APPENDIX I
ACCESSIBILITY ANALYSIS

Think Forward

Memorandum

TO: Strand Associates, Inc.

FROM: Cambridge Systematics

DATE: September 2024

RE: Madison Beltline PEL: Accessibility Analysis

This memo is a summary report of the accessibility analysis for the Madison Beltline Planning and Environmental Linkages (PEL) study. It consists of two main sections. Accessibility benefits of the individual components are presented in section 1, and the strategy packages are evaluated in section 2.

Section 1: Individual Components

In this section, the accessibility benefit results of Madison's Beltline crossings are presented with maps and tables. Providing theory, context, or interpretation of the results is not the intent of this section as these have been reported elsewhere. The purpose is to present the key results of the accessibility study in one place for convenience.

There are two types of crossings across the beltline: all-modes crossings and what we call PedBike crossings. All-modes crossings enhance access for motor vehicles as well as non-motorized users. However, PedBike crossings are only used by non-motorized users.

PedBike crossings are facilities that provide high utility access for both pedestrians and bicyclists. They can either consist of two separate paths side by side or a shared-use path with no motor traffic. To achieve this, such component must be both pedestrian- and bicycle-friendly.

A path is pedestrian-friendly if all necessary safety and security measures are in place. This often means being compliant with Americans with Disabilities Act (ADA), fully separated from motor traffic, well-lit at night, and having properly maintained surface for comfort. To make the facility bicycle-friendly, it typically requires a low level of traffic stress (LTS), also known as bicycle level of traffic stress (BLTS). According to practices in many US locations, this means the facility should have an LTS of 2 or lower. For more information, see LTS guideline[1].

[1] The LTS criteria was first developed by Peter Furth. It was published in 2012. Link to the Guideline.

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All-Modes Crossing Facilities

Five all-modes crossings are considered across the beltline, A, C, D, E, and F, as shown in Figure 1. Detailed maps of the accessibility benefits for the Auto mode in the county's Traffic Analysis Zones (TAZ) are presented in Appendix A.

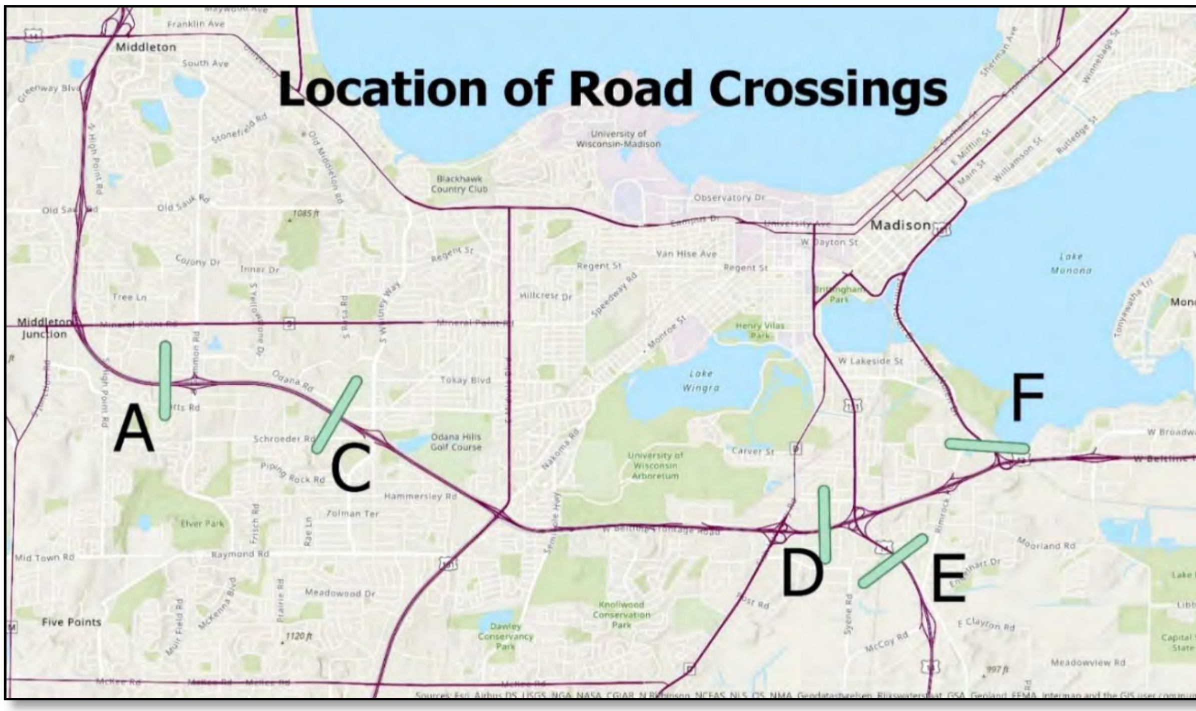

Figure 1 Road facility options for motor vehicle passage across the beltline

It is a premise of the accessibility study that the five roadway crossings above will also be used by non-motorized users. So, a PedBike facility will also be located next to the motorway at each of these locations. Therefore, it is generally expected that pedestrian and bicycle accessibility to be enhanced by the construction of these projects. For detailed maps on the accessibility benefits for pedestrians and bicyclists in the county's Traffic Analysis Zones (TAZ) see Appendices B and C.

Since none of the currently operating transit routes pass through these crossings, the model shows none to very little transit travel time enhancement due to the construction of these bridges. So, the results are shown in Table 1 only for auto, walk, and bike modes.

Table 1 Accessibility Score for the Five Road Crossings

Crossing or Pathway Alternative	**Accessibility Score** (out of 100)			
	Walk	Bike	Auto	Overall
CrsA	54	100	100	85
CrsC	27	20	13	20
CrsD	100	91	42	78
CrsE	33	92	29	51
CrsF	0	0	15	5
Weight	0.333	0.333	0.333	

Figure 2 helps visually see how construction of crossing A improves biking access for a TAZ right at the southern end of the crossing. The light purple polygon represents TAZs that are reachable from the TAZ by bike within 10 minutes before the bridge is built; so, we call it the initial reach. The dark purple areas in the figure show the TAZs that are not reachable by bike in 10 minutes or less prior to construction of the crossing. The reason that these dark purple TAZs are mostly located on the northern edge of the initial reach is that the selected origin TAZ for creation of this map is on the southern end of the bridge. Had a TAZ on the northern side of the bridge been selected, the expansion would have occurred at the southern/western side of the initial reach.

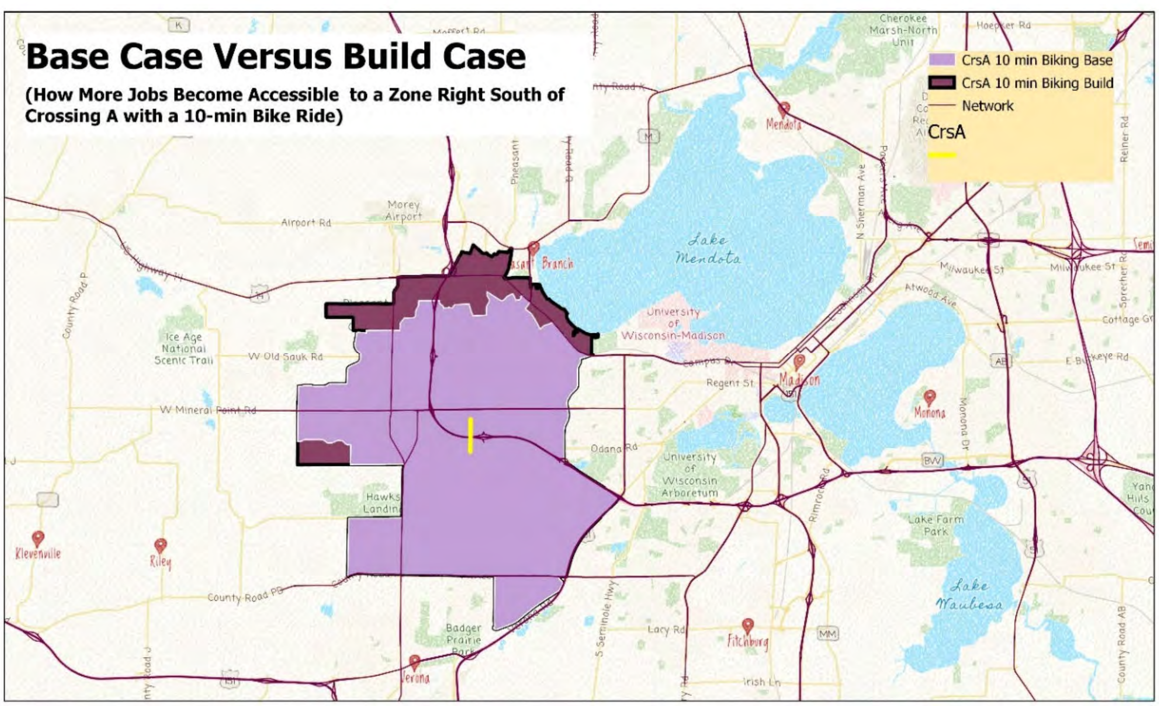

Figure 2 Expansion of bicycling reach from a TAZ near the crossing due to the construction of crossing A

PedBike Facilities

Ten PedBike facilities are considered in the analysis. These facilities are shown in Figure 3. Not all of them cross the beltline. One of them crosses US Highway 14 (PedBike I), one crosses S Whitney way (PedBike D), and four just run along the beltline (PedBikes E, F, G, and MPO1). The rest allow crossing the beltline, though.

