: Guided Busway (LeForge Road to Downtown Ann Arbor)	Station
Alternative C	Above Items Plus: HOV on Fuller Road (Huron Parkway to Current HOV)	
Alternative D	Widen Geddes/Fuller to 4 Lanes (For Comparative Purposes Only)	
Alternative E	Do Nothing (For Comparative Purposes Only)	

Figure 6
November 24, 1993
Revised: February 14, 1994

Geddes/Fuller/CONRAIL Corridor Study

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The specific strategies used in Alternative A and previously reviewed in Screens 1 and 2 are:

- Parking management at key locations along the Geddes/Fuller corridor,
- Increased transit service frequency,
- Smart buses and kiosks,
- Park & Ride with bus transfer,
- Employee RideShare incentive programs,
- Area bicycle circulation program,
- Pedestrian circulation system,
- IVHS - Advanced Traffic Management System with traffic surveillance,
- IVHS - Advanced Traveler Information System with transit information,
- IVHS - Changeable Message Signs with traffic and parking information,
- Traffic signal optimization, phasing, and progression,
- Intersection improvements

Alternative B:
Bus Guideway on Conrail

The second alternative includes all of the strategies of Alternative A plus the following:

- One-lane bus guideway in Conrail right-of-way
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The Conrail right-of-way is an excellent resource for placement of a guided busway because acquisition of additional land is not likely--the bus guideway can coexist along side the existing railroad track.

Satellite park-and-ride lots near the proposed busway stations are also included in this alternative. Additional "feeder" buses that serve neighborhoods would join the guideway at the station locations. Pedestrian enhancements would also be made around station sites. Potential station locations include the McAuley Health Center, Dixboro Road, U.S. 23, and the University of Michigan.

Alternative C:
Extend HOV-Lane on Fuller to Huron Parkway

Alternative C includes all of Alternatives A and B, and adds an extension of the existing HOV lane to Huron Parkway. This alternative serves to further promote use of high-occupancy vehicles by providing a reserved lane for such vehicles during the peak hours.

Alternative D:
Widen Geddes/Fuller to Four Lanes

This alternative was included for comparative purposes only.

Alternative E:
Do Nothing

This alternative was included for comparative purposes only.

SCREEN 3: MICRO LEVEL CRITERIA

The third and final screen was a rigorous evaluation of the strategies of Alternatives A-E against 17 micro-level criteria. These criteria included:

1. Desirable person and vehicle throughput,
2. Ridership,
3. Travel time savings,
4. Proximity to congested roadways,
5. Consistency with transportation plan,
6. Safety,
7. Right-of-way requirements,
8. Air quality,
9. Noise Impacts,
10. Wetlands, woodlands, and other natural features,
11. Impact on side slopes,
12. Existing traffic level of service,
13. Reverse commuter trips,
14. Visual and enhancement opportunities,
15. Capital costs,
16. Operating and maintenance costs, and
17. Cost-effectiveness.

The evaluation process reviewed each strategy in the five alternatives against each of the 17 criteria. Strategies were given scores for each criteria in the range of -5 and +5. A negative score indicated that the strategy will likely adversely affect the criterion with respect to the study's goals and objectives. Conversely, positive scores indicated desirable impacts and work toward achieving the goals and objectives. Scores were weighted to reflect the relative magnitudes of expected impacts (e.g., a +5 indicated very positive impacts and a +2 only moderate positive effects). Scores were then summed by alternative to determine that alternative's overall rating. All criteria were assumed equally important in this final evaluation. Cost-related criteria (numbered 15-17 above) were considered separately.

Brief descriptions of each criterion and how they were used in the evaluation are presented in the following sections.

1. Desirable Person and Vehicle Throughput

Both the Citizens' Advisory Committee and the Steering Committee desire to increase person throughput in the corridor without increasing the vehicle throughput, or to promote use of high-occupancy transportation modes. Theory behind this measure assumes that the same number of person trips can be serviced with fewer vehicles given that those person trips are made in high-occupancy vehicles. This objective equates to moving people, and not just vehicles.

For each strategy, person throughput was estimated by first estimating vehicle reduction in the corridor, and then multiplying this reduction by the average vehicle occupancy rate. In some cases the occupancy rate was also adjusted to account for the impacts a strategy would potentially have on vehicle occupancy.

Actual vehicle occupancies were recorded at four different locations during October of 1993:

- Plymouth Road and Nixon Road,
- Glazier Way and Fuller Road,
- Geddes Road and Earhart Road, and
- Washtenaw Avenue and Pittsfield Road.

Table 7 lists the observed vehicle occupancy rates for these sites. The occupancy rates vary per site and reflect only one day's data collection, so the average occupancy was estimated at 1.10 and used for a general value applicable to both study areas.

TABLE 7
VEHICLE OCCUPANCY RATES

SITE	VEHICLE OCCUPANCY
Plymouth Road and Nixon	1.09
Glazier Way and Fuller Road	1.10
Geddes Road and Earhart Road	1.16
Washtenaw Avenue and Pittsfield Road	1.09
Average Overall	1.10

2. Ridership

The procedure used to forecast transit ridership impacts due to potential transit improvements is presented here. People making trips in the Geddes/Fuller corridor have three primary travel modes to choose from:

Automobile, including

- Single-occupant vehicles, and
- Multiple-occupant vehicles (e.g., carpools, vanpools);

Transit (e.g., bus); and

Non-motorized travel, including

- Walking or jogging, and
- Bicycling.

Travel mode choices are made based upon how well a particular travel mode compares with the traveler's transportation needs and desires. When changes are made to an existing transportation system, a traveler's mode choices can also change. Getting people to change their travel mode is an underlying objective of the Geddes/Fuller Corridor Study. The increased use of multi-occupancy transportation modes such as transit is particularly emphasized.

Forecasting changes in transit ridership is dependent not only upon how well transit itself can satisfy the needs of the traveler, but also how well other modes fill these needs. One way of measuring how well a travel mode fills, or does not fill, the needs of travelers is to determine how costly or inconvenient a trip with that mode can be. A measure used to estimate the cost and inconveniences of a trip is known as "disutility[1]." This measure is defined for transit as follows:

Disutility =

Automobile Riding Time	+
Transit Riding Time * Transit Riding Weight	+
Walking Time * Walking Weight	+
Waiting Time * Waiting Weight	+
Transfer Time * Transfer Weight	+
Initial Wait Penalty	+
First Transfer Penalty	+
Second Transfer Penalty	+
Fare - Value of Time	+
(Tolls + Parking + Veh Op Costs) Value of Time	+
Vehicle Operating Costs - Value of Time	+
Vehicle Ownership Costs - Value of Time	

The transit disutility equation above appears complex, but in reality consists of two elements:

1. The time required to get from origin to destination including walking, waiting, and riding times; and

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[1] Beimborn, E. and Horowitz, A. *Measurement of Transit Benefits, Final Report.* Center of Urban Transportation Studies, University of Wisconsin-Milwaukee, June 1993. Prepared for University Research and Training Program, Office of Technical Assistance and Safety, Urban Mass Transportation Administration, Washington, D.C., DOT-T-93-33.

2. Costs for the trip (converted into time).

Higher disutility values indicate a lessened desirability for travelers to use that alternate travel mode. An underlying assumption of transit disutility is that travelers will always choose the fastest and least expensive transit option.

Disutilities for automobile usage and non-motorized travel can also be estimated by the same equation, although only after omitting terms that do not apply to that mode. For example, a bicyclist would not have transfer time to consider as part of the trip. Given that the largest percentage of trips in the corridor are taken by auto, it is reasonable to assume that the disutility for automobile travel is less than the disutility for transit and non-motorized modes. Consequently, commuters will choose the automobile over transit or bicycle use because driving imposes the least cost and inconvenience.

Disutility is only one variable of a three-part model. Mode choice may be compared to an economic surplus analysis. In economics, if a particular good is priced below consumers' willingness to pay for that good, then people will use that product and the product will sell. Similarly, if the willingness to pay disutility for transit (in time units) exceeds the actual disutility for that transit trip, a portion of the travelers will choose transit. Willingness to pay, disutility, and disutility surplus are related as follows:

Disutility Surplus = Willingness to Pay - Disutility

Disutility surplus is a measure indicating an attractiveness to a particular travel mode. When comparing alternative travel modes, the mode with the highest disutility surplus is less likely to lose use given a change in the present transportation system.

For example, suppose auto usage has a disutility surplus of 100 minutes compared to a disutility surplus of 20 minutes for transit use. If as part of a TDM/TSM plan, suppose that transit service is doubled without increasing transit fares, and parking costs for autos are also doubled. Doubling transit service will likely generate more transit rides; however, the disutility surplus (20 minutes) remains the same. Doubling parking costs for autos may reduce the surplus for automobile usage from 100 minutes to say 60 minutes, but because the surplus for automobiles is still higher than that of transit, it is unlikely that many people will choose to switch modes from their cars to transit. Because people are willing to pay more for automobile usage than for transit and because the disutility for autos is less than transit, attracting transit ridership from the dominant automobile-user population is difficult.

The number of trips taken by car, transit and non-motorized travel are estimated using the logit model. The logit model uses disutility measures to predict the probability of commuters in the Geddes/Fuller corridor to select a particular transportation mode. The probability values for each mode's share of trips are expressed as percentages; the sum of all mode percentages will equal 1.0, or 100 percent. These percentages can then be multiplied by the forecasted number of trips, yielding an estimated number of trips by mode choice in the corridor.

As a final step, disutility surplus, expressed as a percentage of the sum total disutility surplus generated by the three travel modes considered, was multiplied by the forecasted ridership change. This final value was accepted as the expected ridership impact given potential changes in transit service.

The disutility procedure presented above is especially applicable to long-term planning (periods greater than five years). Use of elasticity measures is more appropriate for short-term planning and was used to estimate transit ridership in the near future of five years. Elasticity is a measure of the sensitivity of travel demand to changes in system conditions. Demand is said to be elastic if a 1 percent change in transit service results in a greater than 1 percent change in transit demand. Elasticity values vary from city to city and can be estimated via quasi-experimental approaches and modeling. To retain simplicity for this study, transit service elasticity values derived from similar studies were directly applied to Ann Arbor. Calculations for transit ridership forecasts are presented in the Appendix.

Transit forecasts were made using a combination of the industry-accepted, short-term and long-term modeling procedures as described above. Table 8 summarizes key elements used in the transit ridership forecasting. Figures 7 and 8 illustrate resulting forecasted ridership in transit service for regular transit service and bus guideway operation.

3. Travel Time Savings

Travel time savings are important because time savings beyond 5 to 7 minutes cause travelers to consider using other transportation modes, such as carpooling/vanpooling, bus, and bicycling. Most alternative modes available are high-occupancy modes, which help to increase the person throughput of the corridor. However, achieving these savings in the corridor is difficult because of its relatively short length. Between Dixboro Road and downtown, the corridor is just over 3.2 miles long. Assuming no stops, this segment can be traversed in just under 5 minutes traveling at the posted speed limit of 40 mph.

TABLE 8
TRANSIT RIDERSHIP FORECAST ELEMENTS

Short Term (1 to 5 Years)

Considers Ratio of New Versus Current
- Travel Times
- Total Trip Times
- Service Frequencies
- Fares

Elasticity

Long Term (>5 Years)

Travel Disutility by Mode
- Travel Times
- Total Times
- Service Frequencies
- Costs

Willingness to Pay

Disutility Surplus

Mode Split (Logit) Model

Combine Short and Long Term Forecasts

Determine Percent Increase in Ridership Over Time

Accommodate Population Growth

Distribute Percentage Annually

Figure 7
Forecasted Transit Ridership

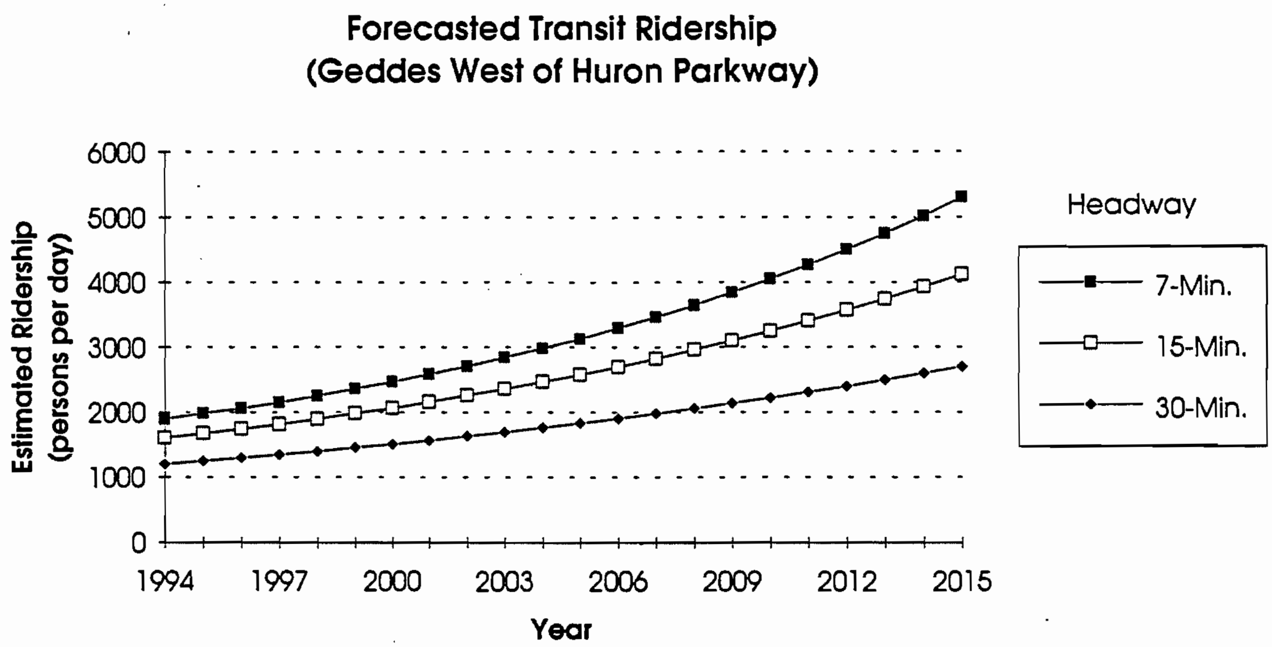
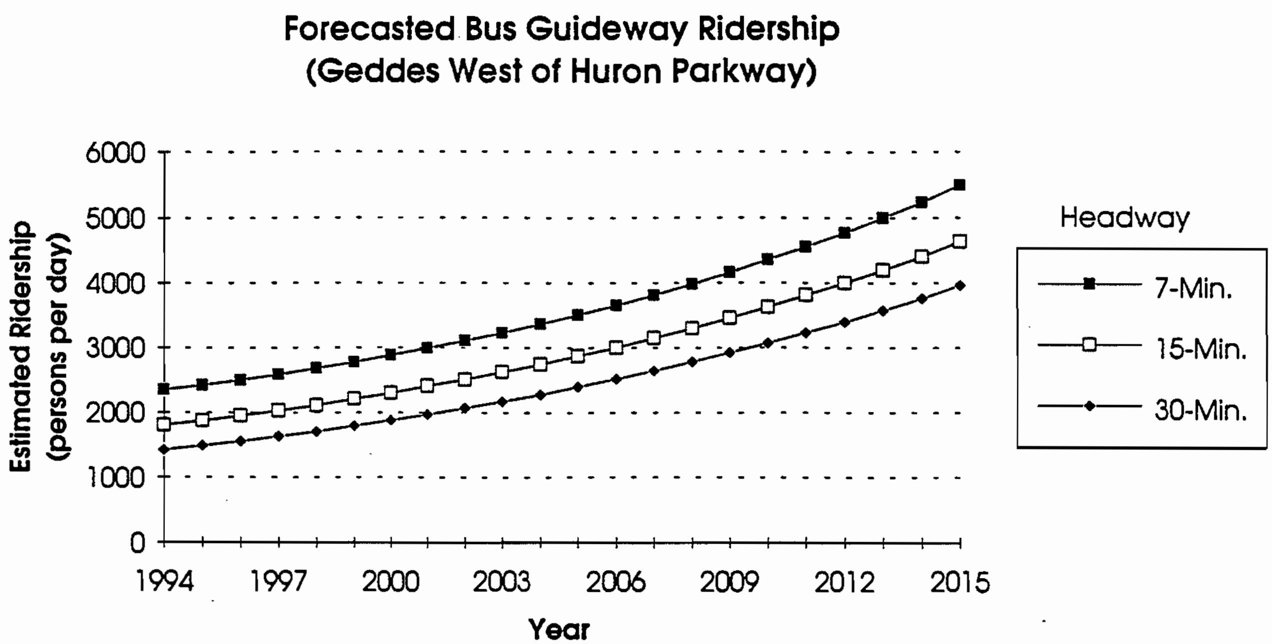


Figure 8
Forecasted Bus Guideway Ridership



4. Proximity to Congested Roadways

Transportation improvements can improve traffic safety and flow but they can also attract additional traffic. Such improvements can have the effect of making existing, non-congested roadways congested. To avoid such negative impacts, strategies' impacts on adjacent roadways were considered. Desirable solutions focus heavier traffic flows to roadways and corridors designated to accommodate such flows, and deter additional traffic from local and residential streets.

5. Consistency with Transportation Plan

Short-term solutions to Geddes/Fuller congestion problems may provide immediate results, but can diminish within a few years. When focusing only on a small area, a site-specific solution can actually cause new problems elsewhere. Consequently, chosen strategies must be consistent with existing transportation plans. This study calls for increased use of multi-occupancy modes of travel, minimal road construction and expansion projects, and improved transit operations.

6. Safety

The general public demands that changes made to the transportation network improve safety. Evaluations for Screen 3 considered how each proposed strategy would impact vehicle/pedestrian interactions and accident potential.

7. Right-of-Way Requirements

Typical of any project that demands additional right-of-way, costs can become exceedingly high. Ann Arbor seeks low cost alternatives which effectively attain the goals and objectives without acquiring additional right-of-way. For the final evaluation, an estimate of additional right of way costs was determined assuming $18,000 per acre for undeveloped land source, and $24,000 per acre for other-use lands such as residential, commercial and industrial properties. Use of University of Michigan land was assumed at no cost. Costs for building condemnation and possible demolition were considered extra in the evaluation. Any necessary legal fees would also add to the cost.

8. Air Quality

Air quality analyses focus on three primary types of pollution: hydrocarbons, carbon monoxide, and nitrous oxides. Carbon monoxide and nitrous oxides come from vehicle exhaust, as do some hydrocarbons. Hydrocarbons are also released from fuel evaporation while the vehicle is running or during refueling. In air quality analyses, one or more of these emissions may be used for comparative purposes. In ozone non-attainment areas, of which the Detroit Metro area is classified, volatile organic compounds (VOC)--a subset of non-methane hydrocarbons--and nitrous oxides (NO_x) are the emissions indicators.