Figure 3 Non-motorized users facility options

Results of the accessibility analysis for the walk and bike modes are respectively presented in

Table 2 and

In Table 3, the MPO1 alternative does not improve accessibility for biking because parallel roads north and south of it currently have low LTS. On its north, Mineral Point Rd has a committed bike path of LTS 1. On its south, Watts Rd is LTS 2. In the build scenario, almost all ODs on either tail of the proposed path use these the above-mentioned roads on their shortest paths. This leads to little accessibility improvement for construction of this PedBike path.

Table 3.

For more than half of the PedBike facilities, no score is shown in

Table 2. This is because walking on these facilities to go to work almost always requires investing more than half an hour. This is beyond the threshold the analysis team decided to use for the walk mode. The reason is that not many people are willing to walk to their workplace for more than 30 minutes. So, while each of these PedBike crossings will improve home-to-work travel time for some people, they still have to walk more than 30 minutes when using these facilities. The model will not take these improved travel times seriously because those people are not likely to make those trips.

Table 2 Accessibility Score for the ten PedBike Facilities for the Walk Mode

Crossing or Pathway Alternative	Accessibility Score for Walking (out of 100)
PedBikeA	82
PedBikeB	81
PedBikeD	Model not Sensitive
PedBikeE	Model not Sensitive
PedBikeF	Model not Sensitive
PedBikeG	Model not Sensitive
PedBikeI	41
PedBikeJ	Model not Sensitive
PedBikeMPO1	Model not Sensitive
PedBikeMPO2	Model not Sensitive

In Table 3, the MPO1 alternative does not improve accessibility for biking because parallel roads north and south of it currently have low LTS. On its north, Mineral Point Rd has a committed bike path of LTS 1. On its south, Watts Rd is LTS 2. In the build scenario, almost all ODs on either tail of the proposed path use these the above-mentioned roads on their shortest paths. This leads to little accessibility improvement for construction of this PedBike path.

Table 3 Accessibility Score for the ten PedBike Facilities for the Bike Mode

Crossing or Pathway Alternative	Accessibility Score for Biking (out of 100)
PedBikeA	39
PedBikeB	24
PedBikeD	47
PedBikeE	31
PedBikeF	13
PedBikeG	26
PedBikeI	94
PedBikeJ	45
PedBikeMPO1	0
PedBikeMPO2	79

Section 2: Strategy Packages

In this section, impact of combinations of individual components is assessed as each Strategy Package (SP) involves implementation of multiple improvement components that have been discussed in the earlier stages of the project. The summary provides an overview of the accessibility benefits that can be achieved in three different scenarios: SP2: Higher Priority Components, SP3: Mid-to-High Priority Components, and SP4: All Retained Components. Outputs of the travel demand model runs have been combined in an Excel workbook, which is provided with this memo.

The accessibility benefit to each of the four modes available in the travel demand model – namely walking, biking, riding the bus, and driving – is reported by total number of person-hours saved in the entire modeled region. Total saving associated with a strategy package is defined as the network-wide estimated amount of reduction in travel time by mode and by destination type. Four types of destinations were considered in the analysis: Jobs, Service Locations, Retails, and Schools[2].

The accessibility methodology ignores unreasonable travel choices by precluding certain trips. For example, when it comes to walking, any improved travel time to destinations that are beyond 30-minute walk time are ignored. This ensures that the model only responds to reasonable transportation options.

Depending on the perspective, two sets of results are presented, as follows.

Benefits Weighted by Population

One set of results are travel time improvements weighted upon population of Traffic Analysis Zones (TAZ). Results in this manner are speculative, as they assume what might occur if everyone relied on the same mode of transportation to reach identical destinations. The idea behind these imaginary cases is to account for the OD trips that are not currently observed in the trip tables because there is no reasonable path between them. With accessibility, the study team's intent is to examine latent demand, which would gradually appear if viable options were provided. While unrealistic, these results help to show how investments benefit certain road users more than others, or how differently they impact destination types.

This analysis indicates that, in general, bicyclists benefit more than any other mode as the result of the improvements. Cars and buses are expected to gain a little higher benefits than pedestrians as they can travel to farther destinations (they also have slightly higher access time thresholds). However, they are not expected to achieve benefits as much as bikes because unlike bikes they already benefit from a well-connected network with a lot of alternative routes.

To establish a scoring system, the base scenario score was set to zero, and the score for the highest build scenario (SP4, which requires investment in all the identified components) was set to 100. This allows to estimate how much of the maximum achievable benefit can be gained by

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[2] Of note, service and retail locations are subsets of job locations.

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the low or mid investment scenarios. Figure 4 through Figure 7 show where the strategy packages stand with this scoring system.

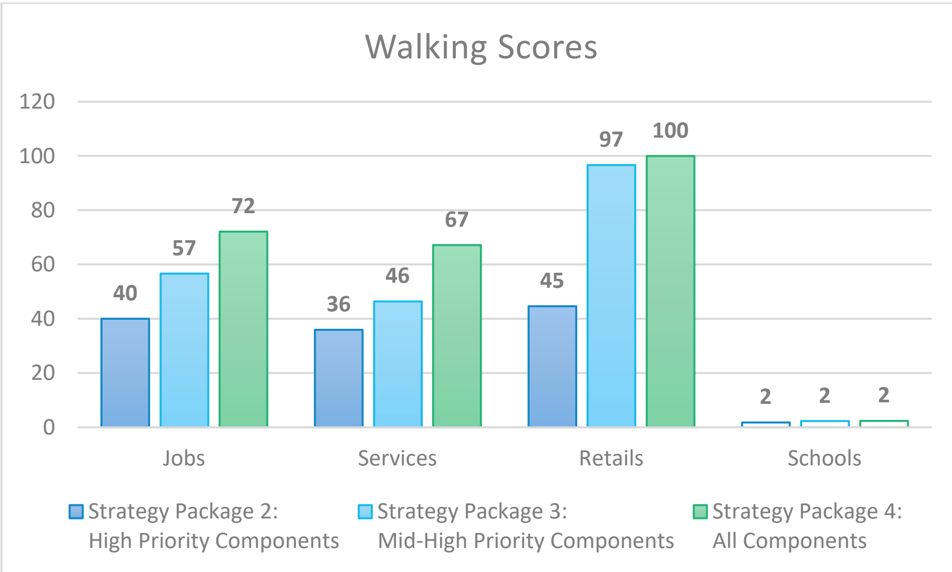


Figure 4 Strategy packages scores for walking by using zone populations for weighting the benefits

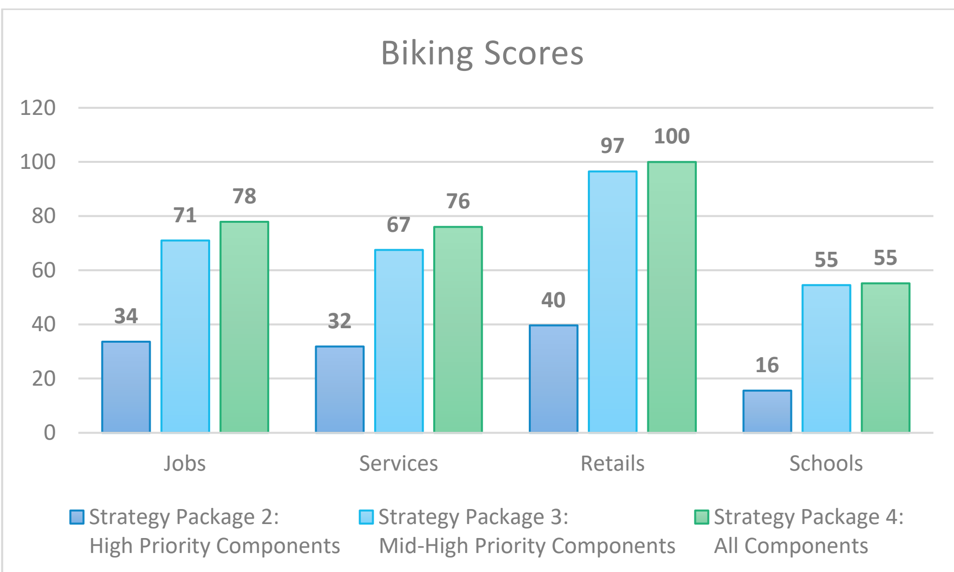


Figure 5 Strategy packages scores for biking by using zone populations for weighting the benefits

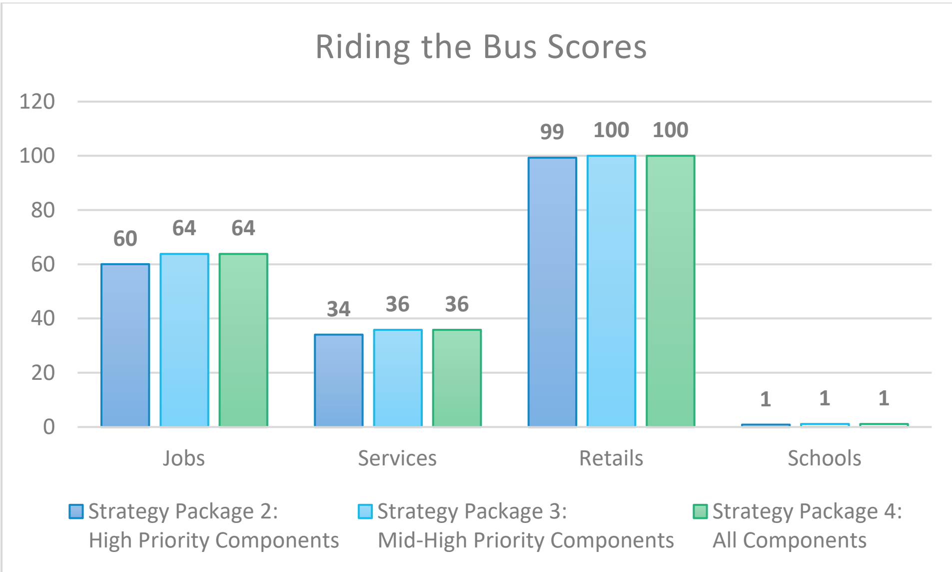


Figure 6 Strategy packages scores for taking the bus by using zone populations for weighting the benefits

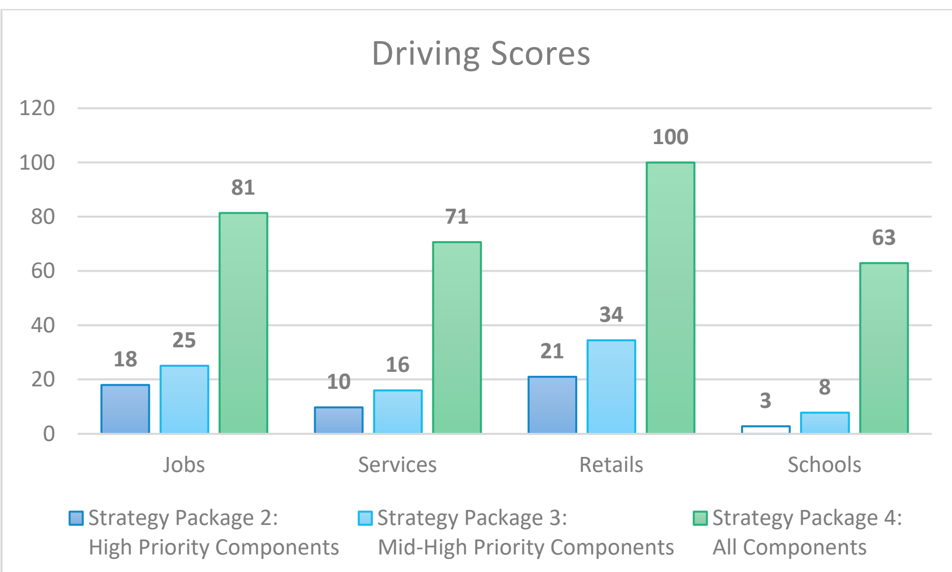


Figure 7 Strategy packages scores for driving a car by using zone populations for weighting the benefits

As an example, in Figure 7, one can see that SP2 and SP3 respectively bring about 21 and 34 percent of the maximum accessibility benefit for driving to retail jobs.

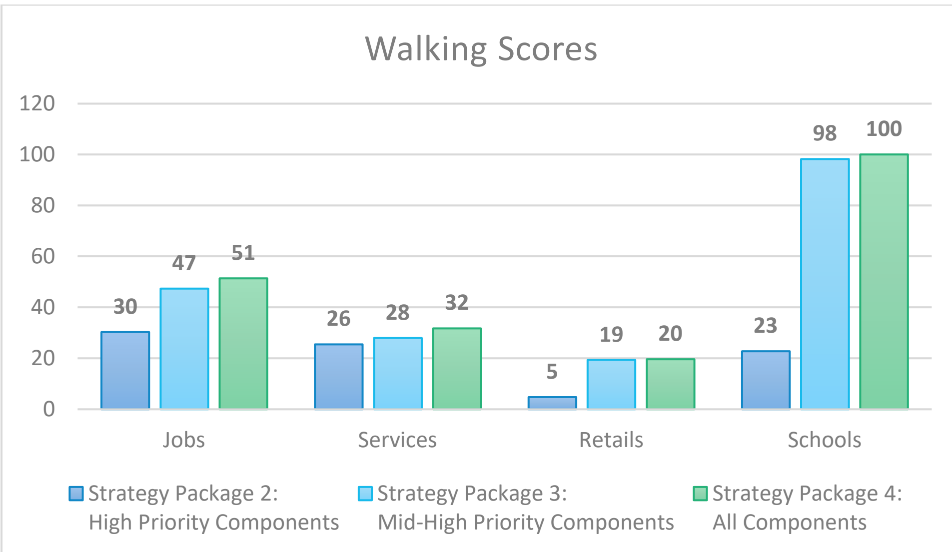
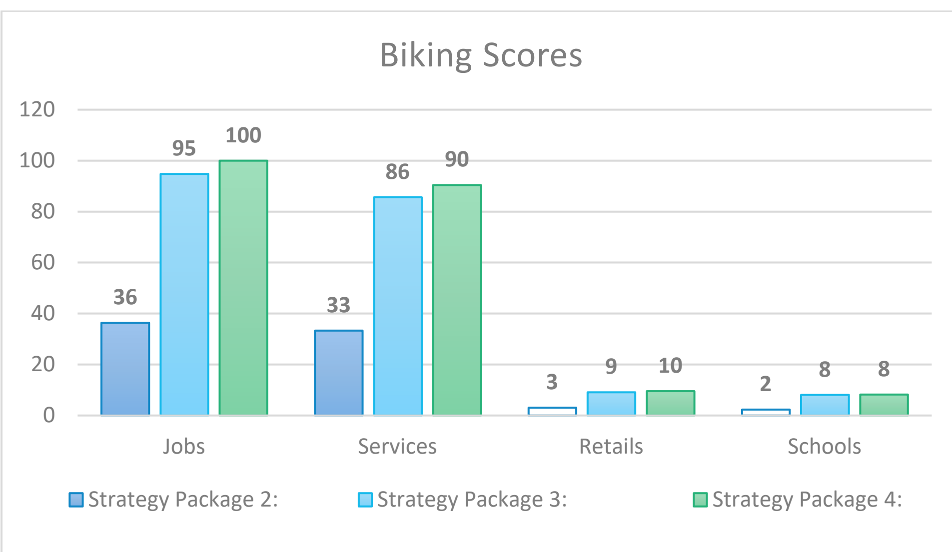


Figure 8 Strategy packages scores for walking by using actual trip tables for weighting the benefits



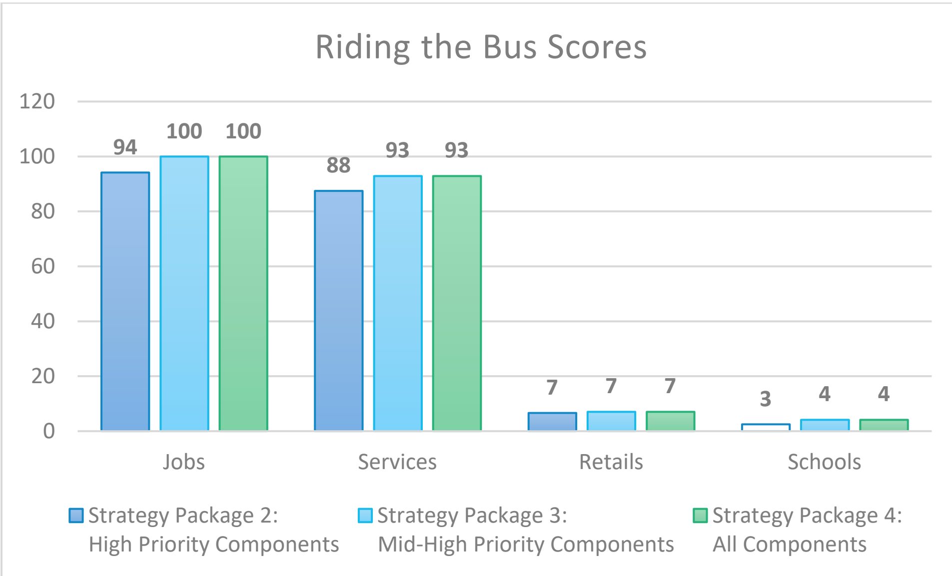


Figure 10   Strategy packages scores for taking the bus by using actual trip tables for weighting the benefits