Many different variables impact the severity of vehicle emissions including:

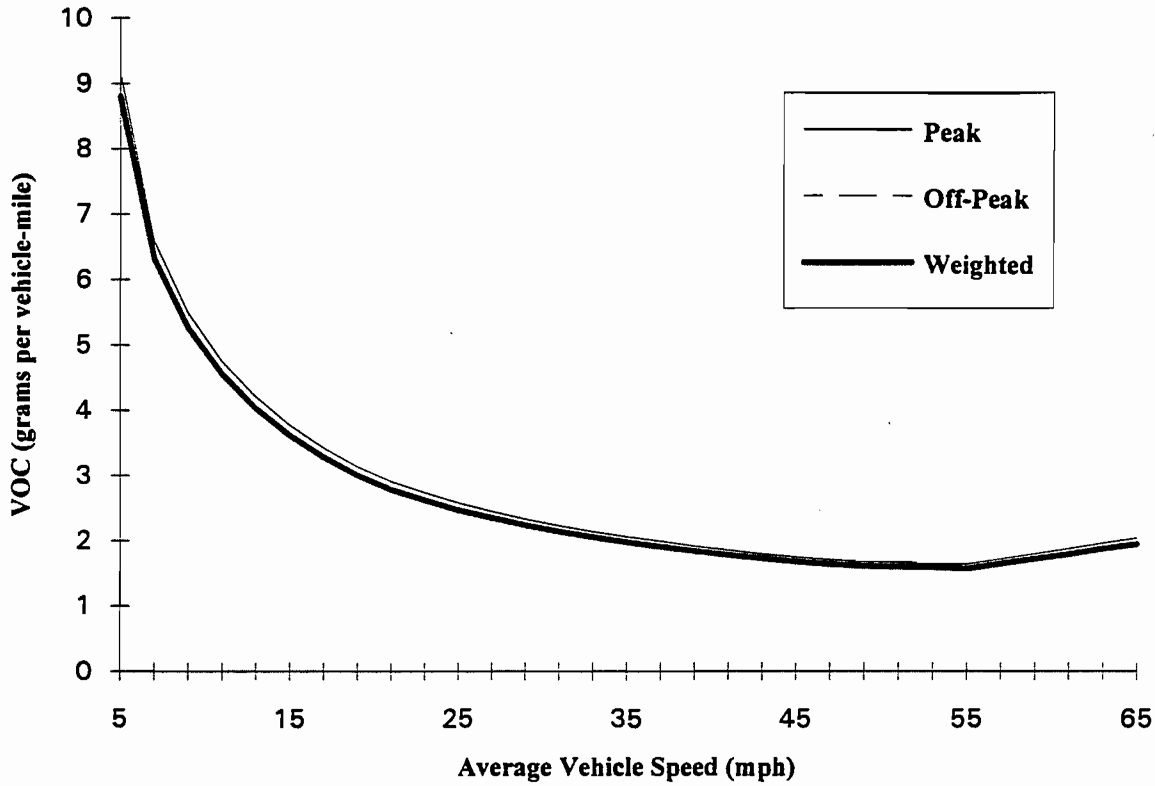
- Vehicle type, age, speed;
- Vehicle operating mode (cold or warm start);
- Ambient conditions (temperature, humidity, altitude, windspeed, etc.); and
- Length of vehicle trips.

These variables are assigned values relative to the geographic region under evaluation. Southeast Michigan Council of Governments (SEMCOG) provided the necessary information to perform air quality analyses for this study. Using SEMCOG's information and an emissions modeling program called **Mobile 5**, estimates of emissions before and after implementation of a strategy can be compared by estimating differences in vehicle travel speeds. For the Detroit Metro Area (of which Ann Arbor is part), SEMCOG strives to comply with the federally-mandated goal of a 15 percent reduction in VOC by the year 1996. SEMCOG estimates that 36 percent of VOC emissions originate from automobiles, so any reduction in VOC emissions from auto use in the Geddes/Fuller corridor will help to achieve this goal.

Ann Arbor's estimated amount of VOCs in grams per vehicle-mile of travel is presented in Figure 9. The figure contains three curves: emissions for peak hours, off-peak hours, and weighted-hours between peak and off-peak hours. The weighted curve reflects 4 hours per day of peak traffic conditions, and is drawn heavy because it represents conditions for a typical day in Ann Arbor. The off-peak curve lies just below the weighted curve line and cannot be easily seen.

As shown in Figure 9, vehicle emissions increase with higher speeds, but only when traveling above 55 miles per hour. VOC emissions are reduced by approximately 2 percent for every one mile per hour increase in speed between travel speeds of 25 and 55 mph. This range of speeds is typical of travel conditions today. Because the posted speed limit (varies between 30 and 40 mph) is below 55 mph, an increase in average vehicle speed is desirable with respect to VOC emissions. Below 25 mph, the emission rates increase significantly per mph decrease. By estimating changes in vehicle speeds and leaving all other variables constant, differences in VOC emissions can be observed.

Figure 9
VOC Emissions for Ann Arbor



Ann Arbor's estimated amount of NO_x in grams per vehicle-mile of travel is presented in Figure 10. This figure is similar to the VOC figure in that curves are presented for the peak, off-peak, and weighted-hours. For NO_x emissions are lowest at vehicle speeds of about 25 mph. NO_x emissions increase approximately 1 percent per 2 mph increase in average vehicle speed up to about 47 mph. This observation contrasts with VOC emission findings where speed increases actually reduce VOC emissions.

In order to observe the combined effect of average vehicle speeds on VOC and NO_x emissions, Figure 11 was developed. Figure 11 shows the weighted-hours emissions for VOC, NO_x, and their sum. The sum minimum emissions rate occurs at average vehicle speeds of about 45 mph. For the range of average vehicle speeds typical in the corridor (25 to 45 mph), VOC and NO_x emissions are reduced approximately 1.5 percent per 2 mph increase in average vehicle speeds. Assuming equal importance of both VOC and NO_x, improvements which increase average vehicle speeds in the corridor would be desirable.

9. Noise Impacts

Transportation noise in the Geddes/Fuller corridor is a concern. Transportation noise originates from vehicles' exhaust systems and from interactions of the vehicles' tires and the roadway surface. The faster a vehicle travels, the greater the emitted noise. Similarly, the coarser the roadway surface, the greater the noise.

Typically, mean noise levels in the Geddes/Fuller corridor vary between approximately 46 and 50 dBA. These levels compare to normal conversation at about 12 feet distance. Higher noise levels (60 to 90 dBA) are observed with passing buses and trucks, and at intersection locations where a greater amount of vehicle braking and acceleration occurs.

Strategies applied to the Geddes/Fuller corridor can have a dual effect on noise. Improving traffic flow can reduce the noise at intersections, for example, but actually increase the overall noise for the corridor because of increased vehicle speeds. The average human ear cannot detect differences in sounds that are within about ± 3 dBA. Estimates of noise impacts for alternative strategies use this ± 3 dBA threshold for evaluation purposes.

10. Wetlands, Woodlands, and Other Natural Features

The goals of this study as identified at the beginning of this report, recognize the importance of preserving the pristine environment of lands adjacent to the Huron River. Alternative strategies' impacts on wetlands, woodlands, and other natural features influenced the overall rating for that particular strategy. Because much of this study is conceptual, impacts on such features were determined as positive or negative only. Positive

Figure 10
NO_x Emissions for Ann Arbor

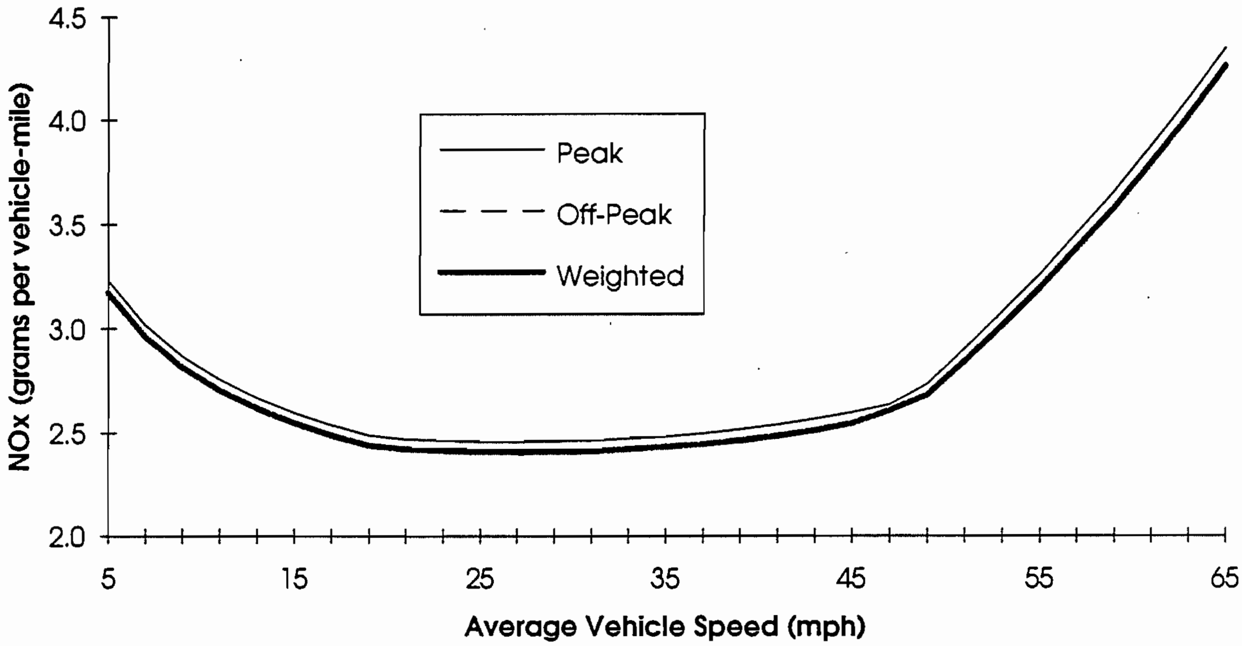
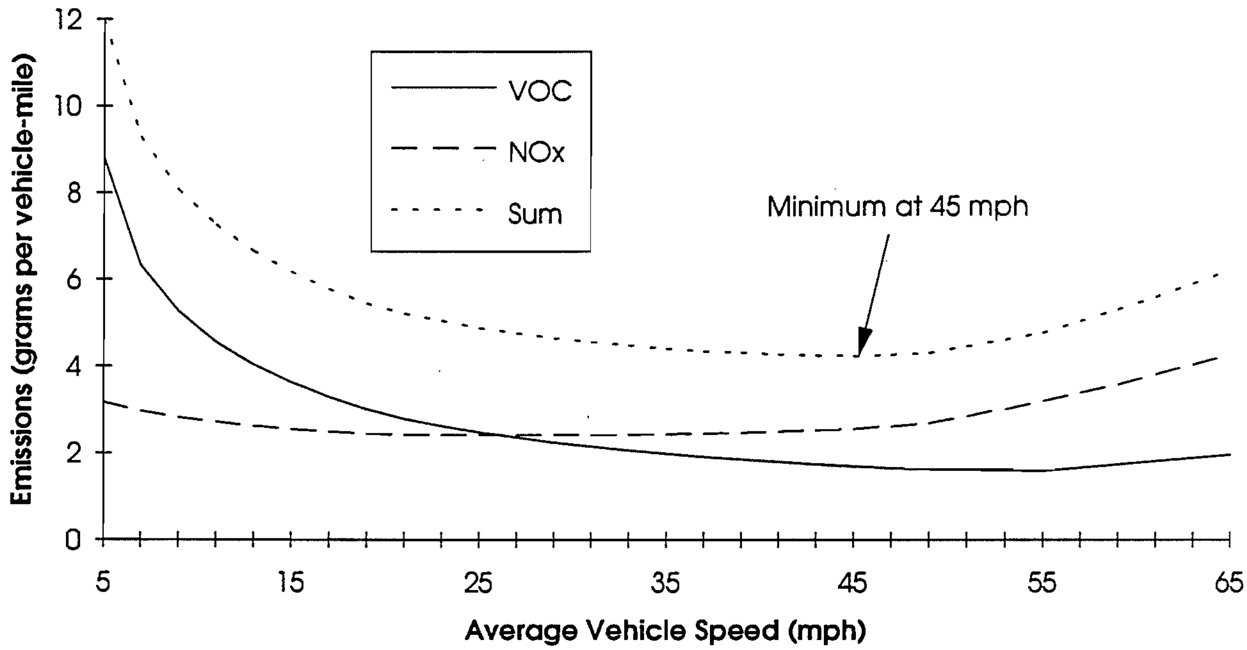


Figure 11
Sum of VOC and NO_x Emissions for Ann Arbor



impacts imply that opportunities to enhance and/or preserve those features exist. Negative impacts refer to necessary removal or modification to the existing environment that would reduce the amount of foliage and habitat conducive to wildlife and aesthetic beauty. Closely tied to impacts on these features are right-of-way requirements.

11. Impact on Side Slopes

Ann Arbor wishes to mitigate its future transportation deficiencies without significantly disturbing existing conditions. Preservation of existing side slopes is one desire of the city. Modification to side slopes is undesirable because it changes the landscape of existing terrain, harms vegetation, can create erosion problems, and is generally costly. This impact is linked directly to right-of-way requirements.

12. Existing Traffic Level of Service

Level of service (LOS) is a qualitative measure that describes the operational conditions within a traffic stream as perceived by motorists and/or passengers. The Transportation Research Board defines six levels of service in the *1985 Highway Capacity Manual* as follows:

Level of Service A represents free-flow conditions. Individual users are virtually unaffected by the presence of others in the traffic stream. Freedom to select desired speeds and to maneuver within the traffic stream is extremely high. Motorists, passengers, and pedestrians general level of comfort and convenience is excellent.

Level of Service B is in the range of stable flow, but the presence of other users in the traffic stream begins to be noticeable. Freedom to select desired speeds is relatively unaffected, but there is a slight decline in the freedom to maneuver within the traffic stream from LOS A.

Level of Service C is in the range of stable flow, but marks the beginning of the range of flow in which the operation of individual users become significantly affected by interactions with others in the traffic stream. The selection of speed is now affected by the presence of others, and maneuvering within the traffic stream requires substantial vigilance on the part of the user.

Level of Service D represents high-density, but stable flow. Speed and freedom to maneuver are severely restricted and the driver or pedestrian experiences a generally poor level of comfort and convenience.

Level of Service E represents operating conditions at or near the capacity level. All speeds are reduced to a low, but relatively uniform value. Freedom to maneuver within the traffic stream is extremely difficult, and is generally accomplished by forcing maneuvers.

Level of Service F is used to define forced or breakdown flow. This condition exists wherever the amount of traffic approaching a point exceeds the amount which can traverse the point. Queues form behind such locations. Operations within the queue are characterized by stop-and-go waves, and they are extremely unstable.

The criteria for determining LOS varies among different roadway classifications, and per intersection location. For example, measures such as average vehicle speed and service flowrate govern LOS classifications for two lane highways, while delay determines an intersection level of service. Consequently, LOS varies per location in the corridor. LOS D is an acceptable target for transportation improvements in the Detroit Metro area, and was accepted as the target LOS for this study. The 1990 Transportation Plan Update cited LOS C as a target value. This LOS is not attainable in the corridor without widening, therefore, the target LOS was adjusted to meet the Detroit Metro standard.

13. Reverse Commuter Trips

Reverse commuter trips refer to work trips originating in the central city and terminating outside the City of Ann Arbor. Although these trips typically are less frequently made than in the peak direction, safe and efficient flow of these trips is also desired.

14. Visual and Enhancement Opportunities

The driving public can judge roadways as either pleasing or unpleasing based upon the visual impact of the roadway environment. Even though many roadways in Ann Arbor are very scenic, the driving population draws conclusions based upon that which they frequently see. People generally appreciate natural vistas consisting of trees, foliage, and undisturbed plant life. This study attempted to maintain existing, pleasing vistas and to identify opportunities where enhancements may be made.

15. Capital Costs

Capital costs for potential strategies were also included in Screen 3. In an environment of limited resources, costs often guide decisions regarding which strategies to pursue and implement. For each alternative, capital costs were estimated. Calculations are provided in the Appendix.

16. Operating and Maintenance Costs

Operating and maintenance (O&M) costs are a significant factor in determining the local and federal ability to fund the operation and maintenance of recommended improvements. O&M cost estimates are included in the Appendix with the capital cost estimates.

17. Cost-Effectiveness

Much emphasis is placed on receiving the best "bang for the buck." Screen 3 uses different measures to arrive at the cost-effectiveness of the proposed strategies. A few of these measures include:

- Cost-benefit index
- Cost-effectiveness index
- Benefit cost ratio

The cost-effectiveness analyses are presented in a separate chapter. Capital costs, and operating and maintenance costs are included in the cost-effectiveness analyses.

SCREEN 3: RESULTS

Each alternative in Screen 3 was scored against the 17 micro-level criteria. The first 14 criteria consider the benefits of alternatives while the Criteria 15, 16, and 17 consider cost implications. This section presents the results of the benefit analysis for Criteria 1-14. Costs are considered in the following section.

Each strategy within each alternative was evaluated against the benefit criteria and given a score ranging from +5 to -5. The total of all criteria scores for each of these strategies and the unique strategies within each alternative was then calculated.

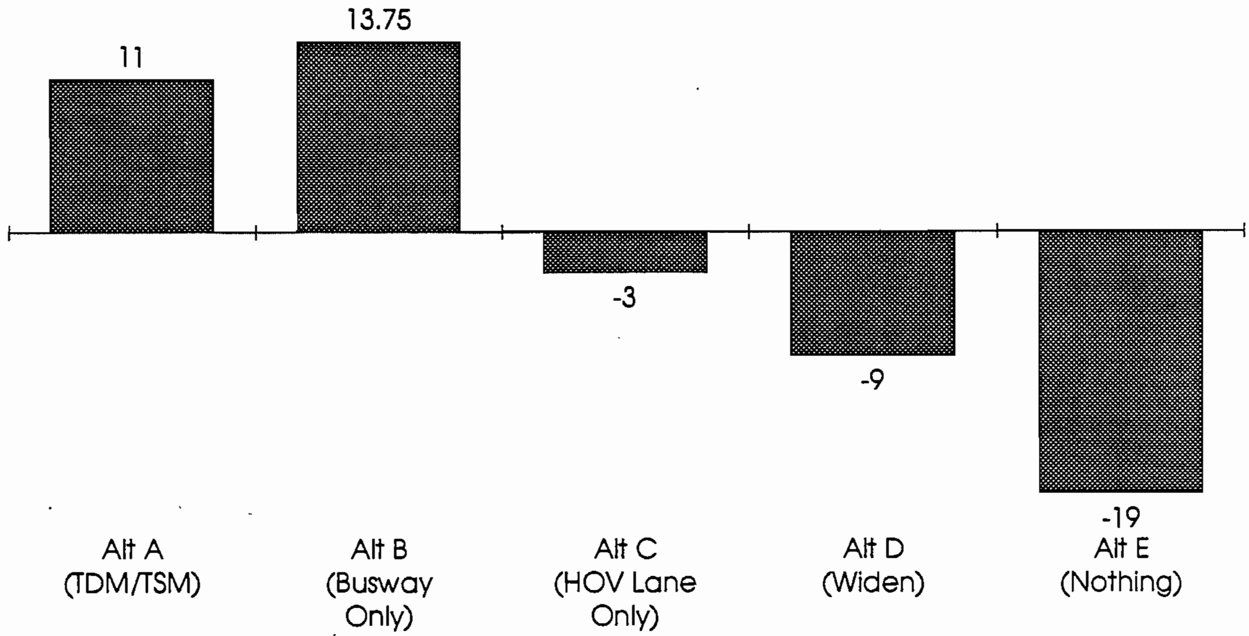
The scores of the unique strategies within each alternative provide the most insight into each alternative. Recall that Alternative A is the basis of Alternative B and that Alternative B is the basis for Alternative C. To accurately assess the impact of the addition of strategies to Alternatives B and C, the average scores of the strategies unique to a specific alternative were calculated. These average scores of unique strategies are shown in Figure 12.

From Figure 12, it can be seen that unique Alternative B strategies are slightly more beneficial and on the same order of magnitude of the core strategies of Alternative A. The unique Alternative B strategies are the bus guideway, additional park-and-ride lots, feeder buses and pedestrian improvements. This improvement of scores of unique Alternative B strategies caused the overall average of Alternative B to slightly improve over Alternative A.

The unique Alternative C strategy received an average score of -3.0. This caused the overall average score of Alternative C to decrease below Alternatives A and B. The unique Alternative C strategy is the extension of the HOV lane on Geddes/Fuller. Alternatives D and E also scored negatively as initially expected. Full details of the scoring for Screen 3 are presented in the Appendix.

In the following sections, Screen 3 evaluation results for each strategy are presented. A potential recommended implementation of that strategy is first presented. This recommendation is based upon results of the evaluation for that particular strategy as provided in the Appendix. (This potential recommendation will be used later in comparison with other strategies in the selection of a preferred alternative.) A brief discussion of existing conditions is then presented, followed by the analysis of the strategy. Finally, potential advantages and disadvantages of the recommendation are listed. To simplify the subsequent sections, the results of the evaluation have been grouped into related strategies for discussion purposes only.

Figure 12
Screen 3 Evaluation Results



Parking Restrictions and Management

Potential Recommendations

- Allocate (as necessary) parking stalls near building entrances as HOV-reserved at the University of Michigan, Medical Center, and VA Hospital.
- HOVs receive free parking.
- Pending utilization of the reserved stalls, increase the number of HOV-reserved parking stalls accordingly over time.