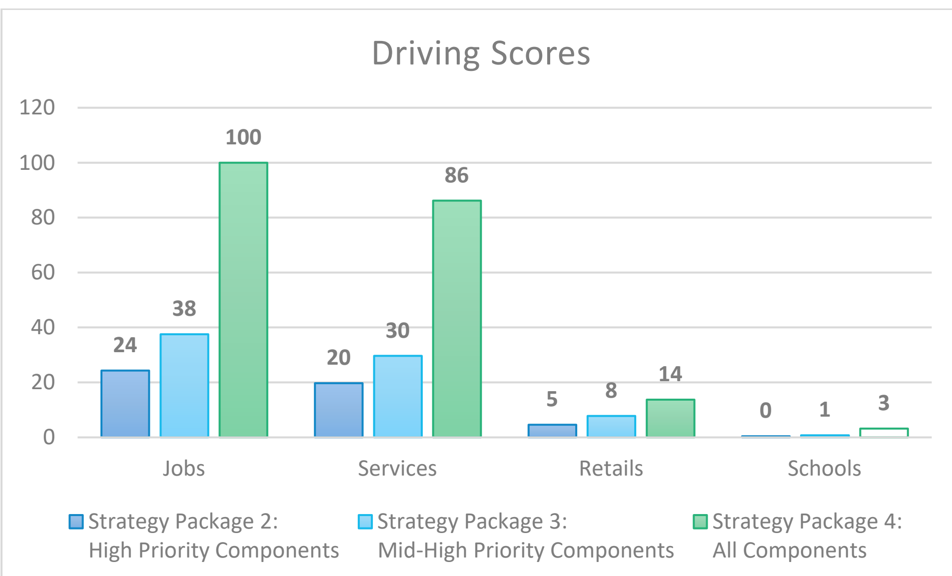


Figure 11   Strategy packages scores for driving a car by using actual trip tables for weighting the benefits

Table 4 shows total number of hours saved during a weekday AM peak period according to 2016 trip tables. Of note, when calculating the total number of hours saved in the last row of this table, the “to Services” and the “to Retails” trips have not been included to avoid double-counting because these savings are already included in “to Jobs” value. Values in Table 4 are the basis of the score calculations that appeared in Figure 8 through Figure 11.

Table 4 Total Number of Hours Saved with Each of the Strategy Packages by Mode and Destination Type During the AM Period

Trip Type	Time Saved in Hours		
	Strategy Package 2: High Priority Components	**Strategy Package 3: Mid-High Priority Components**	**Strategy Package 4: All Components**
Walk to Jobs	6.14	9.6	10.42
Walk to Services	5.17	5.67	6.44
Walk to Retails	0.97	3.93	3.98
Walk to Schools	4.62	19.91	20.27
Bike to Jobs	21.79	56.7	59.82
Bike to Services	19.94	51.25	54.1
Bike to Retails	1.85	5.46	5.72
Bike to Schools	1.38	4.84	4.92
Bus Ride to Jobs	2.26	2.4	2.4
Bus Ride to Services	2.1	2.23	2.23
Bus Ride to Retails	0.16	0.17	0.17
Bus Ride to Schools	0.06	0.1	0.1
Drive to Jobs	8.8	13.55	36.11
Drive to Services	7.14	10.72	31.14
Drive to Retails	1.66	2.83	4.97
Drive to Schools	0.15	0.28	1.16
Total Hours Saved (Total = Jobs + Schools). The Services and Retails values shown in gray added together = Jobs	**45.20**	**107.38**	**135.20**

Figure 12 demonstrates differences in time savings between strategy packages for various modes and job destinations. Additionally, Figure 13 shows a summary of total hours saved for the three strategy packages side by side.

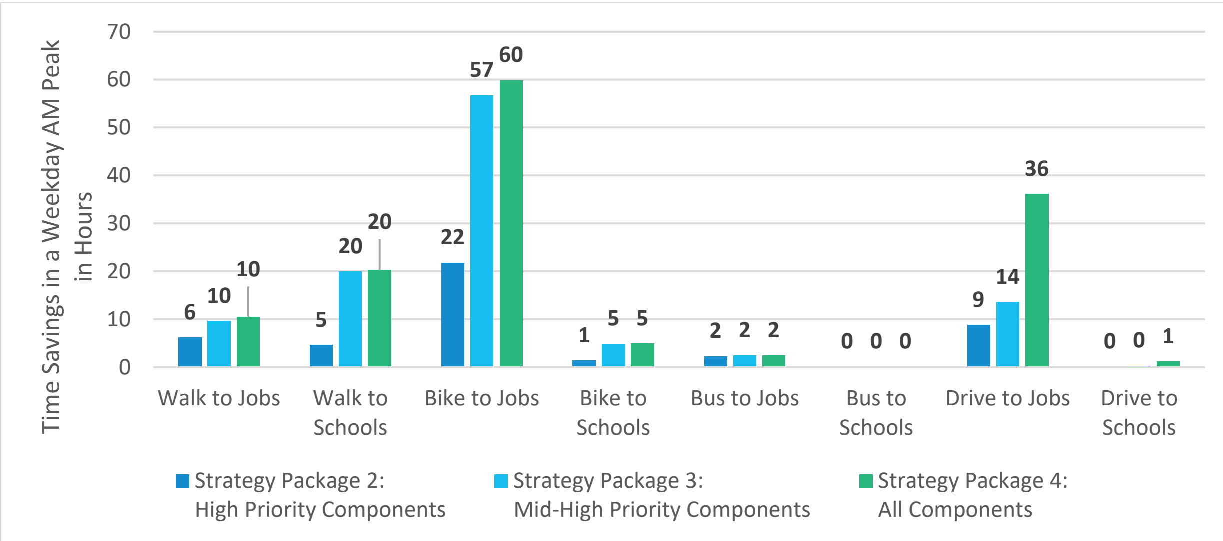


Figure 12 Hours saved by strategy package, mode, and destination type

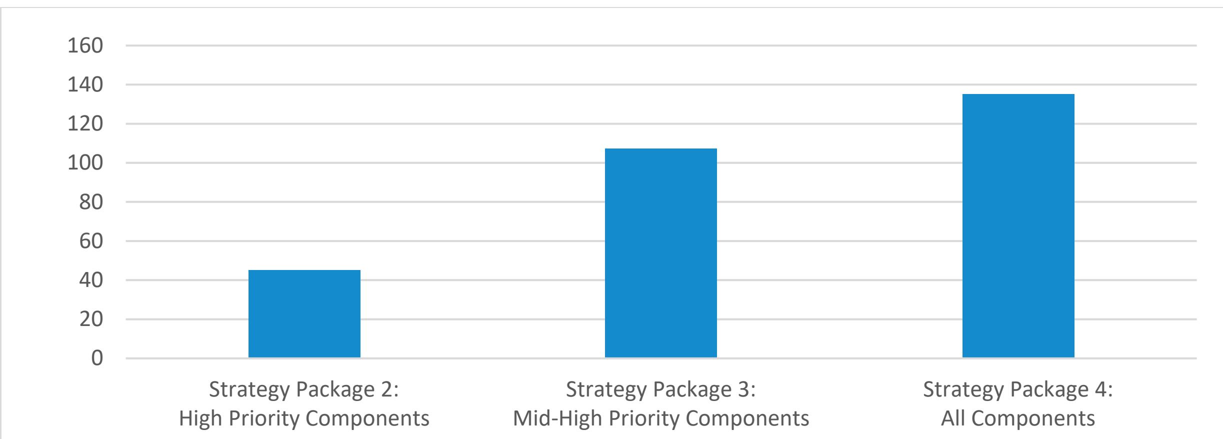


Figure 13 Summary of the magnitude of the saving benefits in the three strategy packages

Summary

In the first section of this memo, the accessibility benefit results for the individual components, including the all-modes crossings and PedBike facilities around Madison's beltline were presented. Results for the two types of facilities, all-modes crossings and PedBike crossings, were reported separately.

In the second section, accessibility benefits of three strategy packages (SP) against a base case as well as each other were evaluated. SP 2 offers a limited number of improvements that have higher priority; SP 3 features medium and high priority improvements; and SP 4 is the full investment scenario with all the recommended improvements included in the package.

Results indicate that, among the four modes that were examined, bicyclists will benefit the most from the enhancements, on the contrary to the bus riders will be marginal.