Existing Conditions

Presently, the City of Ann Arbor, the University of Michigan, and the University Medical Center are all short of parking. Past parking studies for the University of Michigan Central Campus in 1989 revealed that:

- A shortage for staff parking exists; fewer than 60 percent of people working at the center had available parking stalls during the day;
- Parking demand (growth) models estimated that Central Campus staff would increase 9 percent by 1993, and that medical center staff would increase 21 percent by 1993; and
- Increasing available parking by 5 percent would do little to ease tight parking conditions at both the medical center and central campus.

Since the time of the study, the number of parking spaces at the University of Michigan increased by approximately 457 from 20,063 to 20,520; and by 381 from 6,522 to 6,903 at the medical center. Only 20 new parking stalls have been provided at central campus since 1990. Despite these additions, the number of stalls per employee is far below similar facilities and recommended values by the Institute of Transportation Engineers. Given this shortage in parking, many possibilities of eliminating and further restricting existing parking were abandoned.

Strategy Analysis

Parking restrictions and management techniques have the potential to reduce vehicle trips significantly in the Geddes/Fuller corridor. Providing reduced-rate, HOV-priority parking creates an incentive for commuters to carpool.

One measure that captures the effectiveness of a HOV-priority parking strategy is vehicle occupancy. Presently the vehicle occupancy rate in the corridor is approximately 1.10 persons per vehicle. HOV-priority parking has the potential to increase vehicle occupancy rates by promoting multiple-occupant travel.

An analysis of existing travel on the Geddes/Fuller corridor to the two major parking generators (University of Michigan and its Medical Center) was conducted. Of the existing 15,100 vehicles per day using the corridor, approximately 20 percent are destined for campus parking and 10 percent for the medical center. These percentages equate to about 5,200 vehicles per day.

Costs for this recommendation are relatively low. Capital costs for an HOV priority parking strategy depend upon the percentage of stalls designated as such. Items to consider include additional signing, pavement marking, and curb painting.

HOV-priority parking is most effective when parking supply is scarce as it is at the University of Michigan and Medical Center. However, the public may not tolerate any kind of action that seems restrictive. HOV-priority parking can be perceived as "forcing" people to carpool when not everybody has ability to do so. Thus, such actions can be perceived as poor and unfair planning instead of helping existing traffic problems.

The effect of HOV-priority parking on transit ridership is considered minimal. A parking study conducted at the University Medical Center found that when their parking facilities were filled, employees accepted greater walking distances and parked on the central campus grounds. Others left early for work in order to find parking. Thus, a parking shortage can influence a person's trip departure time, but is less likely to alter that person's chosen travel mode. This observation manifests itself in the few numbers (80 car/van poolers out of over 20,000 employees) of car/van poolers at the University of Michigan.

Travel time savings in the corridor are expected to be minimal with this recommendation because the total number of vehicles on the roadway is not expected to change dramatically. The door-to-door trip time, however, can be reduced significantly. For example, if parking stalls located adjacent to or very near the Medical Center were devoted to HOVs, walking time from the car to the building and the time required to find a parking place would be reduced.

Present guidelines for parking facilities indicate absolute maximum walking distances of 1000 feet, but generally not more than 400 feet. Assuming a typical walking distance of 400 feet with a walking pace of 2.4 feet per second, approximately 3 minutes are required to travel from the parking stall to the building. If the distance is reduced to say 100 feet or less, the walking time is about 30 seconds. This time differential becomes more significant during round-trips and in inclement weather. Time savings of more than 5 to 7 minutes are required before commuters will change modes of transportation--in this case from SOV to HOV. For the example given above, a 5 minute time savings is possible, but only for round trips.

HOV-priority parking does not significantly improve traffic level of service. Figure 13 illustrates the level of service (LOS) for Fuller Road west of Huron Parkway for a typical weekday both before and after HOV priority parking was considered. For both the AM and PM peak hours, the roadway operates at LOS E which indicates that during these hours, operations are at or near capacity of the roadway. At LOS E, travel conditions are unstable and vehicle speeds are reduced to a low, but relatively uniform value (below 30 mph).

The evaluation next considered the impact HOV priority parking would have on the LOS of Fuller Road (also seen in Figure 13). Note that existing conditions use the 1.10 vehicle occupancy rate as determined by the data collection efforts whereas an extremely optimistic occupancy rate of 1.55 was used for future conditions. As seen in Figure 13, the parking strategies affect LOS differently per hour observed. The greatest improvement is seen between 6:00 and 7:00 a.m. where LOS improves from D to C. This figure considers only vehicles destined for parking at the University of Michigan, the Medical Center and the VA Hospital.

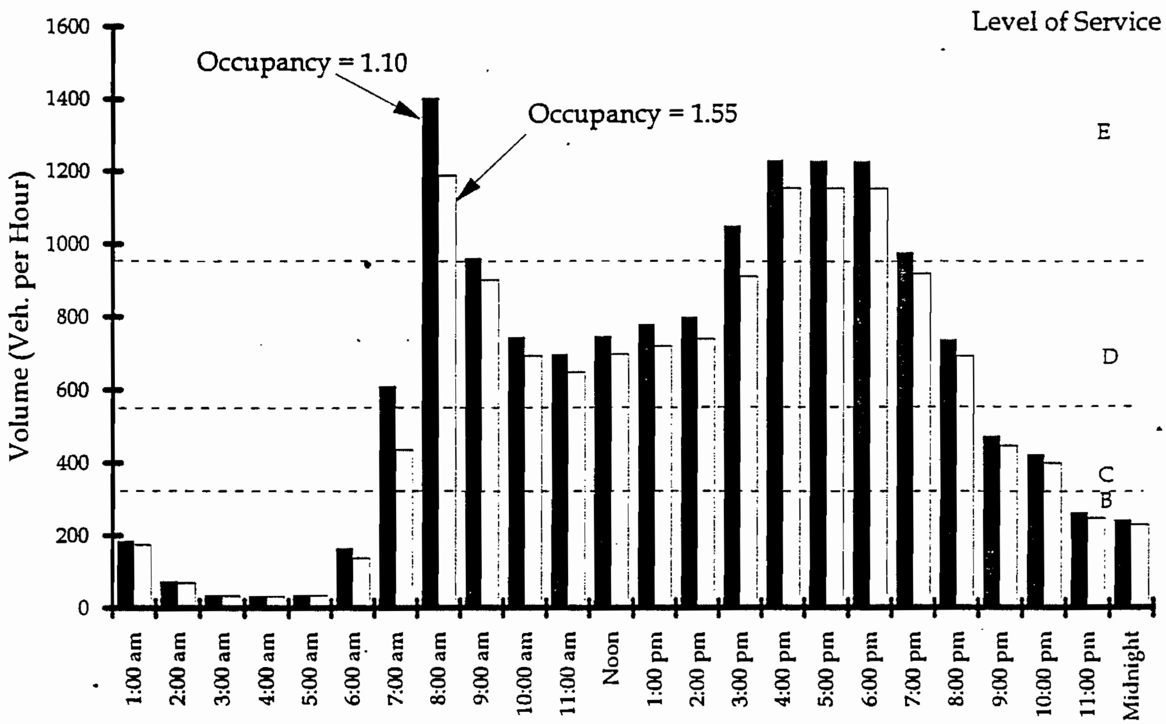
A 1.55 occupancy rate on Fuller Road is not realistic. Table 9 provides more practical occupancy rates for different percentages of HOV priority parking. Table 9 also shows the number of vehicle reductions given various percentages of HOV-priority parking. For example, allocating 5 percent HOV-priority parking would create a 6.0 percent increase in vehicle occupancy and reduce the number of vehicles in the corridor by 253.

TABLE 9
VEHICLE REDUCTION BY HOV PARKING PERCENTAGE *

% HOV Parking	Expected HOV Occupancy	Estimated G/F Occupancy	% Change G/F Occupancy	Vehicle Reduction
0	--	1.10	--	--
5	2.08	1.17	6.0	253
10	2.10	1.20	9.4	386
15	2.12	1.24	12.9	515
20	2.14	1.28	16.6	640

* Assumes 10% of vehicles are HOV and 100% use of designated HOV parking stalls.

Figure 13
1994 Level of Service by Vehicle Occupancy Rate on Fuller/Geddes *



* Only for vehicles destined for the Univ. of Michigan, the Medical Center and the VA Hospital

Finally, if HOVs were permitted a free parking rate, revenue would be lost. An analysis was conducted to determine the magnitude of this loss in the future. Assuming 5 percent HOV reserved parking with no parking fee for HOVs, approximately $325,000 and $110,000 is lost in revenue annually to the University of Michigan and Medical Center, respectively. In order to offset this loss, another source of revenue must be created. Perhaps the most logical source of additional revenue is from increased parking fees for SOVs. This option, however, may not be well received by affected individuals because parking rates have increased at least 12 percent annually since 1991. Another possibility is to offer HOVs reduced rates, but still increase SOV rates to a lesser degree. Other options including agency subsidies and commuter cost-sharing considerations.

Potential Advantages

- Reduction in vehicle trips
- Increased vehicle occupancy
- Low capital and operating costs
- Reduced door-to-door time

Potential Disadvantages

- Perception of poor or unfair planning
- Minimal effect on transit use
- Minimal travel time reduction
- Minimal level of service improvement
- Lost parking revenue

Additions to Transit Services

Potential Recommendations

- First, increase transit frequency to 15-minute headways during peak hours, then (when appropriate) for all-day service on Route 3 regular fixed-route buses.
- Operate three feeder buses in the peak hours.
- Continue with fare subsidies for non-SOV commuters.

Existing Conditions

Ann Arbor Transportation Authority provides four fixed-routes that service east-west movement in the primary and secondary service areas. These are Routes #2, #3, #4 and #5 as shown in Figure 14. Route 7 services the periphery of Ann Arbor, and Route 5 services the southern portion of the secondary study area.

Inbound and outbound boardings are virtually mirror reflections of each other, which simplifies evaluation of fixed-route transit. Existing ridership directly within the primary study area (Route #3 and part of #2) was estimated at 1,154 riders per day.

During weekday service, all routes operate at 30 minute headways midday, and either 45 or 60 minute headways on weekends. Peak headways are typically 15 minutes. The number of passengers per service mile varies between 1.6 and 3.4. The percent of costs recovered from fares varies between 23 and 42 percent.

With increasing congestion in the corridor, the need for more transit riders intensifies. Ridership growth is slow because of limited service and the inflexibility of fixed-route schedules. Therefore, enhancements to the existing transit are recommended to better provide the service that commuters desire.

Strategy Analysis

Ann Arbor Transportation Authority services a significant number of trips in the primary study area. Transit enhancements would better serve these riders and attract new riders.

A ridership forecast model was used to estimate ridership given service improvements. Ridership is expected to increase 5.6 percent annually given the recommended improvements. Figure 15 illustrates these results. Assuming a doubling of transit service, a 1.0 percent reduction in vehicles in the Geddes/Fuller corridor is expected.

Fixed Route Transit Servicing Primary Study Area

Route 2
Route 3
Route 4
Route 5
Route 7

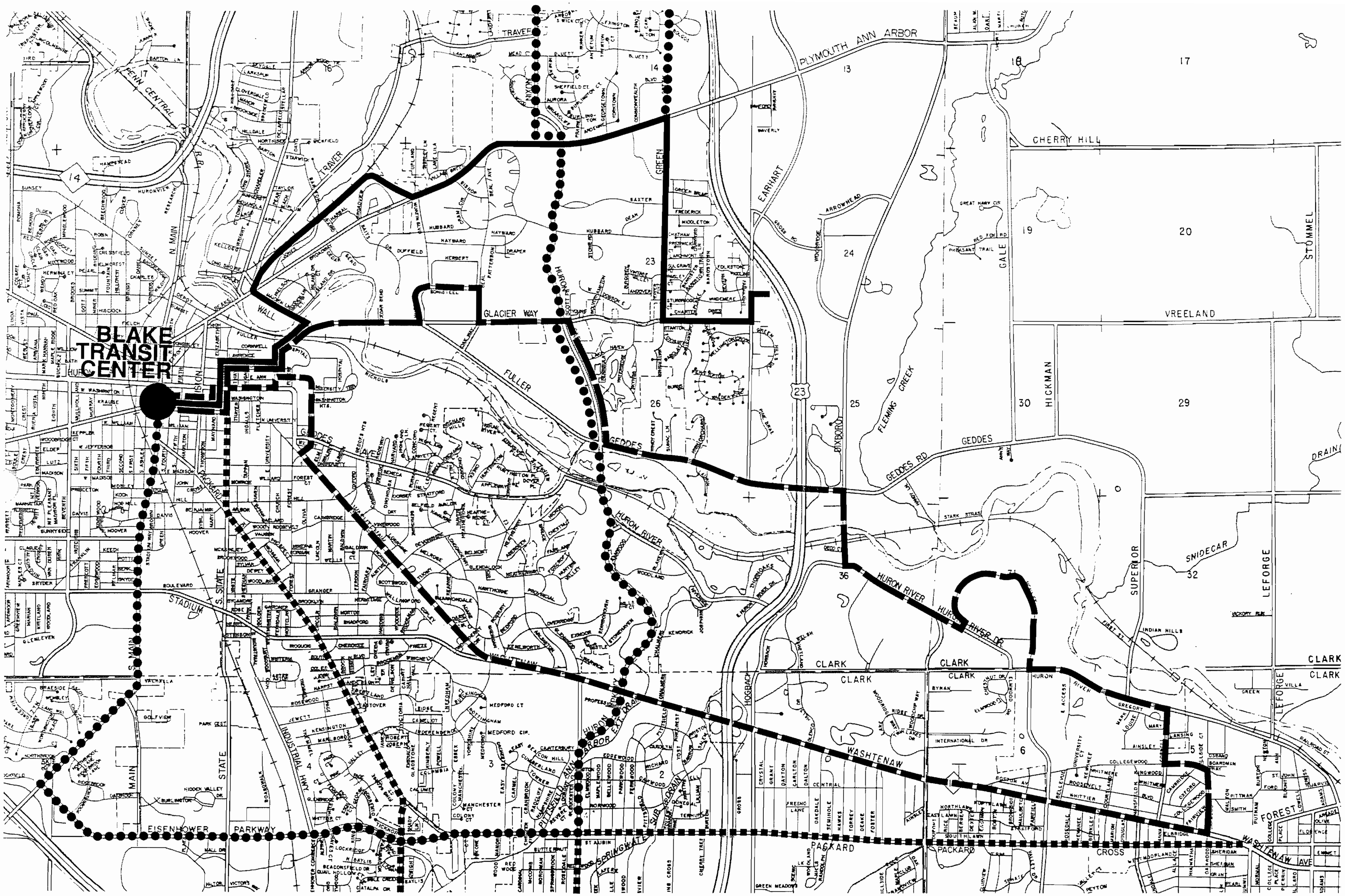


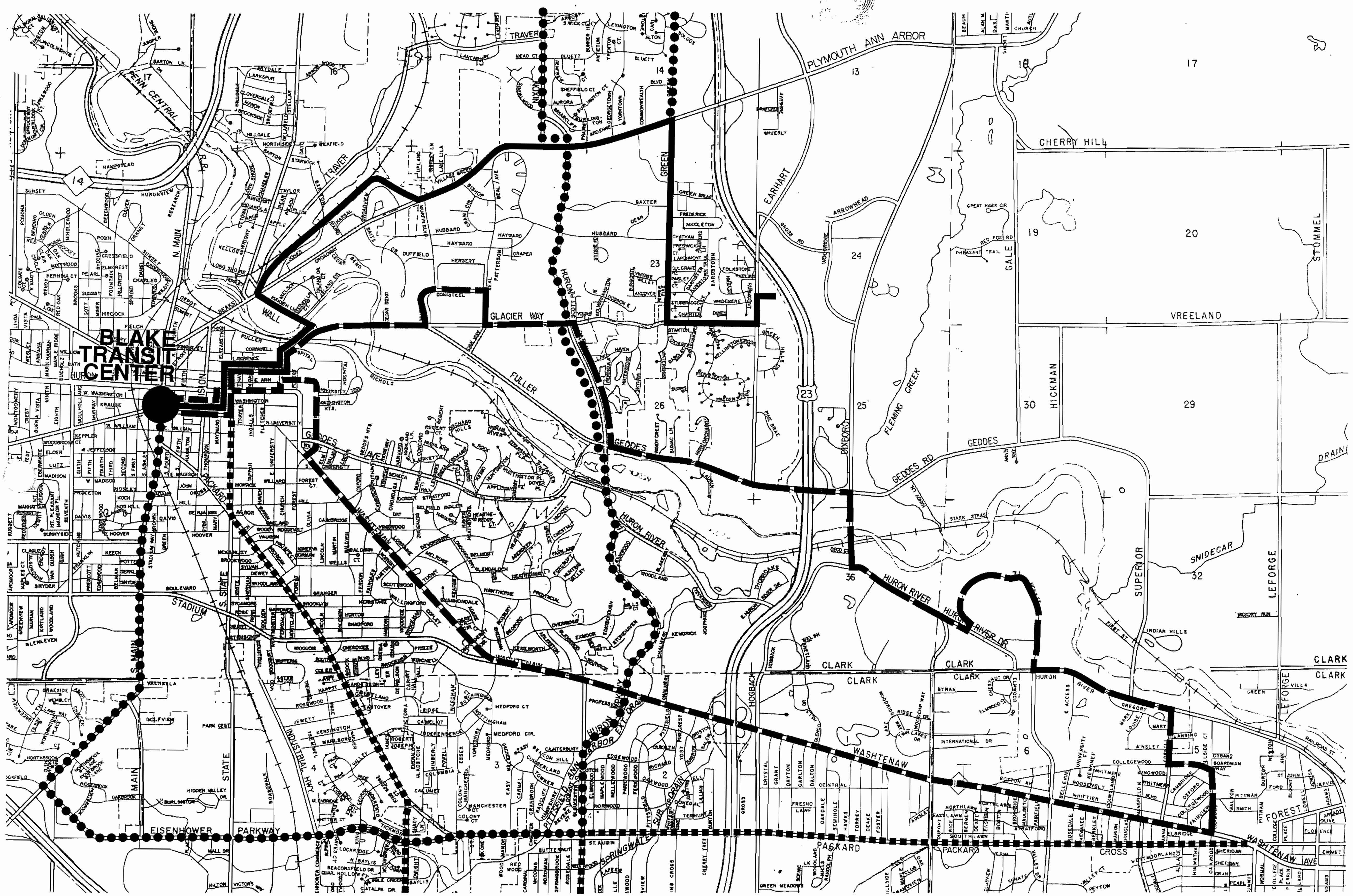
Figure 13

Geddes/Fuller/CONRAIL Corridor Study

North

0 500 1000 2000

BRW



Fixed Route Transit Servicing Primary Study Area

- Route 2
- Route 3
- Route 4
- Route 5
- Route 7

Figure 14

Geddes/Fuller/CONRAIL Corridor Study

North

0 500 1000 2000

BRW

Figure 15
Forecasted Transit Ridership

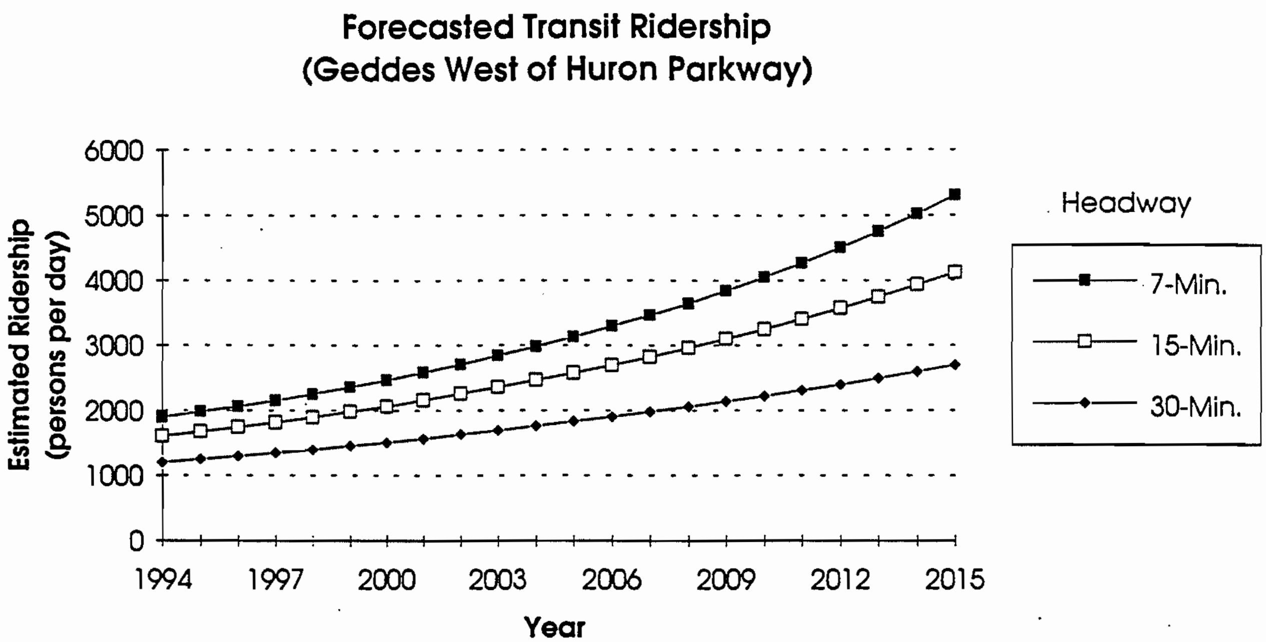


Figure 15 represents the forecasted transit ridership for trips that may be serviced within the primary study area. This figure was generated using the procedure described in the Ridership section of Screen 3 criteria. From the figure, a reduction from 30-minute to 15-minute headways results in an increase of approximately 400 rides per day. Reducing the headways to 7½ minutes adds an additional 300 rides per day. The additional rides originate from the increased attractiveness of the bus as a result of increased service frequency.