Overall, considering 2016 trip patterns the hours of travel time savings are;

- SP2 – High Priority Components: 45 Hours
- SP3 – Mid-High Priority Components: 107 Hours
- SP4 – All Components 135 Hours

Appendix A: Accessibility Benefit Maps for Auto Mode

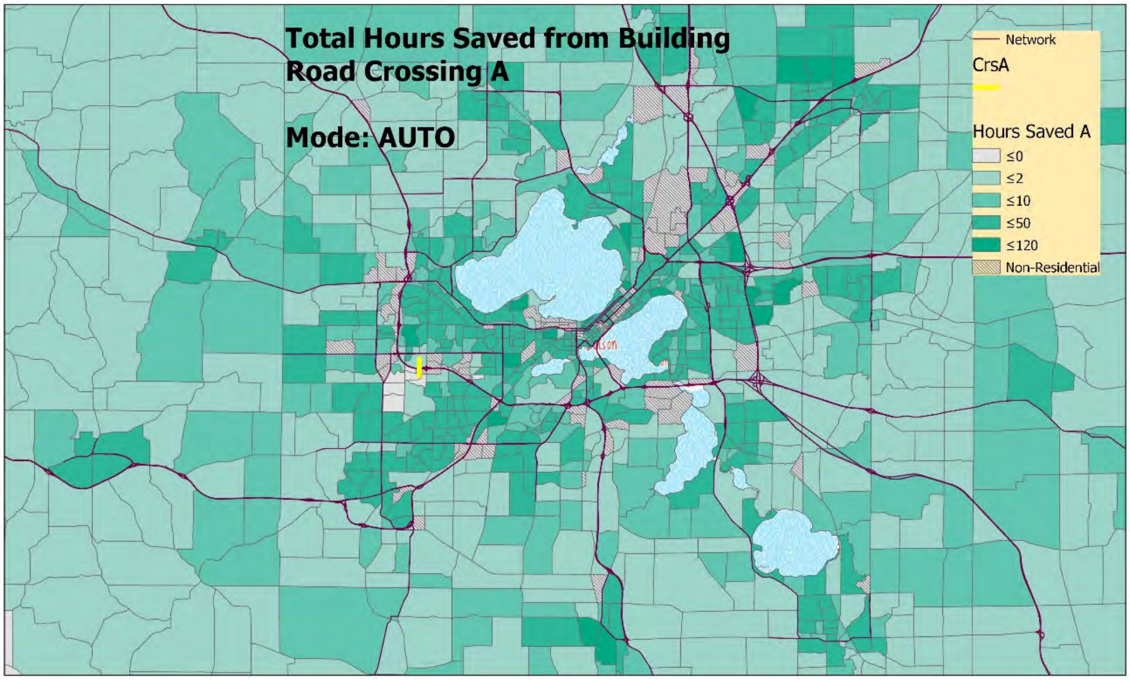


Figure A1 Total hours saved from building road crossing A for auto

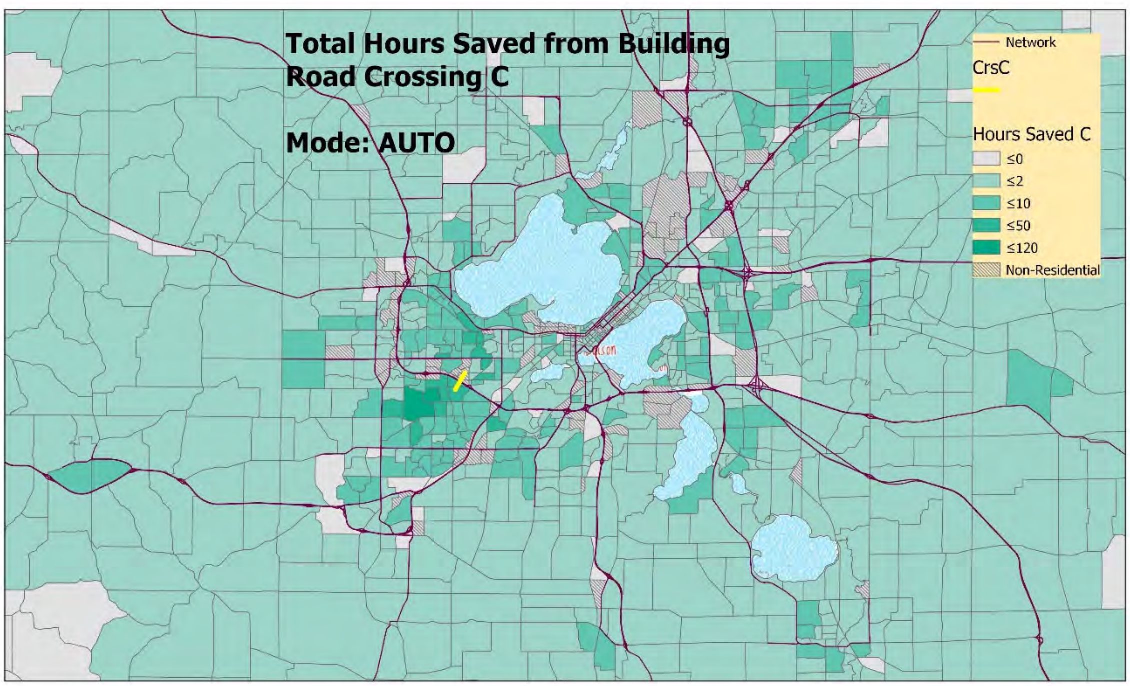


Figure A2 Total hours saved from building road crossing C for auto

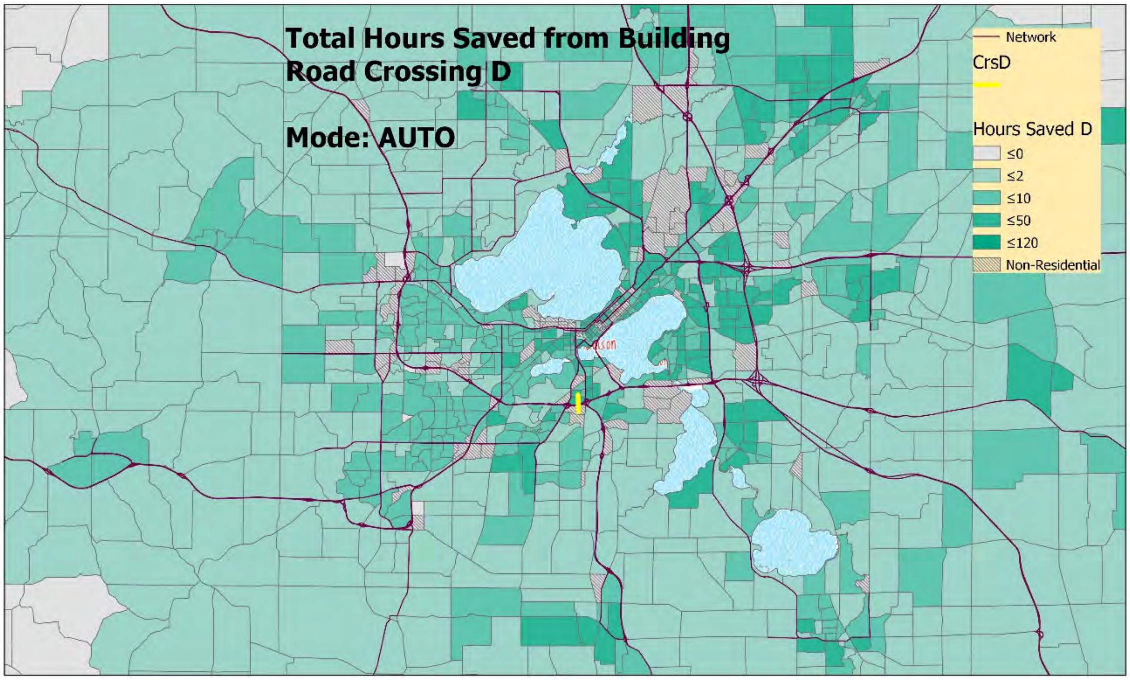


Figure A3 Total hours saved from building road crossing D for auto

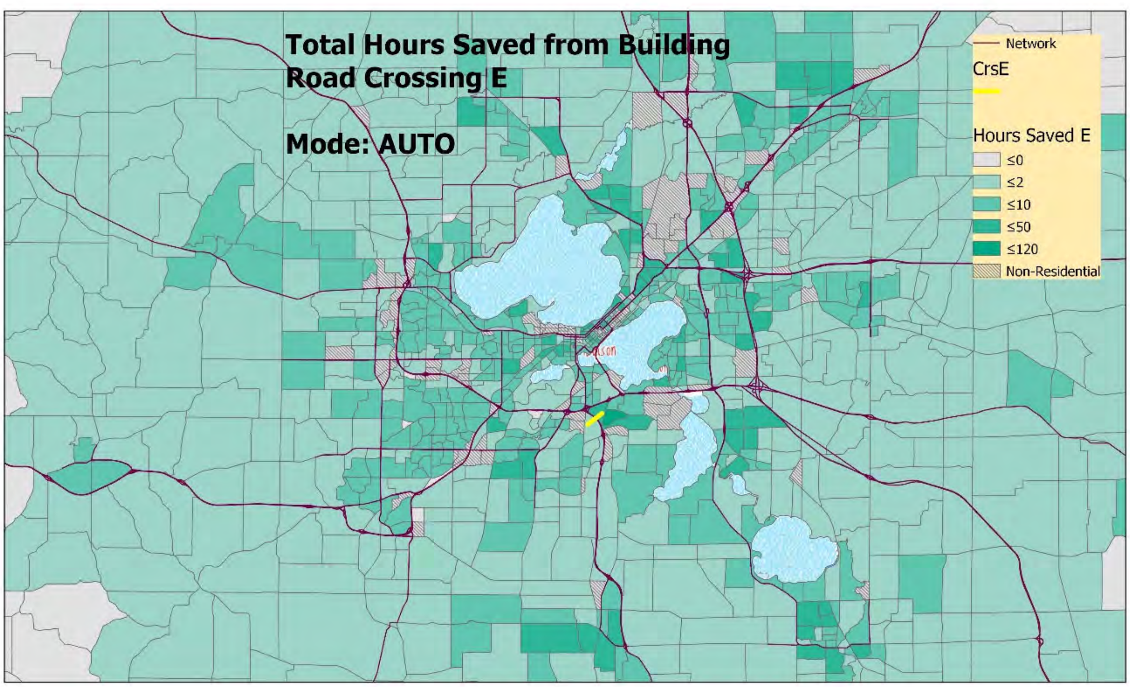


Figure A4 Total hours saved from building road crossing E for auto

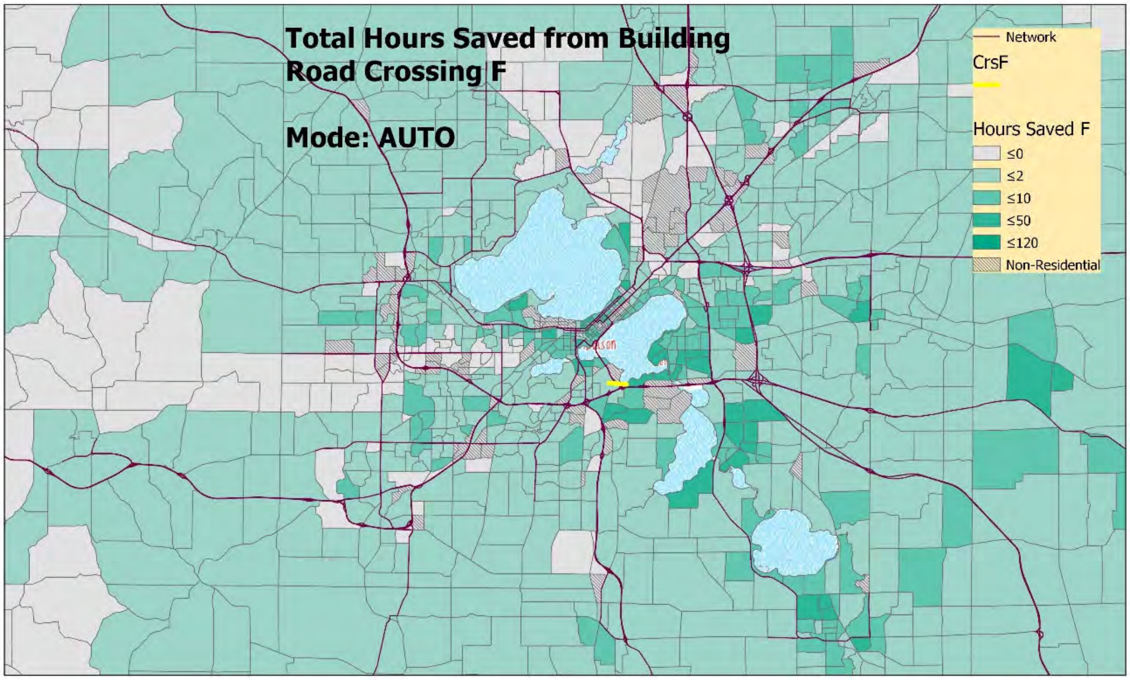


Figure A5 Total hours saved from building road crossing F for auto

Appendix B: Accessibility Benefit Maps for Walk Mode

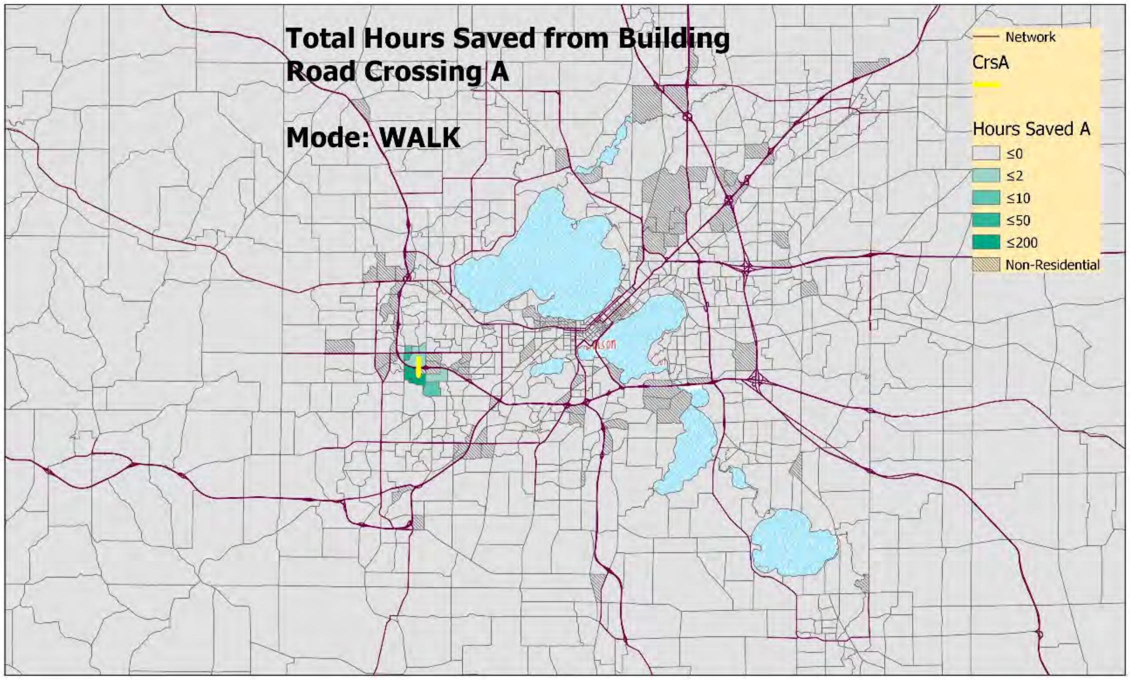


Figure B1 Total hours saved from building a PedBike facility on road crossing A for walking

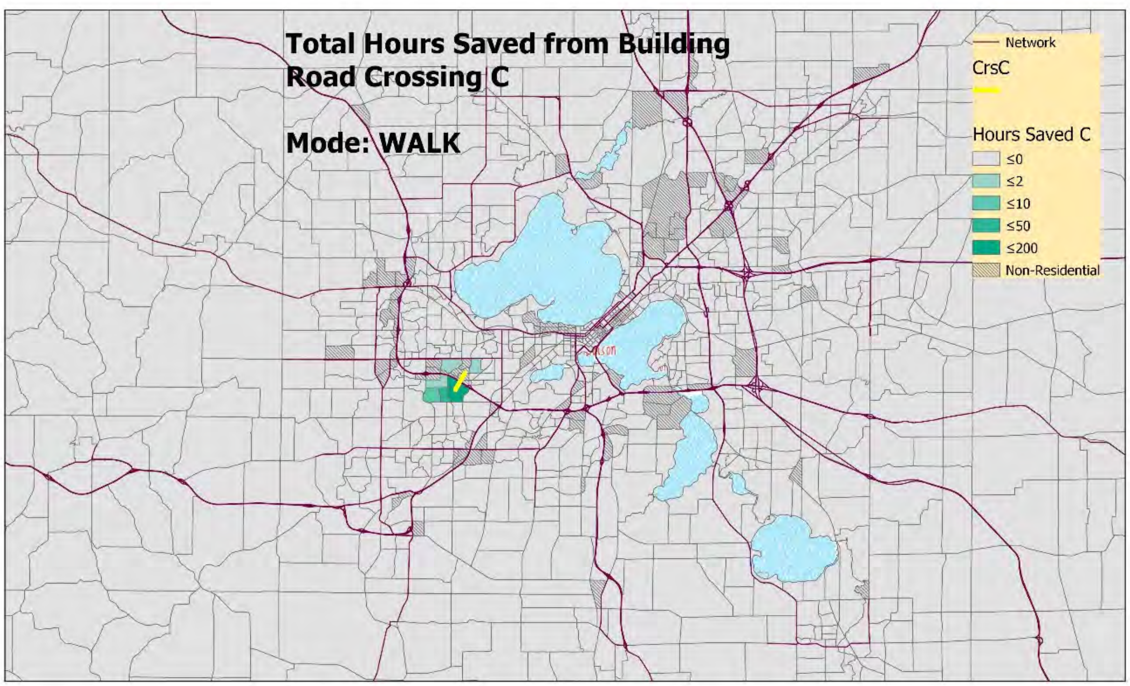


Figure B2 Total hours saved from building a PedBike facility on road crossing C for walking