Transit improvements that may promote new and additional ridership include:

- Increased bus service frequency (reduced bus headways) during peak and off peak hours;

- Reduced fares;

- Incentives and/or subsidy programs that benefit transit riders and ease costs;

- Addition of express and limited stop routes; and

- Addition of feeder buses to park-and-ride lots.

These possibilities cater not only to the existing transit rider, but also attempt to attract riders who presently use other transportation modes. The disadvantage is that transit improvements impose additional costs on AATA's existing tight budget.

Although the capital subsidies have either remained the same or in some instances increased, the potential for future reduction in operation funds could adversely affect AATA's existing fixed-route service. Given this potential, providing additional transit service may be difficult.

There is no guarantee ridership will increase given improved transit service, a reduction in fares, or both. The fact remains that the buses operate in the same traffic streams as the private automobile. Without special, priority treatments of buses, buses can move no faster than automobiles. Typically, without improved travel times, the general public does not choose transit as their preferred mode of transportation.

It is difficult to accurately predict how much time can be saved by improved transit services because trip times are partially dependent upon the number of riders, which varies per day, stop location and traffic conditions. Travel time savings for bus riders were estimated at 3.5 minutes per trip due to increased frequency and less time for boardings. This was based upon an average bus speed increase of 2.5 mph over a 3.2 mile trip.

An additional six new buses and three feeder buses are proposed for transit enhancements. Capital costs for the buses are estimated at just over $1.9 million. Operating costs of the additional service equate to approximately $1.09 million per year. These additional operating costs equate to an approximate 7 percent increase in AATA operating budget without new federal or state operating subsidies. In order to cover these additional costs, a 20 percent increase in local operating subsidies is required (assuming 700 additional riders per day).

Potential Advantages

- Increased transit ridership
- Reduced vehicle trips
- No impact to wetlands, woodlands or natural features
- No new construction needed
- No impact to side slopes

Potential Disadvantages

- Increased capital and operating cost of bus service

Smart Buses, Kiosks, and ATIS Transit Information

Potential Recommendations

- Implement Ann Arbor Transportation Authority's planned Intelligent Transportation System (ITS), incorporating buses, kiosks and ATIS Transit Information.

Existing Conditions

AATA recently received a federal grant to implement advanced technologies with its transit fleet. A major focus of these technologies lies in promoting real-time route and schedule information via cable television computer networks and kiosks. Implementation of these applications is presently underway.

Strategy Analysis

Kiosks are (computer) monitors placed at high-visibility locations that display real-time traveler information. With respect to AATA, the information assists transit riders in planning and managing their trips. For example, the kiosks would be placed at shopping malls, transit centers, and other high-population density employment centers. Information available might include, but not be limited to:

- Schedule information for all relevant fixed-route transit service;

- Trip management features which would describe which buses to catch at particular times to get from origin to destination; and

- Bus status such as on-time, late, disabled.

Other information such as traffic conditions, weather, and special event data may also eventually be added to the system. Cable television gets transit and traffic information into an individual's home. Computer systems can be used to provide similar information to the University and other large employers.

AATA smart bus technology is a demonstration of unproven technology. Better information regarding potential benefits and impacts will be available as the demonstration nears completion.

Potential Advantages

- Increased transit ridership
- Improved transit service

Potential Disadvantages

- Unproven technology
- Costly to implement

Park-and-Ride with Bus Transfer

Potential Recommendation

- Procure future opportunities to provide park-and-ride lots at existing, less-used parking facilities.

- Further investigate construction of new surface park-and-ride lots at key locations within the primary study area.

Existing Conditions

Only two AATA park-and-ride lots exists within either the primary or secondary focus areas: Pioneer High School on South Main south of Stadium Boulevard and Eastern Michigan University stadium park-and-ride. The Pioneer High School site is located on the southwest side of the secondary service area and has no effect on the Geddes/Fuller corridor. Other sites currently in planning include Arborland Mall and at the University of Michigan Auxiliary Services Building at Green and

Plymouth Roads. These two locations may impact a few trips taken in Geddes/Fuller corridor.

Two highly utilized park-and-ride lots exist in the Ann Arbor area: Chrysler Arena and Eastern Michigan University. Their success suggests the positive impacts park-and-ride can have on the Geddes/Fuller corridor.

Strategy Analysis

Figure 16 illustrates potential park-and-ride locations. Table 10 lists these locations, the type of lot, and a maximum likely number of stalls. Only two of the eight sites listed are proposed new lots. The remaining sites either utilize existing, unused parking, renovate existing parking, and/or expand upon existing parking.

As seen in Table 10, 1,310 parking stalls are provided under the given lot sizes. Figure 17 illustrates the impact that 100 percent occupancy at potential park-and-ride locations has on traffic LOS on Fuller Road west of Huron Parkway. With the exception of a couple hours, LOS improves, but only slightly. These minor improvements to LOS apply directly to person and vehicle throughput, air quality, and noise impacts.

Park-and-ride lots work best when coordinated with other multi-occupant modes of travel such as transit and carpool/vanpool programs. Provision of bicycle lockers and a good bicycle facilities can also make park-and-ride more attractive. As a result, this strategy is difficult to justify independently. Additional bus and feeder bus service to these lots is needed. Bus schedule changes are also necessary to complement commuter trip patterns. Because all of these items are essential, implementation of park-and-ride lots becomes more complex and costly as well.

TABLE 10
POTENTIAL PARK-AND-RIDE LOCATIONS

Location	Type	Maximum Spaces
Eastern Michigan University West Campus (Stadium)	Shared-Surface	300
Dixboro Road and Conrail Right-of-Way	Expanded-Surface	40
Parker Mill Park at Dixboro Road	Shared-Surface	60
Dixboro Road and Geddes Road Southeast Quadrant	New-Surface	200
Concordia College	Shared-Surface	60
Plymouth Road and Green Street	Renovated-Surface	150
Arborland Mall Washtenaw Avenue and U.S. 23	Shared-Surface	500
Plymouth Road and U.S. 23	New Surface	400
TOTAL		1,710

Potential Park-and-Ride Lot Locations

Current Fixed Route Service

- Route 2
- Route 3
- Route 4
- Route 5
- Route 7
- Potential Location

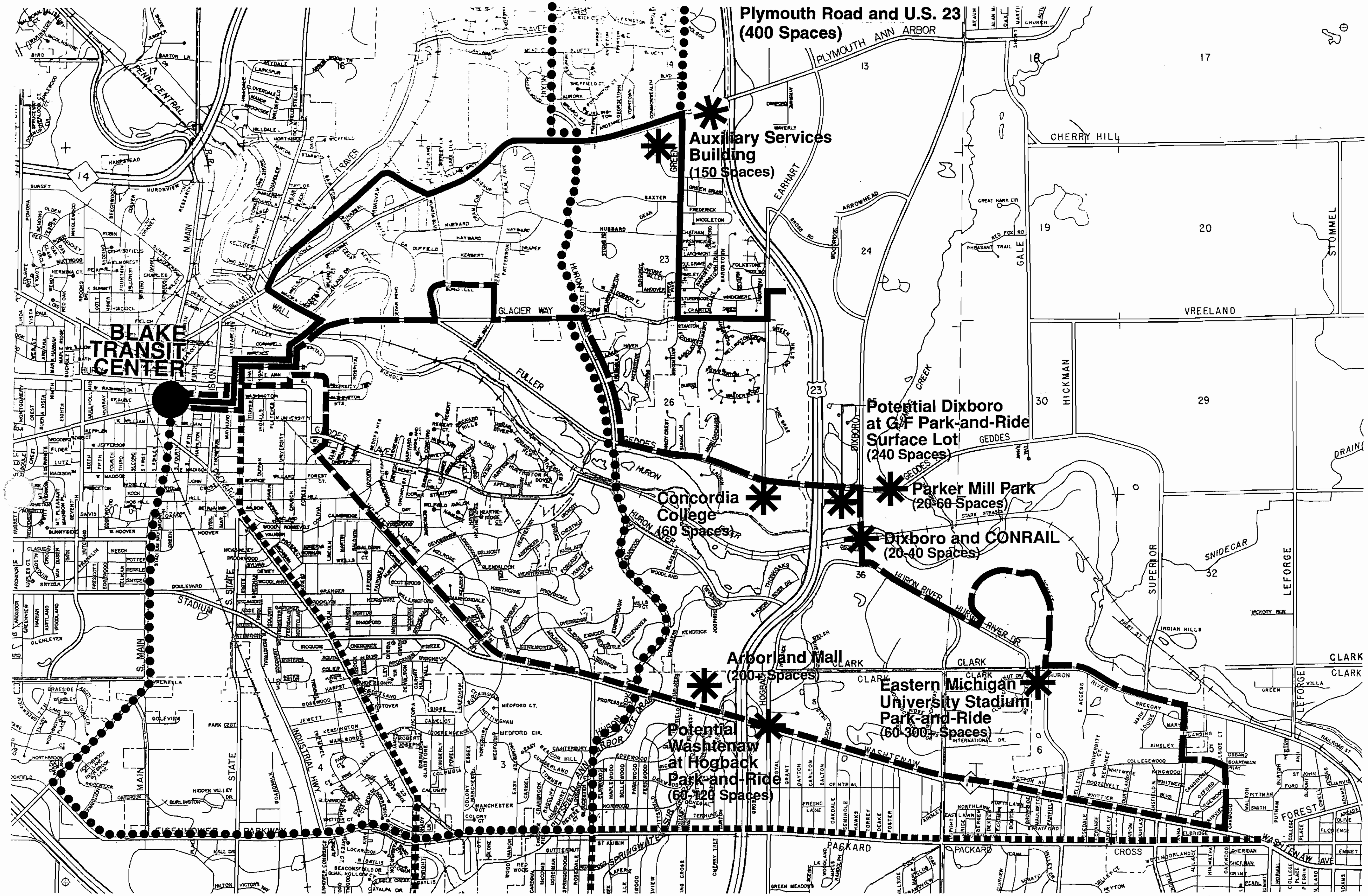


Figure 16

Geddes/Fuller/CONRAIL
Corridor Study

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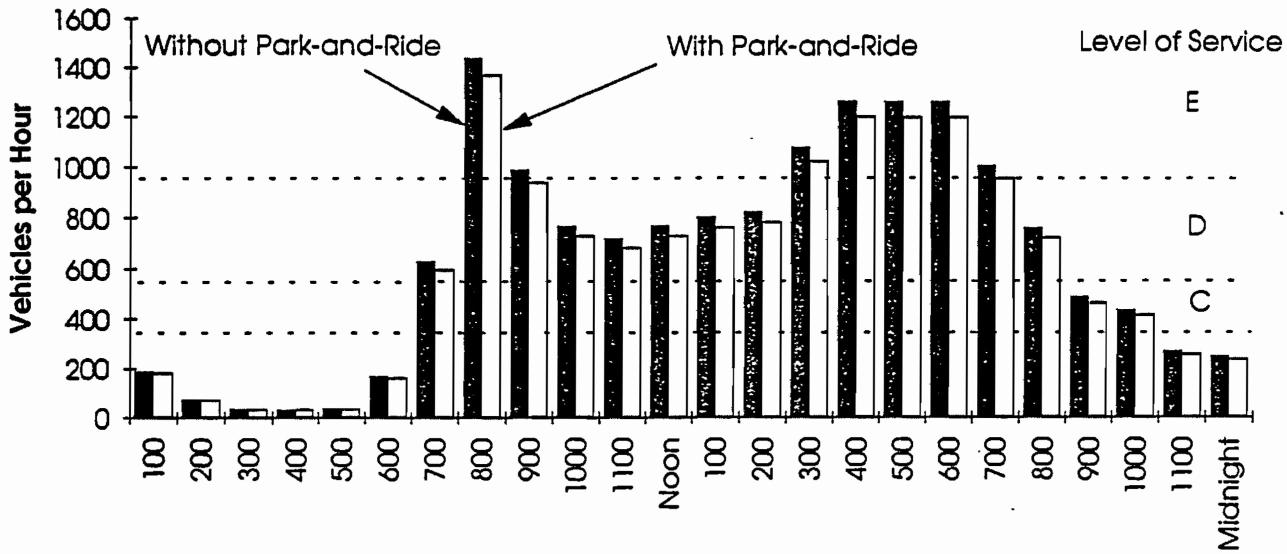
Figure 17
Effect of Park-and-Ride on Geddes/Fuller Traffic



Whenever a strategy focuses on changing human trip behavior, risks of public non-acceptance arise. It is difficult to accurately predict the actual number of people willing to utilize park-and-ride facilities. As a result, efforts focus mostly on placing lots in locations at which commuters pass by frequently and can see the park-and-ride facility. Easy access to and from the lot is also required.

Similar to difficulties associated with enhancements to transit, carpools and vanpools must use the same roadway network as do SOVs. Consequently, there is no priority treatment for HOVs, and travel time savings remain unchanged or increase due to parking and loading times at the park-and-ride sites.

In larger metro areas, park-and-ride facilities have resulted in reductions of air pollution for heavily traveled corridors overall, but have actually increased emissions at the park-and-ride sites. Consequently, some reports indicate a net null effect of park-and-ride on air quality. Construction of new park-and-ride lots is likely to impact existing wetlands, woodlands, and other natural features. If so, landscaping can be applied to minimize the negative impacts, and in some cases actually improve the overall aesthetics of an area.

Potential Advantages

- Minor improvements to traffic throughput
- Minor improvements to air and noise impacts

Potential Disadvantages

- Increased cost of additional bus service
- Risk of public non-acceptance
- Impact to environment around parking facilities

Employee RideShare Programs

Potential Recommendations

- Continue with existing RideShare program
- Market RideShare with the proposed transportation enhancements
- Direct efforts toward a public information campaign

Existing Conditions

The AATA RideShare program is a free carpool and vanpool matching service designated to assist commuters traveling to work or college in Washtenaw County. Participants need only call the AATA to receive information and assistance. Several informational brochures are available and the AATA will provide people to contact regarding joining an existing carpool or vanpool.

AATA also works directly with larger employers in the Ann Arbor area. These employers include:

- University of Michigan
- Environmental Research Institute of Michigan
- VA Medical Hospital
- Ann Arbor News
- Ann Arbor Public Schools
- Eastern Michigan University
- Braun-Brumfield
- Great Lakes Bancorp
- Environmental Protection Agency

Twenty-nine (29) other employers have been contacted regarding employee RideShare programs.

AATA also uses advertising to promote RideShare. "Riding alone is highway robbery" is one theme of an advertising campaign used to encourage commuters to share rides to work. The ad design featured a hand holding a gasoline pump nozzle which is still "smoking" after robbing its user of gasoline dollars that could have been put to better use. AATA RideShare offers commuters an alternative to driving alone.

Strategy Analysis

Table 11 lists the number of inquiries and applicants for AATA RideShare. The number of applicants has increased an average of about 35 percent per year since 1990. This increase indicates that the program is gaining acceptance and that AATA's efforts have been successful.

TABLE 11
INQUIRIES AND APPLICANTS OF AATA RideShare

Year	1989	1990	1991	1992	1993	Total
Inquiries	121	90	165	203	180	759
Applicants	48	51	99	125	150	473

In theory, RideShare programs produce desirable benefits with virtually every evaluation criterion. The magnitude of such benefits in Ann Arbor is small, however, because of the relatively small number of participants in the program. In 1993, only 150 applicants participated out of over 44,000 employed people in the region.

Perhaps the greatest benefit of RideShare is the cost savings to the users. AATA estimates that average annual driving alone costs are $1,663. This estimate is for a 20 mile round-trip commute, exclusive of parking costs. In a 3-person carpool, the same commute costs only $554, a savings of $1,109 annually, or about 300 percent! Savings are also attainable using a 7-person mini-vanpool or 15-person vanpool. On a day-to-day basis, the savings may seem negligible, but over a year the savings become substantial.

The greatest disadvantage of RideShare is the cost related to operating the program. AATA receives a state grant of $21,000 annually for one half-time staff member devoted to the RideShare program. However, a total of three people share this revenue. On average, operating the RideShare programs costs about $16 per person hour, or $700 per month (excluding benefits). The remaining funds are spent on advertising and printing of brochures. RideShare programs typically generate no funds, nor will they ever, or else people would likely use them even less.

Another disadvantage of RideShare is that total trip and travel times can increase due to loading and unloading times. As with transit, RideShare vehicles share the same roadway network with SOVs, so any additional stops only add to the total trip time.

Because of the small number of commuters actually using RideShare, its impact on traffic LOS is virtually negligible. Perhaps the same can be said about air quality improvements, noise impacts, and the like, but at least some benefit is attained. Any step in the positive direction is better than doing nothing while conditions slip slowly away in the negative direction.

Potential Advantages

- Reduced cost to users
- Reduced vehicle trips
- Improved traffic conditions
- Reduced environmental impact

Potential Disadvantages

- Requires public operational funding
- Increased user travel times

Area Bicycle Circulation System

Potential Recommendation

- Coordinate future bicycle circulation plans with existing plans as established by the City of Ann Arbor and Washtenaw County.