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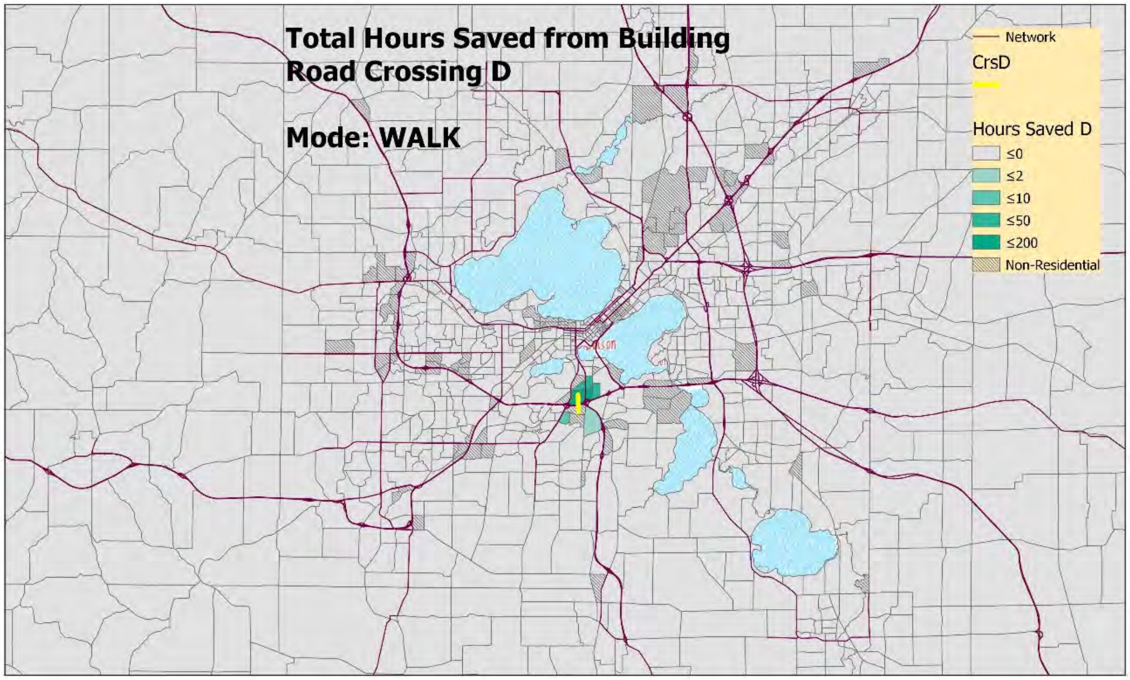

Figure B3 Total hours saved from building a PedBike facility on road crossing D for walking

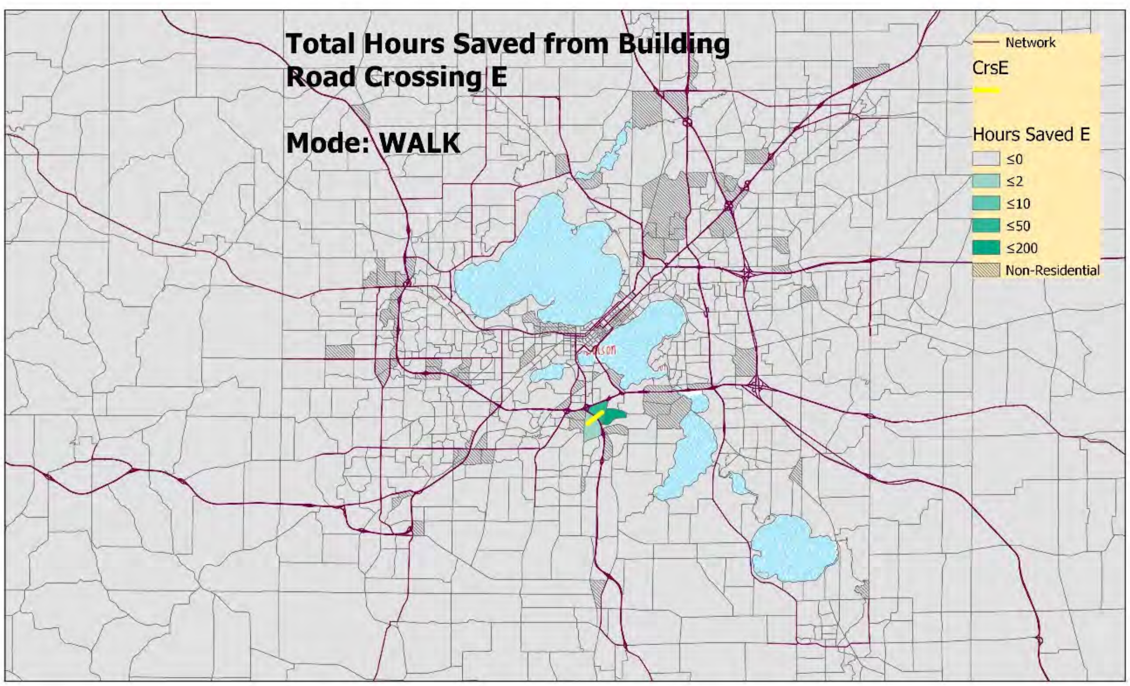

Figure B4 Total hours saved from building a PedBike facility on road crossing E for walking

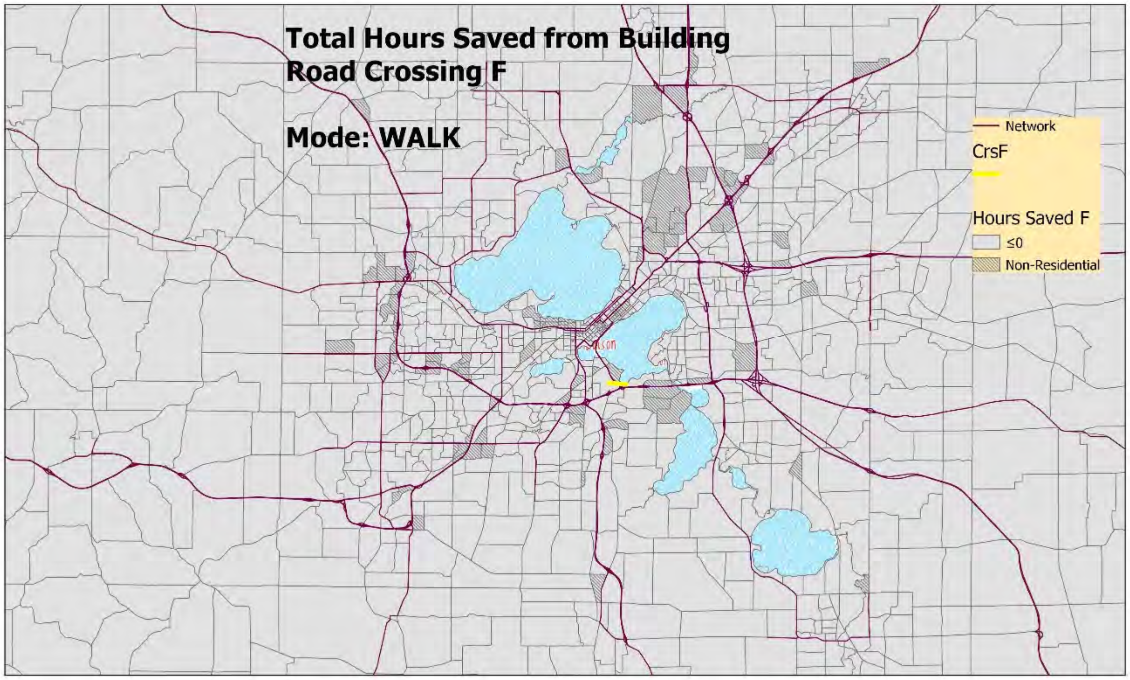

Figure B5 Total hours saved from building a PedBike facility on road crossing F for walking

Appendix C: Accessibility Benefit Maps for Bike Mode

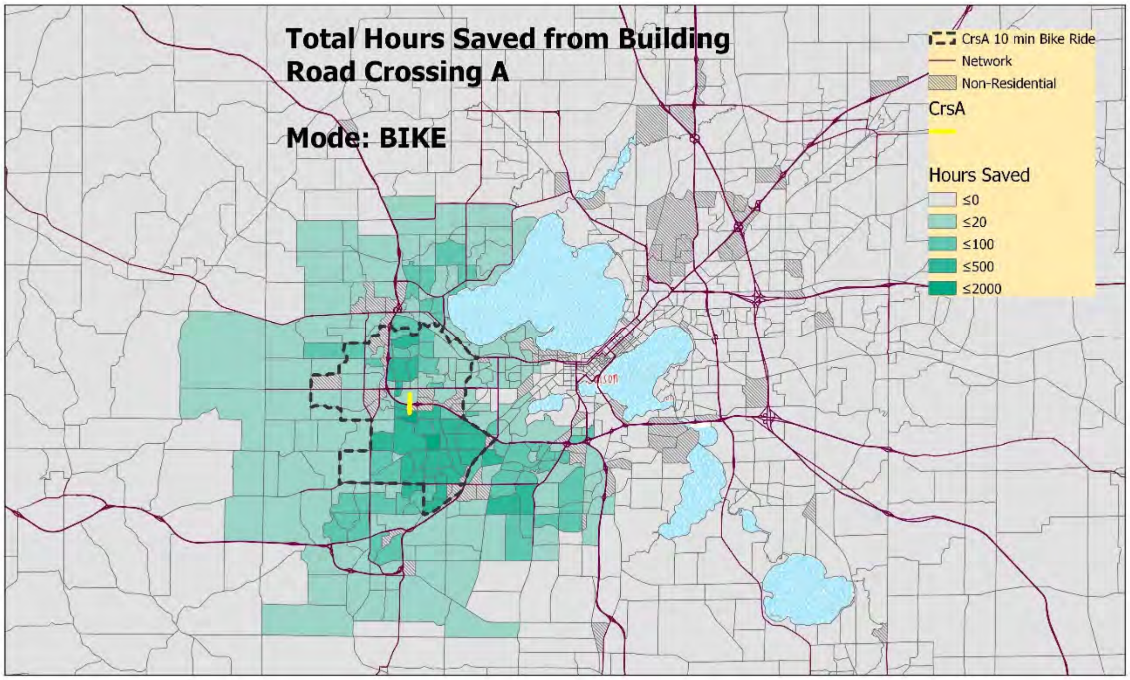

Figure C1 Total hours saved from building a PedBike facility on road crossing A for bicycling