Existing Conditions

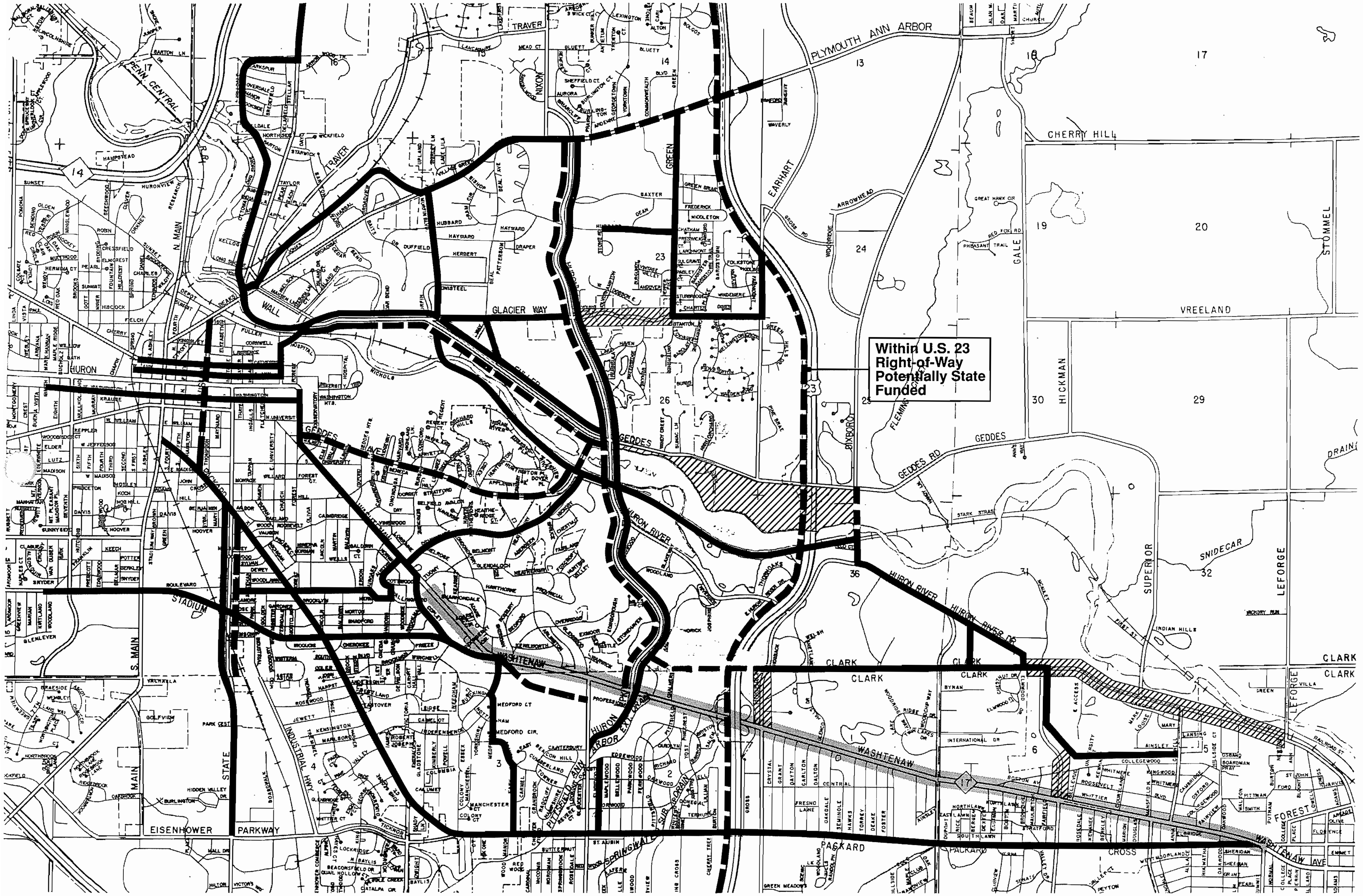
In 1992, the City of Ann Arbor Department of Parks and Recreation developed Ann Arbor's Bicycle Master Plan. The purposes of the plan are as follows:

- To provide convenient and easy access for bicyclists;
- To develop a strategy to implement the bicycle master plan goals and objectives, considering four areas:
  - The rehabilitation of existing bicycle travel facilities,
  - The development of new bicycle travel facilities,
  - The improvement of bicycle education programs, and
  - The expansion of the enforcement of bicycle related traffic laws;
- To seek the cooperation of all agencies, public and private which plan and provide bicycle programs and facilities in the Ann Arbor area;
- To seek continued citizen participation and involvement through the Bicycle Coordinating Committee;
- To identify and establish capital funding sources, utilizing both tax supported and alternative, innovative funding mechanisms.

The plan then identifies high priority projects to rehabilitate and develop bicycle facilities. These projects are shown in Figure 18, as well as potential future additions to the plan.

Strategy Analysis

An estimated 62,353 bicycles exist within the City of Ann Arbor. This creates a high potential for bicycle use to impact traffic congestion. However, only 22 percent of these bicycles belong to University of Michigan students, and only a percentage of these individuals actually ride their bicycles to campus. Assuming that only 25 percent of students with bicycles actually ride to the campus, and that only 10 percent of these



Bicycle Circulation Plan

- Existing Facility
- Priority Facility for Rehabilitation and Development
- Potential Additions to Bike Plan
- Potential Long Term Future Additions to Bike Plan (Difficult to implement due to heavy traffic movements)

Source: Ann Arbor's Bicycle Master Plan, February 1992 (Modified by Citizens' Advisory and Steering Committees, April 1994)

Figure 18

Geddes/Fuller/CONRAIL Corridor Study

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students utilize the Geddes/Fuller corridor for commuter purposes, approximately 343 trips are made by bicycle. These trips represent more than twice the enrollment of AATA's RideShare program.

Bicycle use produces no air pollution, is relatively silent, and when used on existing roadway and bicycle facilities, does not harm wetlands, woodlands, or other natural features. Except for costs to provide and maintain the bicycle facility, all costs are covered by the rider. In addition, riders receive exercise and can enjoy the outdoors.

Ann Arbor's Plan for Parks, Recreation and Open Space identifies bicycle riding as the number one recreational activity for teenagers ages 13 to 17. The greater majority of this subgroup are not legal driving age. For adults, bicycling ranked as the fourth most popular recreational activity behind walking, swimming, and running/jogging. These results raise the question: If working adults preference for recreation is not the bicycle, how likely are they to choose riding a bicycle to work? Reasons vary per person as to why they would or would not ride a bicycle to work, but the concern remains as to the actual number of people willing to ride their bicycles. Provisions of incentives can help promote bicycle use. One incentive may include bicycle racks on AATA buses.

The Ann Arbor Bicycle Master Plan identifies poor weather conditions as the number one reason why cyclists choose not ride their bicycles. Michigan, being located in the northern part of the U.S., experiences several winter months where weather conditions may be considered non-conducive to bicycle riding. Consequently, the expected number of cyclists is seasonal and riding is more popular in the warmer summer months.

Construction of bicycle facilities can be expensive if exclusive right-of-way is required. Table 12 lists approximate costs per mile for different bicycle facilities.

TABLE 12
APPROXIMATE BICYCLE FACILITY COSTS PER MILE BY FACILITY TYPE

Facility Type	Approximate Cost per Mile
Bicycle Lane (Adjacent to traffic, striped for exclusive bike use)	$4,000 to $8,000 (sufficient roadway shoulder width) $100,000 (insufficient roadway shoulder width)
Bicycle Path (Separated from traffic, on own or state Right-Of-Way)	$100,000 to $125,000
Bicycle Route (Signed route on existing roadway network)	$1,000 to $3,000

The bicycle path is the most expensive facility type, and generally the preferred type of bicycle facility. Seventy-five (75) percent of bicyclists indicated that they prefer to ride separated from traffic. Others wish to travel on existing roadways where they are not restricted to the slower speed limits mandated on bicycle facilities.

Bicycle safety is of utmost importance. Provision of safety measures can drive costs up, but cannot be compromised. Consideration must be given of grade separations at heavily congested roadways and over the Conrail right-of-way. Lighting and special curb designs may also be considered. In general, all major streets should have both bicycle and pedestrian facilities that assure safe access and use.

Potential Advantages

- Large base of potential users
- Decrease in vehicle trips
- Improvement in traffic conditions
- Low cost requirements for existing facilities
- No environmental impact
- Has recreational as well as transportatin benefits

Potential Disadvantages

- Low commuter potential
- Poor weather discourages use
- New facilities can be expensive

Pedestrian Circulation System

Potential Recommendations

- Coordinate efforts with the City of Ann Arbor to assure consistency with the Ann Arbor Master Plan.

- Facilitate site-specific, pedestrian circulation plans as alternative strategies are adopted--particularly plans which complement transit use.

- Begin a pedestrian system beautification program where existing sidewalks and pathways are cleared of weeds, overgrown shrubbery, and debris. Procurement of a funding mechanism for this program should also begin.

- Consider grade-separated crossings of Conrail's right-of-way.

- Develop an area-wide plan that links Ann Arbor pedestrian and bicycle circulation plans together.

Existing Conditions

It appears that no specific, area-wide pedestrian circulation system plan has been developed for Ann Arbor, although specific site pedestrian plans have. The Ann Arbor Department of Parks and Recreation has included pedestrian circulation plans in its commitment to preserving the two most recognized qualities of Ann Arbor: its openness, and its many trees. A balance between human mobility needs and environmental beauty is sought in many of Ann Arbor's parks and recreational areas. A survey conducted by the Department of Parks and Recreation found 88 percent of respondents to be satisfied with the parks. However, respondents also indicated that they desired greater development and improvement of pedestrian and walking paths within these parks.

Strategy Analysis

Pedestrian travel and walking distances reflect people's desire to minimize travel time and inconvenience. Average walking distances vary per size of the city, topography, trip purpose, cost and type of available parking, and expected length of time parked. Table 13 lists average walking distances by trip purpose, type of parking facility, and length of time parked.

TABLE 13
AVERAGE WALKING DISTANCES FOR ANN ARBOR *[2]

By Trip Purpose			
Shopping	Personal Business	Work	Other
470	390	500	340
By Parking Facility Type			
Curbside	Surface Lot	Garage	Overall Avenue
370	540	330	420
By Length of Time Parked			
½ to 1 hour	1-2 hours	2-5 hours	> 5 hours
420	380	500	440

* Units are in linear feet.

[2](Derived from "Parking Principles," Special Report 125, Transportation Research Board, Washington, D.C. 1971 for a population size between 100,000 and 250,000 people).

Of all values in Table 13, the highest average walking distance of 540 feet is from surface lots. Surface parking lots are common sights at the University of Michigan. AASHTO implies a threshold maximum walking distance of 1,000 feet for parking facilities, and discourages walking distances in excess of 400 feet. The values in Table 13 are consistent with AASHTO's recommended values.

With respect to the evaluation criteria, the relatively short distances given in Table 13 lead to two observations. First, pedestrian travel, or walking, is not likely to impact traffic conditions in the Geddes/Fuller corridor. This observation is justified because commuter trips in this corridor are at least 10 to 50 times farther that the maximum values in Table 13 and with AASHTO's recommended maximum walking distances. Second, improvements should focus on pedestrian facilities where its users' trips correspond to the walking distances in Table 13. Thus, site specific benefits are most likely attainable by pedestrian improvements, rather than corridor-wide benefits.

Because the number of commuter trips made by pedestrian travel in the Geddes/Fuller corridor is very small, quantitative results were not pursued. Of course, walking does not negatively affect air quality, is relatively silent, and has minimal impacts on the environment, but perhaps the greatest advantage of pedestrian enhancement lies with an improvement in the quality of life. Pedestrian facility enhancements can also promote increased transit ridership.

As mentioned earlier, a survey conducted by the Department of Parks and Recreation revealed that respondents desired greater development and improvement of bicycle and walking paths within Ann Arbor parks. Use of these facilities is strongly influenced by their outward appearance. Consequently, beautifying existing facilities will generate greater use.

In the long term, committing half-heartedly to a beautification project is essentially the same as doing nothing. Weeds and shrubs will grow back onto the paths, and debris and litter will eventually return resulting in undesirable walking and riding conditions. Therefore, committing to a beautification project mandates implementation of maintenance of the facilities as well, which costs additional money.

Construction of new facilities may also be required. A typical sidewalk costs about $75,000 per mile (excluding right-of-way costs). A combined bike and pedestrian path costs about 67 percent more than a sidewalk.

Potential Advantages

- Improved quality of life
- No negative environmental impact
- Improved aesthetics
- Recreational as well as transportation benefits

Potential Disadvantages

- Low potential user base
- Minimal traffic impact
- Requires public operational funds

IVHS Applications

Potential Recommendations

- Coordinate efforts with the City of Ann Arbor to establish a Traffic Management Center (TMC).

- Begin planning for placement of infrastructure hardware that collects real-time traffic information.

- Consider the combined roles of traffic surveillance and changeable message signs on U.S. 23 with respect to the TMC.

Existing Conditions

Presently, no Intelligent Vehicle Highway Systems (IVHS) or real-time data collection systems are in place within the corridor. AATA's smart bus operational test may require placement of some IVHS-related equipment to collect traffic data. This IVHS discussion, therefore, is presented with respect to the potential for the corridor.

Strategy Analysis

Congestion on the nation's highways increases continually, particularly in urban areas and along heavily-traveled intercity corridors. Lost productivity nationally amounts to about $100 billion, not including damage done to the environment. Intelligent Vehicle-Highway Systems promise to lessen these costs by altering travel behavior through use of real-time traffic information.

With respect to the Geddes/Fuller corridor, several IVHS technologies were considered to have potential benefits. First, the use of video cameras would monitor intersection operations to assist with traffic operations. In the event of an accident or other unusual traffic flow, the system would dynamically adjust the signal timings to match existing traffic conditions, or operators could manually change the signal phasing to accommodate the greatest demand. The impact of this system would be decreased delay at the intersections and reduced vehicle emissions from idling.

Second, changeable message signs are proposed along U.S. 23 before intersecting Washtenaw Avenue and Geddes Road from the south, and Plymouth Road and Geddes Road from the north. The messages displayed intend to influence motorists' chosen route and mode of travel. For example, messages might include real-time traffic information regarding trip travel times along the Geddes/Fuller corridor to downtown, or to the University of Michigan Medical Center. Brief parking condition messages and messages that promote transit and carpool use will also be included.

Central to the use of IVHS technologies is a Traffic Management Center staffed with traffic control operators. The operators would monitor traffic using the video system and take actions appropriate to the conditions of the roadways under surveillance. The operators could take actions such as changing signal timing, dispatching service or emergency vehicles, and displaying messages on the changeable message signs. The operations center could be staffed during peak hours only or throughout the day.

IVHS technology can be expensive. However, the technology is always improving and the costs are decreasing as production and designs improve. As new and improved products are released, more accurate data collection devices will be made available at potentially lower prices than current products.

Conceptually, the use of IVHS technologies is intriguing. The benefits of increased capacity, safety and mobility without additional right-of-way acquisition are very important. These benefits, however, need to evaluated against the potentially large costs for collecting, processing, and providing real-time information. Most IVHS technologies require additional infrastructure in the form of communication systems, sensors and controllers. Most IVHS communications connections utilize buried cable. Leasing cable from private cable carriers is very expensive, so placing new cable can be comparable in price. Both are expensive; using new cable simply exempts the user from private cable company control.

Because most IVHS applications around the country are new, little information has been published addressing specific benefits acquired from using the technologies. Consequently, the impacts of these high-cost, high-tech applications are mostly unknown. Furthermore, all full-scale, U.S. IVHS applications are occurring in large metropolitan areas which are not meeting clean air standards. In these areas, potential IVHS benefits are most likely to emerge because of the large number of people involved. The four highest priority areas are:

- Los Angeles, California
- Houston, Texas
- Chicago, Illinois
- New York - New Jersey

Each of these areas have large IVHS programs underway with federal funding to support them. Smaller metropolitan areas such as Ann Arbor may have difficulty receiving funding for extensive IVHS applications.

A potential IVHS system for Ann Arbor is presented in Figure 19. The system presented includes:

- Video camera coverage of key intersections affecting the primary study area;

- Manual and/or automatic operation of key signalized intersections; and

- Changeable message signs that relay real-time traffic and parking information to motorists on U.S. 23.

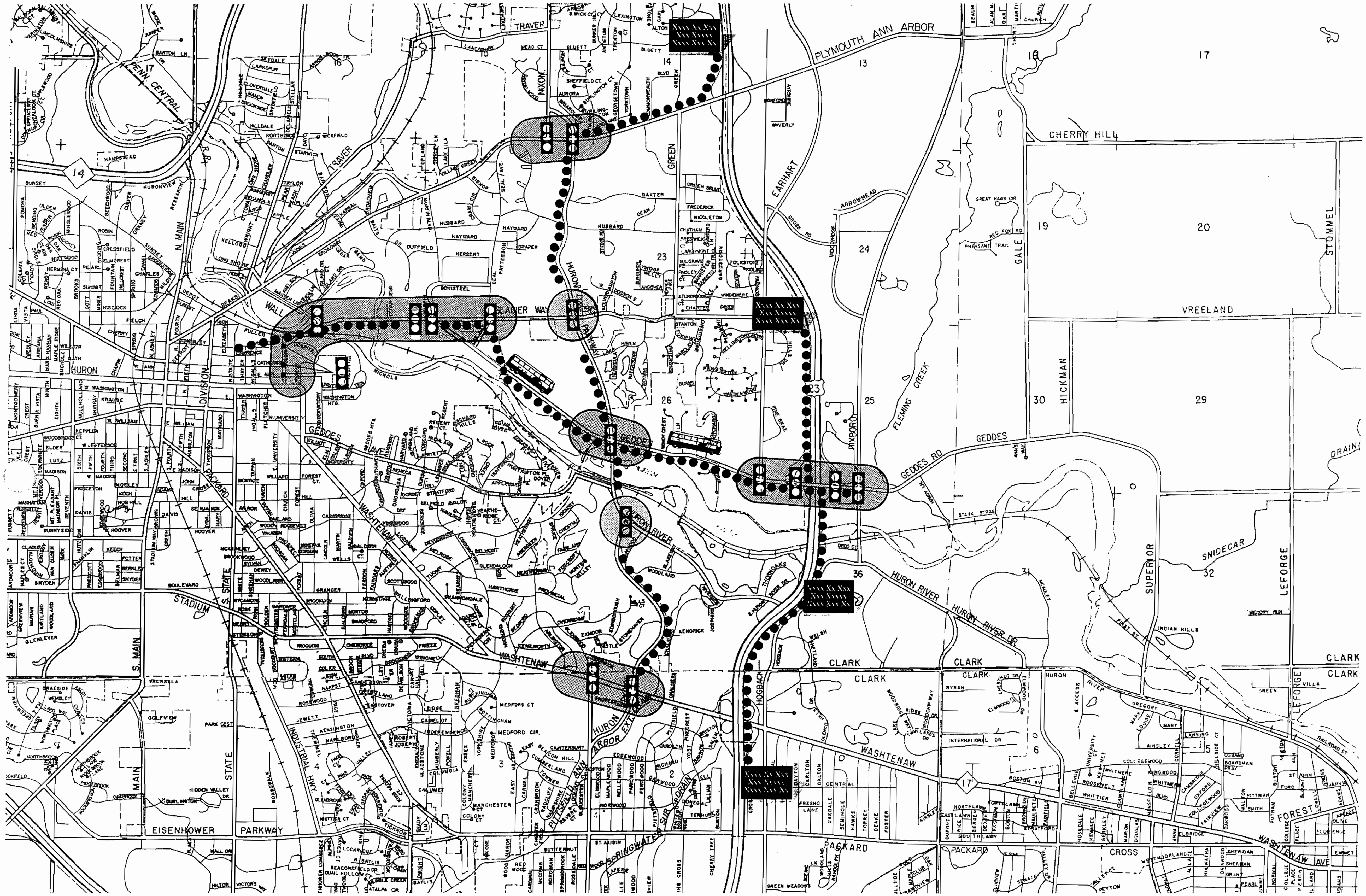
The estimated cost to provide the IVHS configuration presented in Figure 19 is just under $2 million.

Potential Advantages

- Improved traffic operations
- Improved safety
- Improved mobility
- Reduced environmental impact

Potential Disadvantages

- Expensive capital and operating costs
- Low probability of federal funding support
- Specific benefits unknown



Potential IVHS Applications

- Video (Autoscope) Coverage Area
- Traffic Signal--Manual Capabilities
- Communications Connections
- Changeable Message Signs on U.S. 23
- Smart Buses (AATA Intelligent Transportation System)

Figure 19

Geddes/Fuller/CONRAIL Corridor Study

North

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Intersection Improvements, Signal Optimization and Progression

Potential Recommendations

- Optimize all signalized intersections within the primary study area.
- Set timing plans differently for morning and evening peak hours.
- Coordinate efforts with Washtenaw Road Commission and the City of Ann Arbor to coordinate traffic signal progression within the Geddes/Fuller corridor.

Specific intersection recommendations are provided in Table 14. Emphasis focused on intersections within the primary study area. Sufficient data was not available to make recommendations for the following intersections:

- Geddes Road and Earhart Road,
- Washtenaw Avenue and Stadium Boulevard,
- Intersections along Fuller Road and Glazier Way, and
- Plymouth Road and Nixon Road.

Existing Conditions

The Geddes/Fuller corridor is a two lane, rural highway running almost parallel to the Huron River. Between (and including) the intersections of Dixboro Road and Geddes Road, and Fuller Road and Glen Avenue, there are eight signalized intersections. (There will be ten signalized intersections upon completion of the Oak Way realignment.) All signalized intersections within the primary study area operate independently of upstream or downstream intersections. In other words, the controllers at each intersection have no interaction with other signal controllers.

Independent signal control can provide adequate traffic flow when intersection separations are greater than one mile. However, when intersections are close together, such as on Geddes Road at the U.S. 23 interchange, independent signal operations can lead to long standing queues and excessive delay. Delays in excess of 3 minutes have been reported during the peak hours for traffic signals at Geddes Road and U.S. 23, and Huron Parkway and Geddes/Fuller Road. The intersections on Geddes Road at U.S. 23 are 300 to 600 feet apart.

Pavement conditions on Geddes/Fuller vary per location, but are mostly fair to good. A few intersection locations have many potholes and cracking pavement, and are in need of repair. Beyond the pavement edge, less than a two-foot shoulder exists in either direction. For much of

TABLE 14
SIGNALIZED INTERSECTION RECOMMENDATIONS

Intersection	Recommendation
Geddes/Fuller and Huron Parkway	• Optimize existing phasing for peak a.m. and peak p.m. • Add right turn lanes for EB and WB Geddes/Fuller. • Extend left turn bay on WB Geddes Road. • Improve pavement conditions on EB and WB approach legs. • (Future) Add an additional left turn lane to WB Geddes Road.
Geddes Road and U.S. 23	• Realign SB on-ramp with existing signal at SB off-ramp. • Widen existing bridge to provide for left turn lanes at both intersections. If widening bridge is not possible, provide short left turn bays off ends of existing bridge. • Provide right turn lanes at ramp terminals. • Interconnect traffic signals and optimize timing to improve progression.
Geddes Road and Dixboro Road	• Extend left turn lanes. • If possible, add right turn lanes. • Consider double left turn bay for NB Dixboro Road. • Consider provision of EB channelized right turn lane with yield sign.
Dixboro Road and Huron River Drive	• Add EB left turn bay. • Lengthen SB right turn lane. • Add WB right turn lane.
Washtenaw Avenue and Huron Parkway	• Optimize existing signal. • Add right turn lanes on NB and SB Huron Parkway. • Designate exclusive right turn lanes on EB and WB Washtenaw Avenue.
Huron Parkway and Glazier Way	• Signalize and optimize signal. • Stripe pavement to aid turning movements. • Pave Glazier Way east of Huron Parkway.
Huron Parkway and Huron River Drive	• Signalize and optimize signal.

Geddes Road east of Dixboro Road, vegetation covers the shoulder and even encroaches upon the travel lanes at some locations.

Three critical locations in the Geddes/Fuller corridor are the interchange at U.S. 23, the intersection of Huron Parkway and Geddes/Fuller and the intersection of Huron Parkway and Washtenaw Avenue. The U.S. 23 interchange is quickly approaching its design capacity. Geddes Road crosses over U.S. 23 via a two lane bridge. Within 200 feet of the west bridge abutment, the southbound on-ramp begins. Westbound traffic must completely stop for any vehicle attempting to make a southbound left turn onto the on-ramp. This blockage results in long vehicle queues that almost extend to the east (northbound) off-ramp intersection and creates a high rear-end accident potential.

Figure 20 illustrates the existing maximum demand vehicle queues for the Geddes/Fuller and Huron Parkway intersection. The critical approach legs here are found with the Geddes/Fuller roadway. Both the eastbound and westbound approaches have left turn bays: 150 feet long WB, and 200 feet long EB. Eastbound-through/right queues on Fuller Road presently reach 51 vehicles in length. Westbound-through/right queues on Geddes Road reach 28 vehicles in length. Vehicles in these queues extend beyond the beginning taper of the left turn bays such that left-turning vehicles cannot reach the left turn lane until most or all of the queue has dissipated. Similar lane blockage occurs with left-turning vehicles impeding through traffic.

Figure 21 illustrates existing maximum demand vehicle queues for the Huron Parkway and Washtenaw Avenue intersection. These lane blockages disrupt traffic flow, cause increased delay and air emissions, and increase the potential for traffic accidents.

Strategy Analysis

Evaluations of existing conditions were made for all intersections where sufficient data was available. A target LOS C was initially established as the improvement goal for each intersection. LOS C was the accepted target in the 1990 Ann Arbor Transportation Plan. The analysis revealed that LOS C or better is not attainable at all intersections without adding through-lanes to the intersection approach roadways. However, roadway widening is not an acceptable option within the goals and objectives of the study committees. A review of LOS D requirements also revealed that this target was not attainable in the peak hours without additional through lanes. Efforts then focused on providing the best LOS for the forecasted traffic volumes without constructing new through lanes.

Existing Maximum Demand Queue Lengths (PM Peak Hour)

Vehicle Lengths determined using 25 feet per vehicle

XX = Number of Vehicles

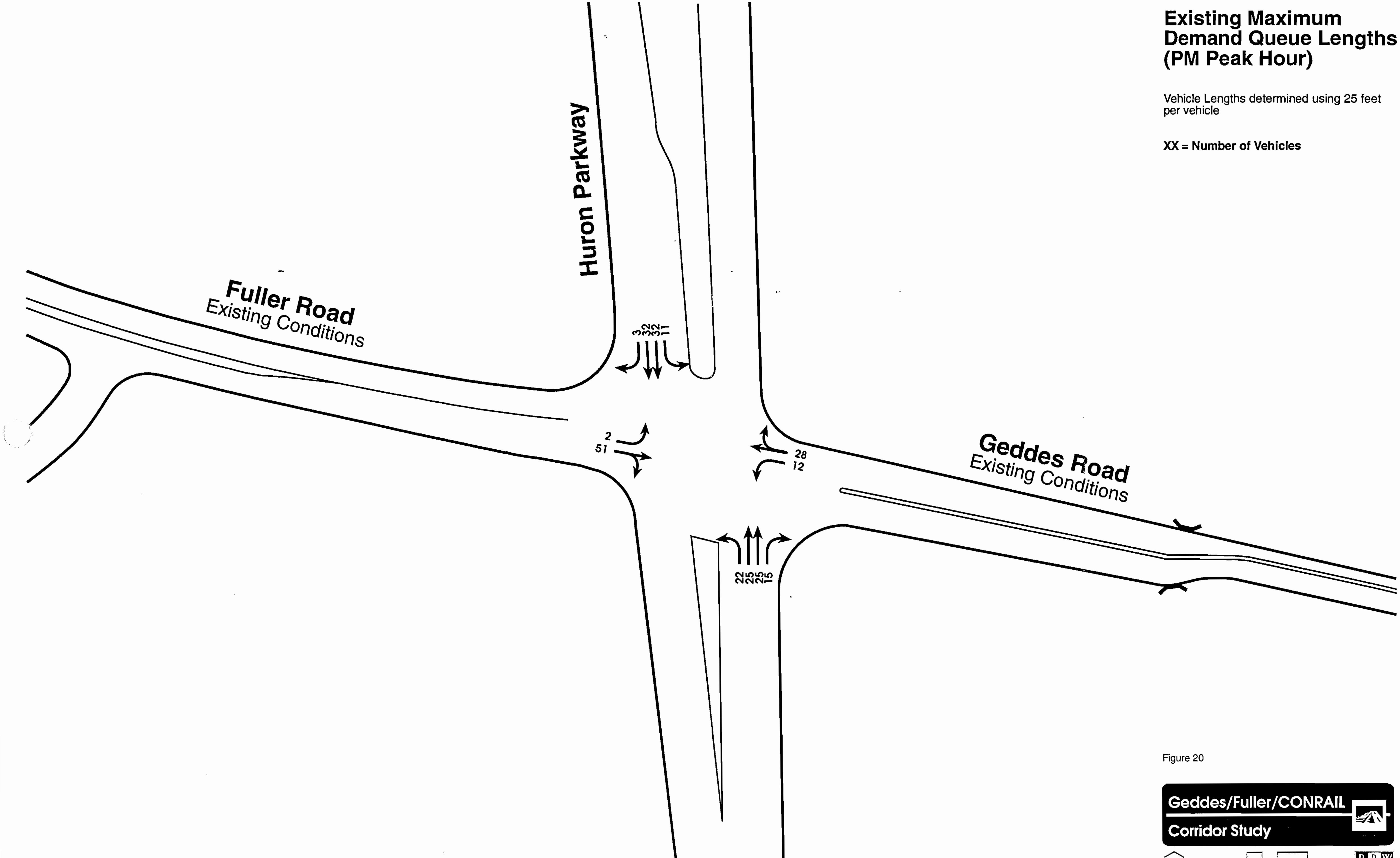

Figure 20

Geddes/Fuller/CONRAIL Corridor Study

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Existing Maximum Demand Queue Lengths (PM Peak Hour)

Vehicle lengths determined using 25 feet per vehicle

XX = Number of Vehicles

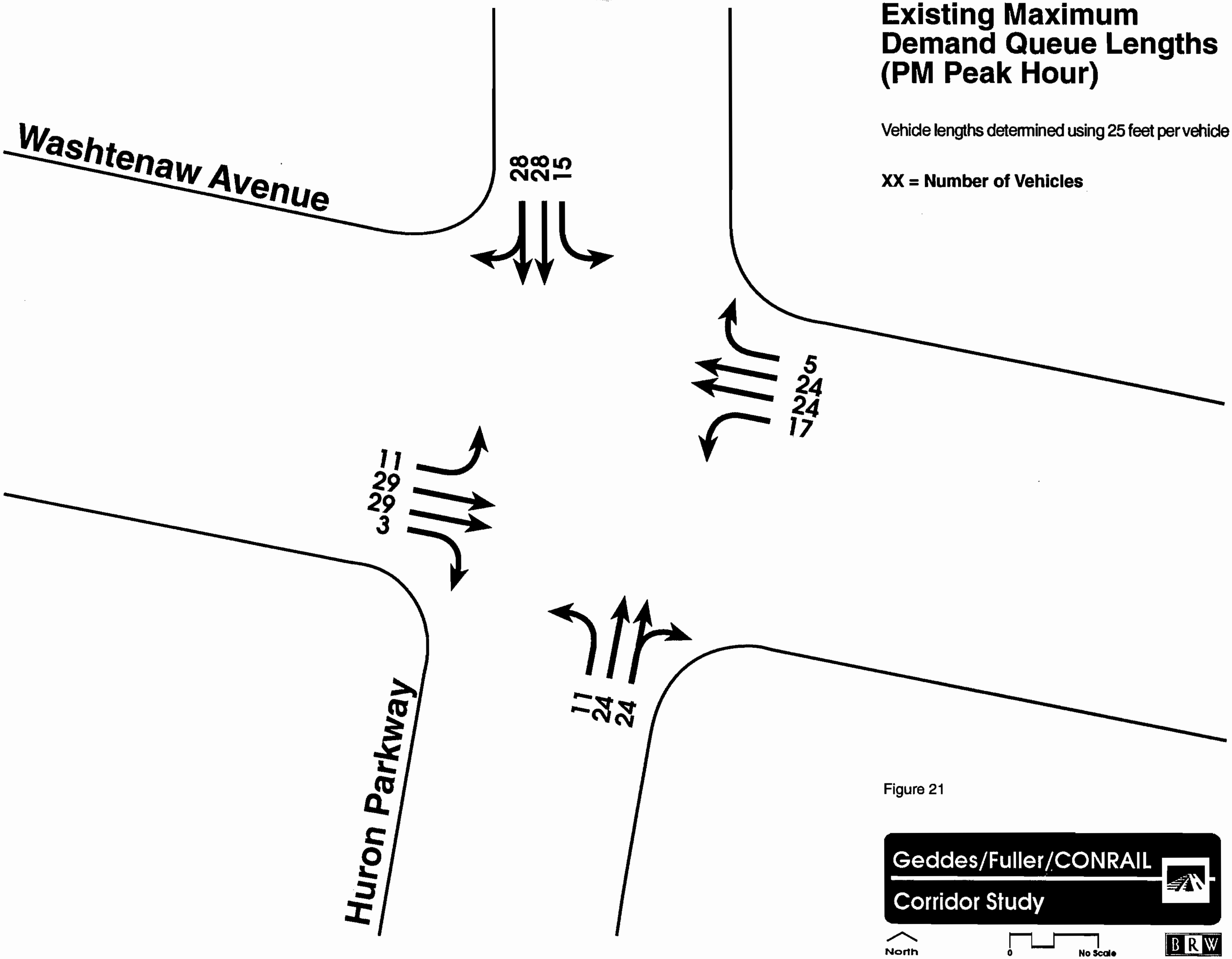

Figure 21

Geddes/Fuller/CONRAIL

Corridor Study

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Table 15 summarizes the results of the analysis for two different measures of effectiveness:

1. *Level of Service*: Refers to the average amount of delay a vehicle experiences in traversing through the intersection considering stopped (idling) time and acceleration/deceleration times. LOS classifications range from A to F; A being the least delay (most favorable condition) and F being substantial delay (undesirable condition).

2. *Degree of Saturation*: Represents a measure of the volume to capacity (V/C) ratio of each lane group, as well as the weighted-V/C's for each approach and the intersection. The degree of saturation is computed as the demand traffic volume divided by the capacity, both described in vehicles per hour. As degree of saturation approaches 1.00, the intersection is operating closer to saturation.

TABLE 15
SUMMARY OF INTERSECTION MEASURES OF EFFECTIVENESS: LEVEL OF SERVICE, AND DEGREE OF SATURATION

Intersection		(Forecast) Year				
		Existing	After Improvements			
			1994	2000	2005	2015
Geddes/Fuller and Huron Parkway		F 1.55	E 0.76	F 1.20	F >1.50	F >1.50
Geddes Road and U.S. 23 (Values in parentheses assume bridge widening)	NB Ramp	F 1.45	C (B) 0.78 (0.60)	F (B) 1.06 (0.63)	F (B) 1.10 (0.73)	F (E) 1.43 (1.06)
	SB Ramp	F 0.91	E (B) 0.87 (0.63)	F (B) 0.94 (0.70)	F (C) 1.18 (0.82)	F (F) >1.18 (1.00)
Geddes Road and Dixboro Road		E 0.75	B 0.56	E 0.87	F 1.09	F 1.16
Dixboro Road and Huron River Drive		D 0.77	B 0.63	B 0.66	D 0.82	F 1.10
Washtenaw Avenue and Huron Parkway		F 1.22	E 0.67	F 0.97	F 1.06	F 1.26
Huron Parkway and Glazier Way		F* 1.55	B 0.32	B 0.55	C 0.67	D 0.90

* LOS for unsignalized intersection.

Level of service and degree of saturation consider actual operational characteristics of the intersections. Operational analyses require extensive amounts of data. In some instances, assumptions were made about an intersection's operational characteristics due to insufficient data. Data used to generate the summary table are provided in the Appendix.

As presented in Table 15, optimizing the existing signals and adding new turning lanes can immediately improve the LOS and reduces the degree of saturation for most intersections. With improved intersection operations, traffic delay can be reduced by approximately 30 seconds per vehicle. This will result in less air pollution, higher average travel speeds of 3 to 5 mph, and increased trip time savings up to 3.5 minutes. Person and vehicle throughput are expected to increase by 20 to 22 percent because of signal optimization. An additional 10 and 11 percent increase is expected by adding turning lanes, extending turn bays, restriping and repaving. Traffic safety is also greatly enhanced by improving intersections. Studies show accident reductions greater than 25 percent are possible after intersection improvements. Finally, intersection improvements require little additional maintenance from the main roadway.

As an example, the recommended improvements of adding turning lanes, extending existing turn lanes, and optimizing existing traffic signalization were applied to the intersections of Huron Parkway and Geddes/Fuller and to the intersection of Huron Parkway and Washtenaw Avenue. These improvements are shown in Figures 22 and 23. For westbound Fuller Road, maximum queues have been reduced from 51 to 34 vehicles--a 33 percent change improvement. Similar queue length reductions can be observed for eastbound Geddes Road, and north- and southbound Huron Parkway queues at Washtenaw Avenue.

Once the forecast volumes were applied to the improved intersections, the excessive queue lengths arise once again. These results imply that short-term benefits from intersection improvements will be significant, but that long-term benefits will be limited by forecasted growth in traffic. By the year 2000, all intersections but Huron Parkway and Glazier Way, and Dixboro Road and Huron River Drive will operate at or below LOS E. By 2015, all but Huron River Drive and Dixboro Road, and the Geddes Road and U.S. 23 interchange will operate at LOS F.

Widening the bridge on Geddes Road over U.S. 23 and adding turning lanes on Geddes Road to the on-ramps appears to provide the greatest, long-term improvement. The existing bridge is a two lane structure with little shoulder space and a sidewalk on either side. Forecasted eastbound and westbound traffic volumes exceed the maximum available capacity of the existing bridge. Widening the bridge from two lanes to four lanes will improve LOS from F today, to LOS B. The widened structure can accommodate traffic demand effectively to the year 2015.

Post Improvement Maximum Demand Queue Lengths (PM Peak Hour)

Vehicle Lengths determined using 25 feet per vehicle

XX = Existing Volumes (Number of Vehicles)
(XX) = Year 2015 Volumes (Number of Vehicles)

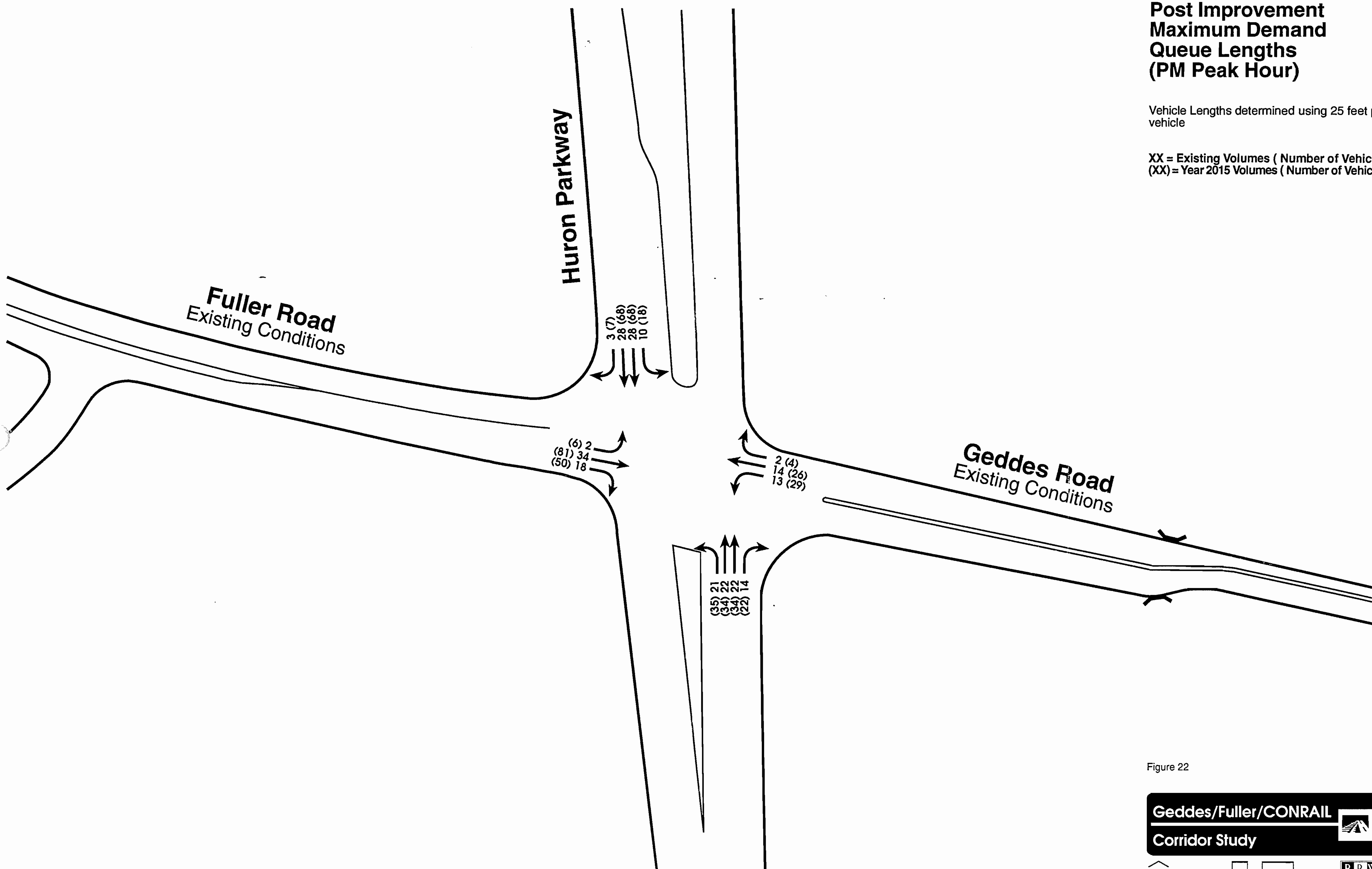


Figure 22

Geddes/Fuller/CONRAIL Corridor Study

North
0 No Scale
BRW

Post Improvement Maximum Demand Queue Lengths (PM Peak Hour)

Vehicle lengths determined using 25 feet per vehicle

XX = Existing Volumes (Number of Vehicles)
(XX) = Year 2015 Volumes (Number of Vehicles)

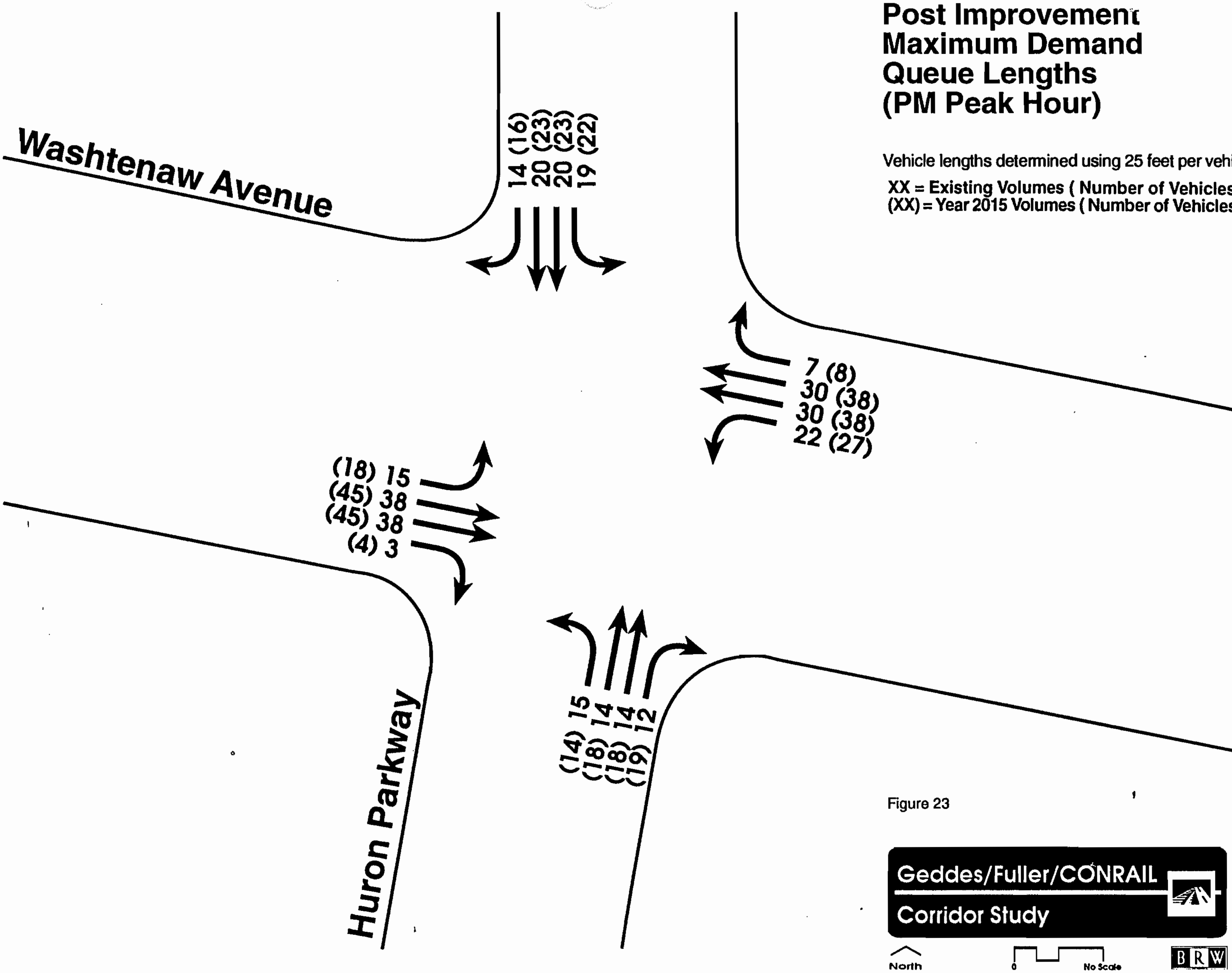


Figure 23

Geddes/Fuller/CONRAIL Corridor Study

BRW

Travel demand forecasts indicate that traffic conditions at the improved intersections and on the roadway will be degraded within six years and completely saturated within 22 years. Short of widening the roadways, this observation supports efforts to promote use of multi-occupant modes of travel such as transit and carpooling, rather than making automobile travel faster and more convenient through intersection improvements. However, available capacity on Geddes/Fuller is also constrained by its two-lane geometric configuration. Therefore, intersection improvements alone cannot satisfy forecasted travel demand, but will improve safety and traffic conditions significantly for the near future.

Costs related to intersection widening can be expensive. Unless a sufficiently wide median is available, additional right-of-way may be required when adding new turning lanes. Right-of-way costs are directly related to land use. Commercial properties generally cost 25 to 200 percent more than undeveloped properties (after legal fees). It is often very difficult to acquire additional right-of-way as well, especially if a property owner refuses to sell. Legal actions and negotiations can take years to settle.

For the Geddes/Fuller corridor, vehicle emissions are reduced by approximately 1.5 percent for every two miles per hour increase in speed between travel speeds of 25 and 45 mph. This range of speeds is typical of travel conditions today in the corridor. Because the posted speed limit varies between 30 and 40 mph (which is less than 55 mph), any increase in average vehicle speed is desirable at least in terms of VOC emissions. Below 25 mph, both VOC and NO_x emission rates increase significantly per mph decrease. Given the forecasted travel volumes, speeds below 25 mph are expected by the year 2000.

Potential Advantages

- Reduced traffic delay by approximately 30 seconds per vehicle
- Increased average travel speeds by 3 to 5 mph
- Trip time savings up to 4 minutes
- Person and vehicle throughput increase up to 20 and 22 percent by signal optimization, plus an additional 10 and 11 percent by adding turning lanes, extending turn bays, restriping, and improving approach pavement
- Accident reductions greater than 25 percent
- Intersection improvements require little maintenance

Potential Disadvantages

- Cost for right-of-way and intersection widening
- Better vehicle flow does little to promote transit use
- Future travel demand may exceed additional capacity provided by adding turn lanes at intersections

One-Lane Bus Guideway on Conrail

Potential Recommendation

- Plan, design, and construct a single-lane bus guideway on Conrail right-of-way from LeForge Road to downtown Ann Arbor. A schematic of a possible guideway configuration is shown in Figures 24 and 25.

Existing Conditions

An Evaluation of Feasibility for a guided bus was conducted by the German consulting firm Studiengesellschaft Verkehr mbH (SNV). The evaluation identified two railroad rights-of-way that have good potential for guided bus use as shown in Figure 26. The Ann Arbor Rail Road (AARR) owns the north-south route. The east-west right-of-way is owned by Conrail. Conrail had two tracks within the existing right-of-way, but one has been removed. This route is of particular importance to the primary study area because this right-of-way parallels much of the Geddes/Fuller corridor.

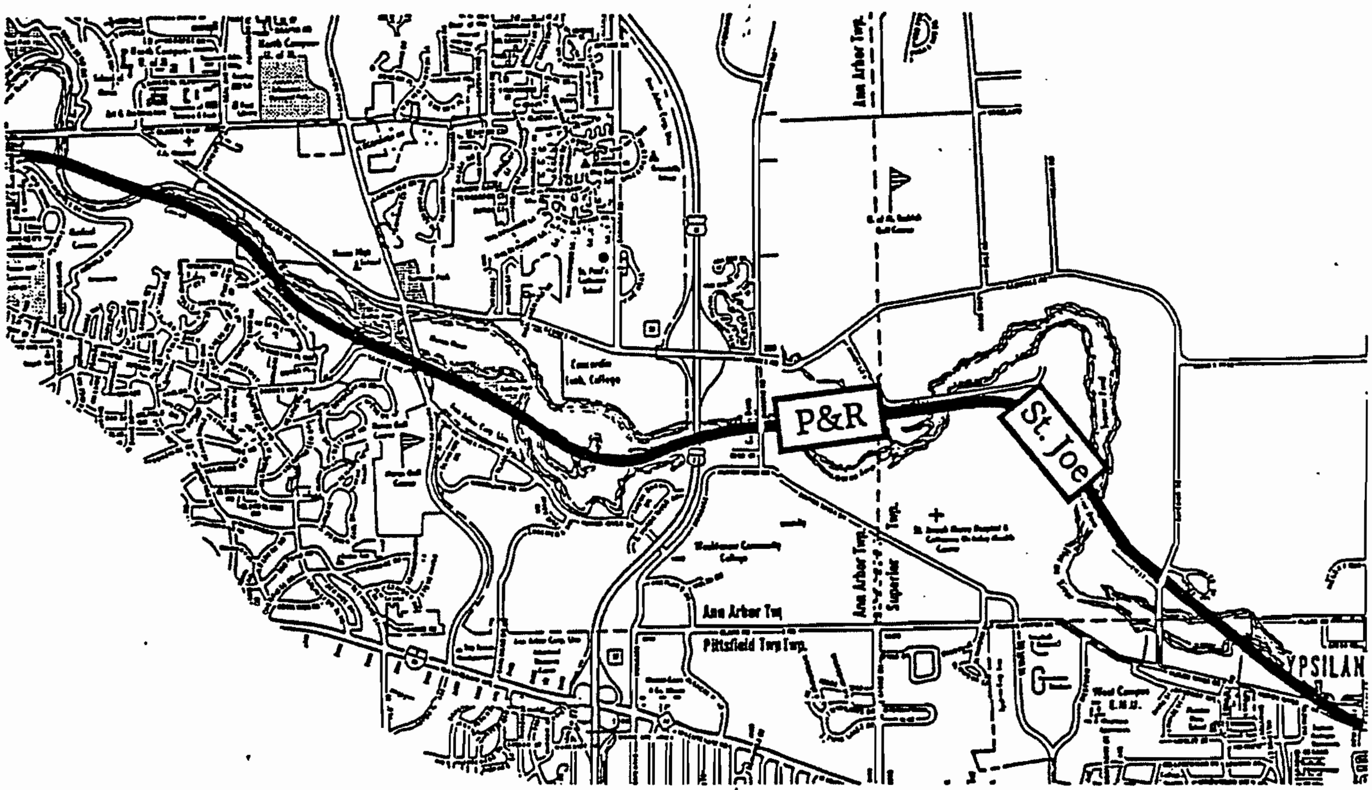
Between downtown Ann Arbor and Huron Parkway, the Geddes/Fuller corridor consists entirely of institutional and open space uses. The only exception is a small, high-density residential pocket south of Fuller Road at Oak Way. The large institutional uses, which are located primarily north of Fuller Road, include the University of Michigan's North Campus, the VA Hospital, and Huron High School. They are characterized by large, expansive grounds and buildings which have large setbacks from the roadways.

The recreational open space uses in this segment are located south of Fuller Road and include Gallup Park, Furstenburg Park, and the University of Michigan's Mitchell Field. The corridor adjoins a short section of the floodplain of the Huron River, just west of Geddes Avenue, and a small wetland is located north of Fuller Road, just east of Oak Way. Some significant wooded areas are located along Fuller Road, east of Oak Way, as well as north of Fuller Street, just west of Bonisteel Boulevard.

To the east of Huron Parkway, the corridor contains a mixture of land uses including:

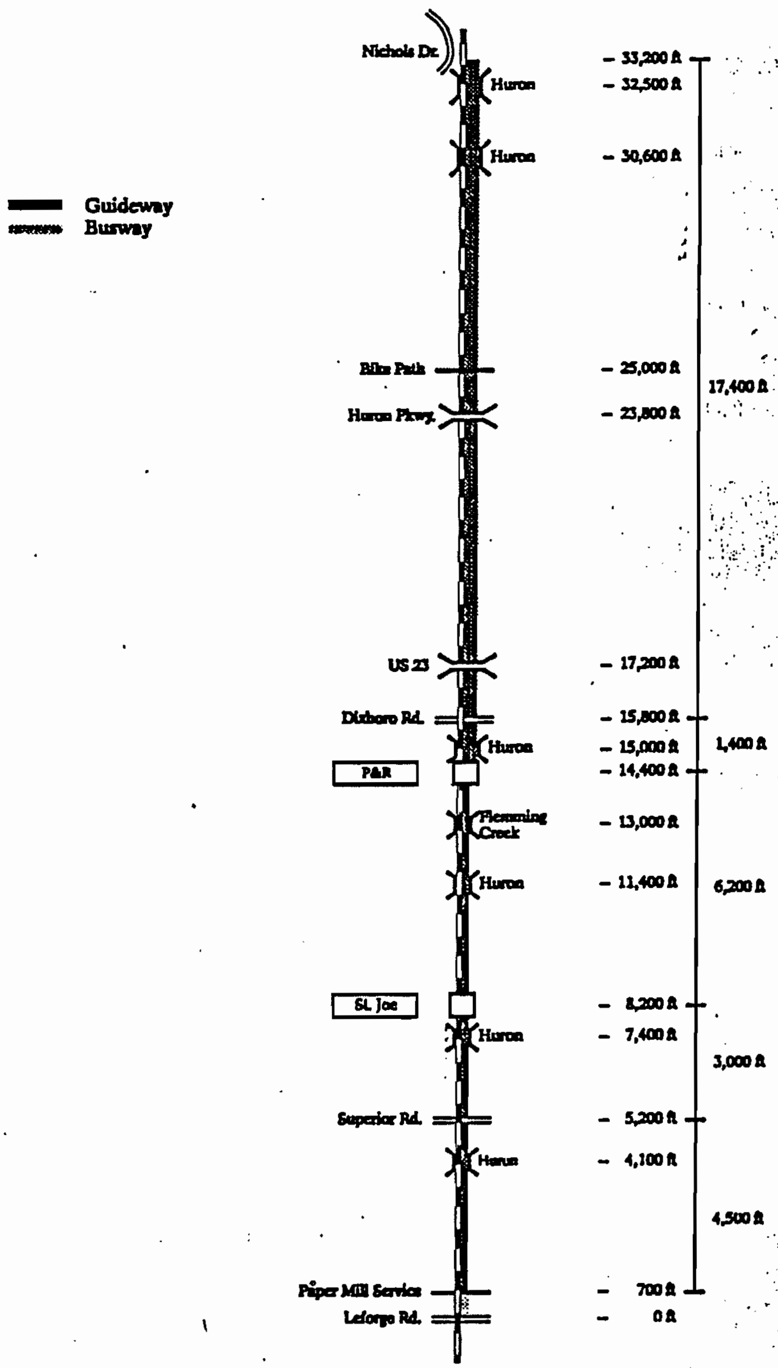
- Concordia College at Earhart Road;
- Ruthven Park;
- The Gallup Park boat launch ramp, east of Huron Parkway;
- Low-density residential uses on both sides of the roadway, in the central portion of the segment; and
- A higher-density residential complex at the easterly end.

Figure 24
Potential Bus Guideway Layout 1



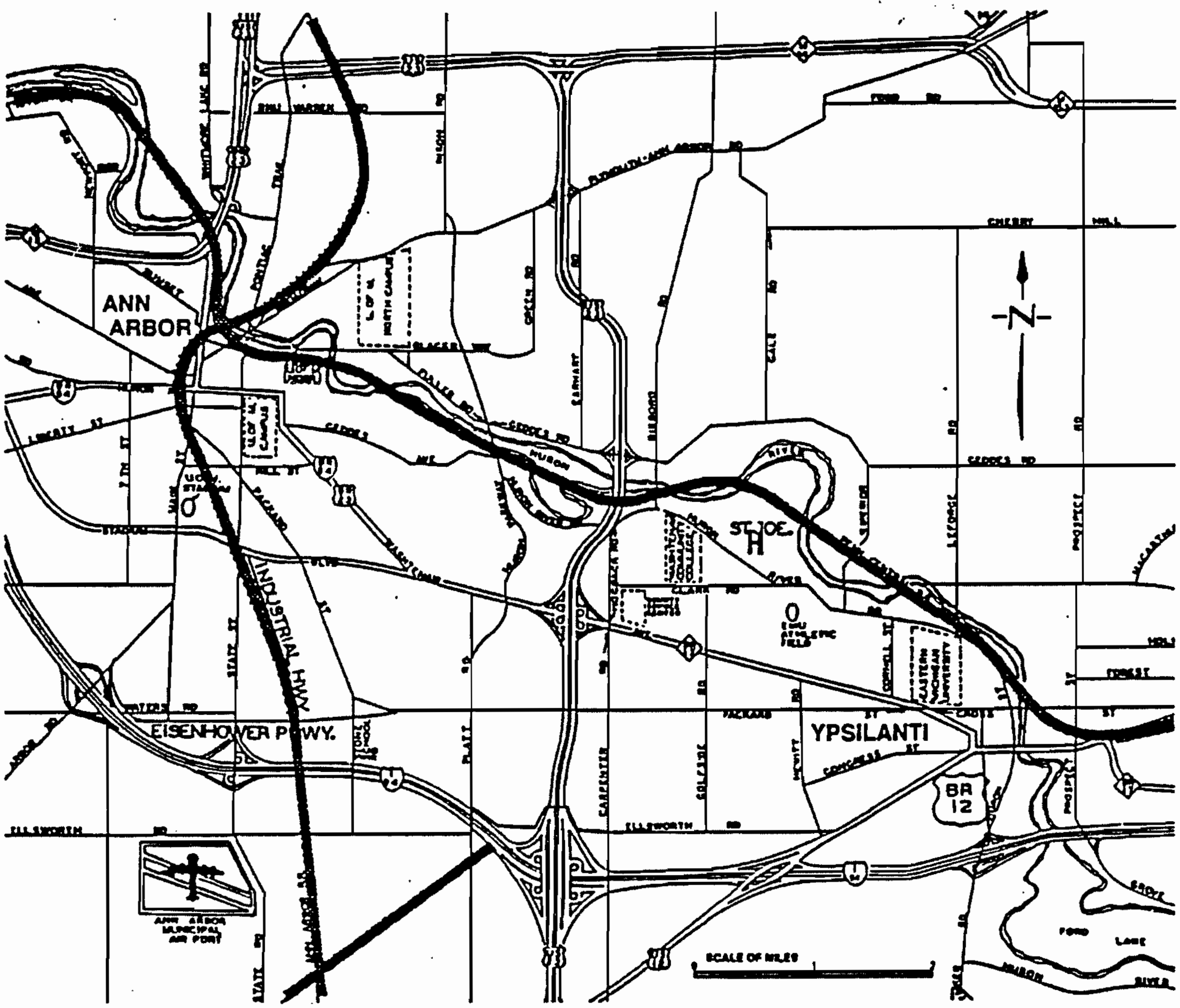
Source: SNV Guided Bus Ann Arbor Report, 1993

Figure 25
Potential Bus Guideway Layout 2



Source: SNV Guided Bus Ann Arbor Report, 1993

Figure 26
Potential Bus Guideway Right-of-Way



Source: SNV Guided Bus Ann Arbor Report, 1993

A wetland is located in the vicinity of Ruthven Park and the Huron Parkway and Windy Crest Drive. The section between Huron Parkway and High Orchard Road is heavily wooded.

Between downtown and Dixboro Road, the Conrail corridor adjoins predominately low-density residential and open space uses. The residential uses are located south of the corridor, predominately between Dow Field and Huron Parkway. Parks and open space which adjoin the corridor include:

- Fuller Park;
- Dow Field; Gallup Park;
- Huron Golf Course; and
- The Huron River and South Pond.

Most of the Conrail corridor, but especially its westerly segment, adjoins or crosses wetlands and floodplains. The section between Huron Parkway and U.S. 23 is located on an embankment which separates South Pond from the Huron River and the corridor crosses the Huron River twice at the Municipal Golf Course. The embankments along the corridor, west of Huron Parkway, are heavily wooded.

To the east of Dixboro Road, the corridor is partially undeveloped. Major land uses along this segment are:

- The Catherine McAuley Health Center,
- The Wastewater Treatment Plant,
- Parker Mill County Park,
- Forest Park,
- Washtenaw Community College, and
- Eastern Michigan University.

The easterly segment of the Conrail corridor also adjoins wetlands and floodplains, especially east of the McAuley Health Center. This segment crosses Fleming Creek once and the meandering Huron River four times. The only significant wooded areas in this segment are at Parker Mill County Park and Forest Park and in the vicinity of Superior Road.

The Geddes/Fuller and the Conrail corridors are highly scenic and offer many vistas and views of the Huron River, the parks, and the institutional facilities in the corridor. The Conrail corridor is somewhat secluded because it is located at the bottom of the embankment and it is screened by vegetation.

Meetings have been held with Conrail officials concerning the possibility of placing a bus guideway in the right-of-way. Conrail has been approached by several agencies regarding use of this right-of-way:

- Amtrak is investigating the possibility of running high-speed rail through the corridor. Conrail's right-of-way through Ann Arbor is one segment of the only direct rail ground link between Detroit and Chicago.

- The City of Ann Arbor Parks and Recreation Department desires use of the right-of-way for pedestrian and bicycle use. The potential for constructing pedestrian overpasses in city parks adjacent to the right-of-way has also been presented.

- In this study, Ann Arbor Transportation Authority (AATA) desires to construct a bus guideway in the right-of-way to serve as a transit-only, line-haul route between Ypsilanti and downtown Ann Arbor.

Conrail officials have not objected to further investigation of placing a bus guideway in the right-of-way. However, Conrail will not support any proposal in which they may be liable for the safety and/or well-being of passengers, or which may adversely affect the services they provide to their customers. Although Conrail ships freight and not people, they do not necessarily oppose the combined movement of people and goods within the same right-of-way provided that all measures have been taken to do so safely, and at the same or better service rate as before. Furthermore, Conrail will assume no responsibility to provide these measures. All costs and efforts must be provided by the proposing agency. Conrail strictly enforces these policies.

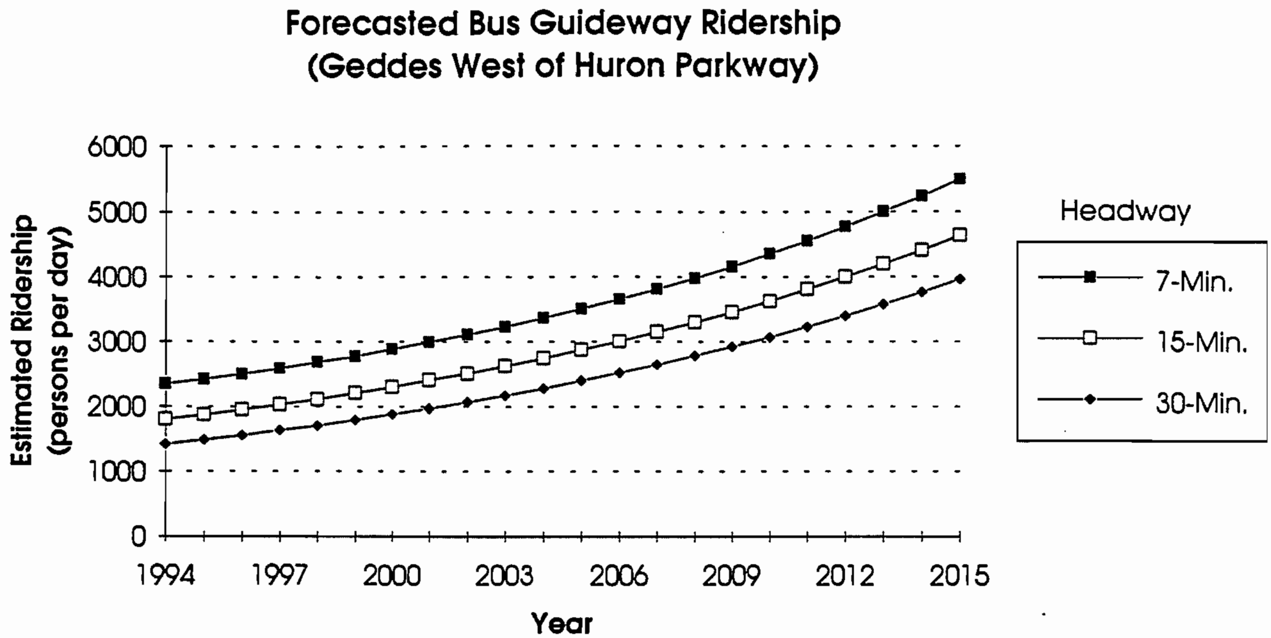
Strategy Analysis

Analyses considered the bus guideway as a transit-only, HOV facility. Buses were assumed to travel 55 mph while on the guideway with no stops between proposed stations. Four stations are of definite possibility, including:

- Terminus location near LeForge Road, servicing Eastern Michigan University and downtown Ypsilanti,
- McAuley Health Center,
- Dixboro Road, and
- University of Michigan Medical Center terminus, servicing downtown Ann Arbor destinations.

Ridership on the bus guideway was forecasted using the disutility model as presented earlier in this report. Results of that model are presented again in Figure 27. Ridership forecasts estimate ridership to triple between 1994 and the forecast year 2015. This estimation assumes 7½-minute bus headways. This forecast also includes additional feeder bus service to the guideway.

Figure 27
Forecasted Bus Guideway Ridership



Accompanying the guideway are park-and-ride lots at the station locations. These lots are necessary amenities to the bus guideway. Pedestrian traffic enhancements such as sidewalks, crosswalks, and signal buttons are also required to assure safety in pedestrian-vehicle interaction at these sites. Other enhancements (e.g., fences, barriers, etc.) may also be necessary along the guideway to minimize the number of illegal pedestrian and bicycle crossings of the right-of-way.

The proposed bus guideway offers many advantages. Transit ridership is expected to increase significantly due to the improved service and lessened trip times. Table 16 lists estimated new and total ridership on the bus guideway. From the table, by the year 2015, the number of new riders on the bus guideway approaches forecasted ridership for continued, existing transit service for the same year. This table demonstrates that over time more people will leave their private automobiles and choose to ride buses utilizing guideway. As a result, the "value" of the guideway actually appreciates as traffic congestion worsens.

TABLE 16
ESTIMATED BUS GUIDEWAY NEW AND TOTAL RIDERSHIP

Year	Transit [1] Daily Ridership	Bus Guideway [2] New Riders	Bus Guideway Total Ridership
1993	1,154		
1994	1,199	798	1,952
2000	1,511	951	2,462
2005	1,832	1,213	3,045
2015	2,693	2,178	4,871

[1] Existing service with 30-minute headway.
[2] Assumes 7½-minute headways during peak hours; 15-minute headways during off-peak hours.

Other benefits may also be attributed to the bus guideway. Trip time savings on the bus guideway are estimated at 5 minutes or more, which is sufficient time to motivate commuters to switch their preferred transportation mode. Servicing these trips in the Conrail corridor reduces traffic on Geddes/Fuller Road causing automobile travel speeds to increase. These benefits improve traffic flow leading to reduced potential for accidents and improved air quality. Person and vehicle throughput both increase in the corridor without adding traffic to existing low traffic roadways. Noise is also expected to be reduced slightly on Geddes/Fuller Road. Finally, the presence of the guideway may give Ann Arbor greater national visibility.

The greatest disadvantage of the bus guideway is its cost. (Costs are presented in the Appendix Screen 3 cost estimate.) Estimated cost for the guideway equals approximately $16.6 million. Additional costs are required to retrofit existing AATA buses with the guideway equipment. SNV estimates this cost as 5 percent of the bus purchase price, or about $10,000 per bus. Park-and-ride lots at station locations add about $1.0 million more to the total cost. Construction of the bus guideway may require widening of existing bridge structures, which could add to the total cost, as will the purchase and/or lease of Conrail's right-of-way. Finally, insurance costs for moving people within the right-of-way must also be considered. Insurance costs are presently unknown. Assuming a useful life of 30 years and 7 percent interest, the bus guideway alternative will cost just over $1.3 million annually in capital costs plus another $1.5 million for operation and maintenance.

The bus guideway may impact existing slopes, wetlands, woodlands, and other natural features. The potential widening of bridges in the Conrail right-of-way may also require acquisition of additional land, which could impact these features. Detailed analyses to identify specific impacts on these features is dependent upon the guideway technology and beyond the scope of this study.

The bus guideway will likely reduce noise and pollution on Geddes/Fuller Road, but may actually add noise and pollution to the Conrail right-of-way. Presently, only 8 to 12 trains per day utilize the existing railroad track; the bus guideway (as described in this section) will generate over 60 bus trips daily. Some people may feel that the buses harm the serene environment and detract from the corridor's aesthetic beauty.

Despite the potential disadvantages of the bus guideway, it most comprehensively satisfies the established goals and objectives as demonstrated by the many positive impacts on the evaluation criteria. Provided that Ann Arbor and its citizens accept the costs to construct, operate and maintain the bus guideway, actual benefits of the guideway will last long-term, or at least throughout its useful life. The bus guideway alone cannot remedy capacity deficiencies due to forecasted travel demand, but its impact is a significant step in doing so.

Potential Advantages

- Transit ridership is expected to increase up to 7 percent annually.
- Trip time savings of 5 minutes or more can motivate commuters to switch their preferred transportation mode.
- Traffic congestion, noise, and pollution is reduced on Geddes/Fuller Road.
- Improved traffic flow leads to reduced potential for accidents.
- Person and vehicle throughput both increase in the corridor without adding traffic to existing low traffic roadways.

- The guideway will add national visibility to Ann Arbor.
- Benefits of the guideway are long-term and satisfy the study's goals and objectives.

Potential Difficulties

- Additional costs for capital and O&M expenses; additional liability costs may be a factor along an active Conrail railroad track.
- Structures may need to be widened which could lead to negative impacts on slopes, wetlands, woodlands, and other natural features.
- Directing travel onto the Conrail right-of-way has the potential to negatively impact air and noise in the immediate vicinity.
- Service is limited to guideway access points

Extend Existing HOV on Geddes/Fuller

Potential Recommendation

- Do not consider extending the existing HOV lane at this time. HOV feasibility criteria cannot be satisfied on Geddes/Fuller road between Huron Parkway and downtown Ann Arbor.

Strategy Analysis

Research into the use of high-occupancy vehicle lanes on suburban arterials streets has revealed a set of criteria for successful implementation[3]. It is suggested that all of the following criteria be met in order to justify feasibility of an HOV facility.

1. *Congestion*: Although a universal definition of traffic congestion does not exist, metro agencies typically designate LOS E and F (speeds about 10 mph) and signal delay between 40 and 60 seconds as criteria for HOV use. This criterion is met on occasion by the Geddes/Fuller corridor in the peak hours.

2. *Travel Time Savings*: A minimum of 5 to 7 minutes of travel time savings are required on HOV lanes for demonstrated effectiveness in travel mode shift. The proposed length of HOV extension is approximately 1.4 miles. In the peak hours, traffic flows an average of approximately 25 miles per hour (3.4 minutes). A five-minute

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[3] Turner, Shawn M. *High-Occupancy Vehicle Priority Treatments on Suburban Arterial Streets.* Graduate Student Papers on Advanced Traffic Management Systems, Civil Engineering Department, Texas A&M University, Texas Transportation Institute, August 1992.

time savings is not possible unless average traffic flow were 12 mph, and an HOV lane provided uninterrupted flow at a minimum of 40 mph. This criterion is not satisfied.

3. *Minimum HOV-Lane and Person Throughput*: HOV lane throughput should service at least the same number of person trips as a regular general-use lane. To determine the demand on the HOV lane, consider:

    - Corridor Growth--short term (2 yrs max.);

    - Latent Demand--estimated as 2/3 of HOV demand;

    - Diversion of other HOVs from Parallel Routes--primary route diversion of 80 percent and secondary route diversion of 25 to 50 percent per route.

    - Present occupancy in the corridor is 1.10, or approximately 10 percent HOV; and 1.09 for both Plymouth Road and Washtenaw. Using occupancy as a surrogate for HOV demand, expected demand on the HOV facility would yield an occupancy rate of 1.28, or roughly 28 percent HOV use.

    - Presently a regular lane services approximately 1000 SOVs per hour in the peak direction. Minimum use at 28 percent HOV use for two-person HOVs is 560 persons per hour; three-person HOVs is 840 persons per hour; and four-person HOVs is 1,120 persons per hour. Therefore, minimum four-person carpools would be required for the same person throughput for a general use lane. Outside of vanpool programs, four-person carpools are rare. This criterion is not met by conditions expected in the corridor over the next two years.

4. *Agency and Public Support*: Agencies must cooperate together to make arterial HOV facilities work. Based upon the analyses in *Minimum HOV-Lane and Person Throughput* above, public acceptance is not likely unless a large portion of all vehicles in the corridor contained 4-person carpools. This criterion is highly unlikely, especially in the short term.

5. *Enforceability*: Enforcement of the HOV policy is critical to successful use of an HOV facility. Present enforcement of the existing HOV is non-existent; no information or plans indicate that enforcement will be made in the future. HOV-lane enforcement for a new facility will be difficult because motorists are accustomed to ignoring it. This criterion is presently not met, but could be by cooperating with the Ann Arbor police department.

6. *Physical Characteristics of the Roadway*: Providing an HOV lane would require widening, which is strictly opposed by the Citizens' Advisory Committee. Even if widening were desired, costs would be high to provide the special geometric and signal preemption features necessary to meet required travel time savings. Under given conditions, this criterion is not met.

7. *Safety*: A general rule of HOV safety is that the number of occurring accidents on the HOV facility should be less than that on an adjacent, general use lane. Without some form of separation or physical barrier between the two lanes, achieving this requirement would be difficult. In addition, the speed on the HOV lane versus the speed on the regular use lane could easily exceed 25 mph, which increases the potential for accidents.

Based upon the failure of an HOV to satisfy six of these seven criteria, recommendation of an HOV facility was eliminated from the possibilities of alternatives for the short term.

Widen Geddes/Fuller to Four Lanes

Potential Recommendation

- Do not widen Geddes/Fuller Road.

Existing Conditions

The Geddes/Fuller corridor is a two lane, rural highway running almost parallel to the Huron River. Between and including the intersections of Dixboro Road and Geddes Road, and Fuller Road and Glen Avenue, there are eight signalized intersections. There will be ten intersections upon completion of the Oak Way realignment. Typically the two-lane configuration flares wider at intersections to accommodate added turning lanes. East of Dixboro Road, there is little access control with many residential driveways and mostly unpaved private roads abutting Geddes Road.

Pavement conditions on Geddes/Fuller vary per location, but are mostly fair to good. A few locations have many potholes and cracking pavement, and are in need of repair. Beyond the pavement edge, a small shoulder exists in either direction. For much of Geddes Road east of Dixboro Road, vegetation covers the shoulder and even encroaches upon the travel lanes in some locations rendering the shoulder virtually unusable.

Strategy Analysis

Forecasted traffic volumes in Geddes/Fuller corridor call for added capacity. Travel demand management techniques cannot fully mitigate

Ann Arbor's future travel demand. Widening from two lanes to four lanes would almost double capacity, vehicle throughput and person throughput. In conjunction with traffic signal optimization and progression, trip travel times would be reduced by more than 5 minutes.

Better roadway facilities generally attract greater amounts of traffic. More traffic leads to degradation of air quality, more noise, and more severe impacts on the environment. Widening also requires acquisition of right-of-way which can negatively impact property owners, and even force some to relocate. Right-of-way costs can also be very expensive and require several years to acquire land. Estimated costs for widening the roadway to four lanes between Oak Way and Dixboro Road equal about $14 million. Operating and maintenance costs equal approximately $110,000 annually.

Potential Advantages

- Benefits all travelers of many different modes,
- Virtually doubles present person and vehicle throughput in the corridor, and
- Minimum 5-minute time savings on all trips.

Potential Difficulties

- Attracts greater traffic volumes,
- Increased traffic negatively impacts noise and air quality, and
- Costs can be very high--right-of-way acquisition.

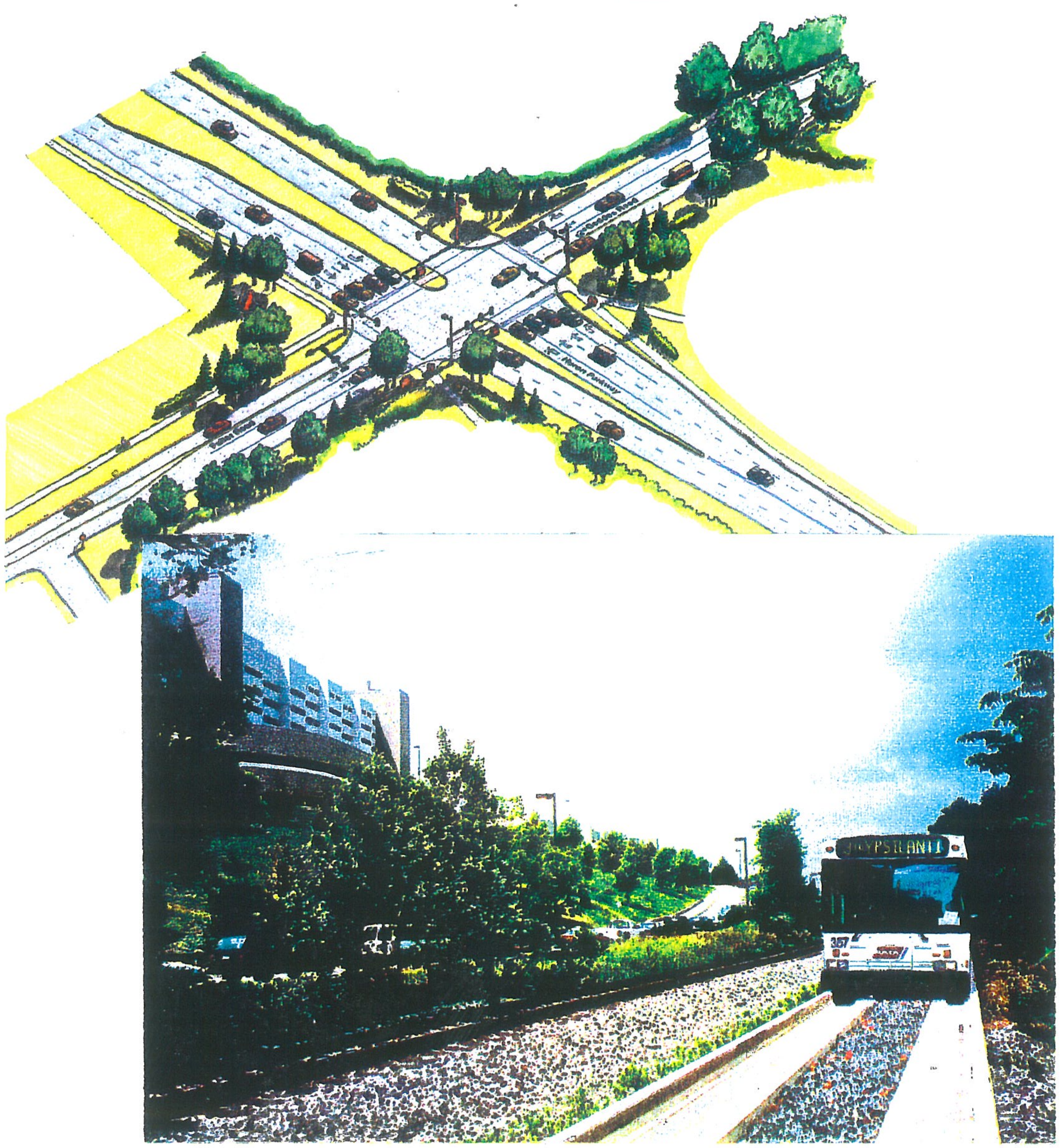
Do Nothing

Potential Recommendation

- Do not do nothing. Ann Arbor is growing and will continue to do so. This option is not reasonable and was evaluated for comparison purposes only.

Geddes/Fuller/Conrail

Corridor Study



June 1994

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Cost - Benefit Evaluation

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, <u>not</u> 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:

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

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-Improvement	Year 2015	Post-Improvement	Year 2015	Post-Improvements	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.

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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 ÷ 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:

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

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:

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

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 desireable) rank = 1; lowest = 19.*

Table 19
Overall Strategy Rankings

Strategy	Cost-Benefit Criteria (Criteria 15-17 only)		Non-Cost Criteria Screen 3	**Final Overall Ranking (Criteria 1-17)**	
	P-Imp	Yr. 2015	(Criteria 1-14)	**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 desireable) 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.