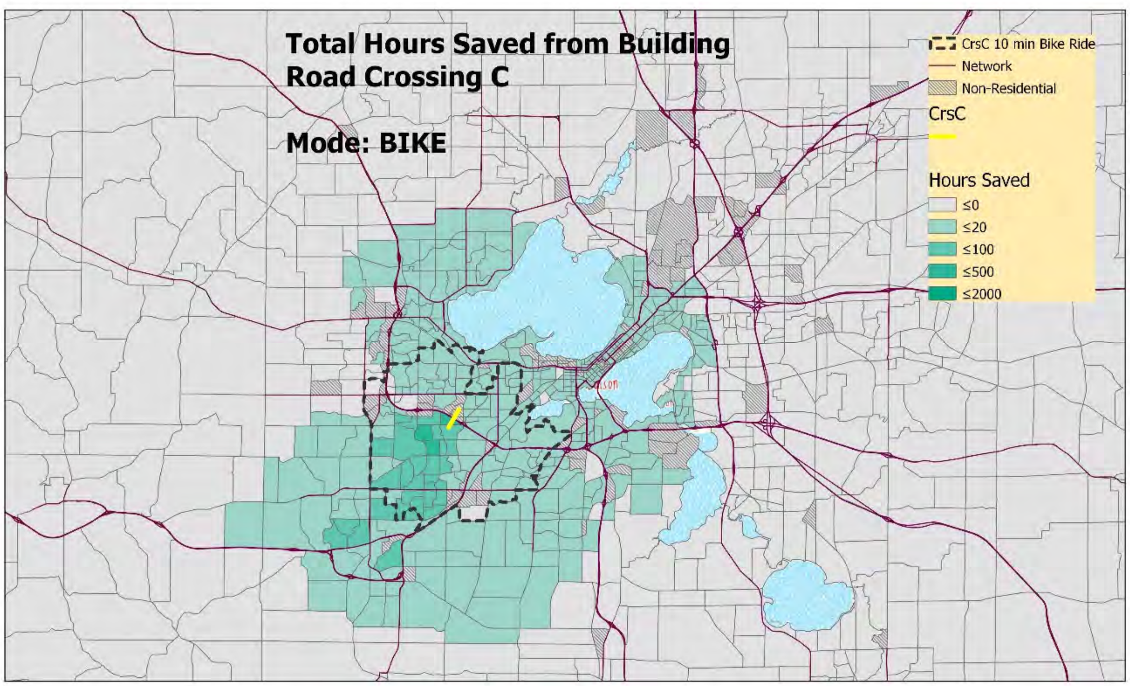

Figure C2 Total hours saved from building a PedBike facility on road crossing C for bicycling

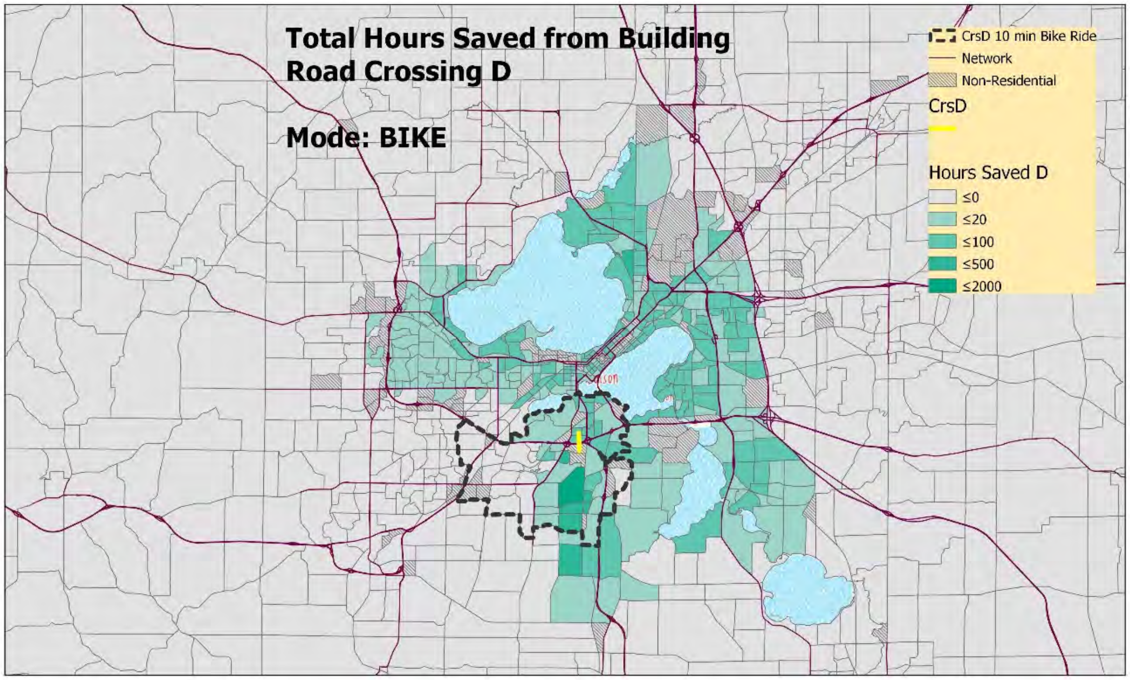

Figure C3 Total hours saved from building a PedBike facility on road crossing D for bicycling

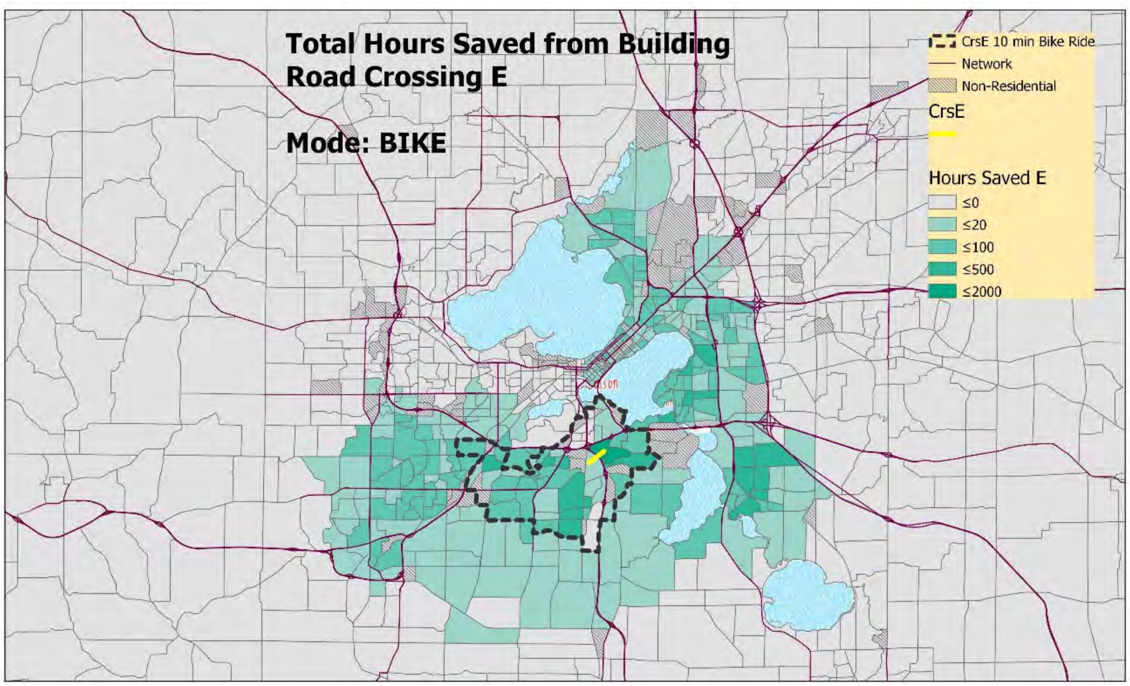

Figure C4 Total hours saved from building a PedBike facility on road crossing E for bicycling

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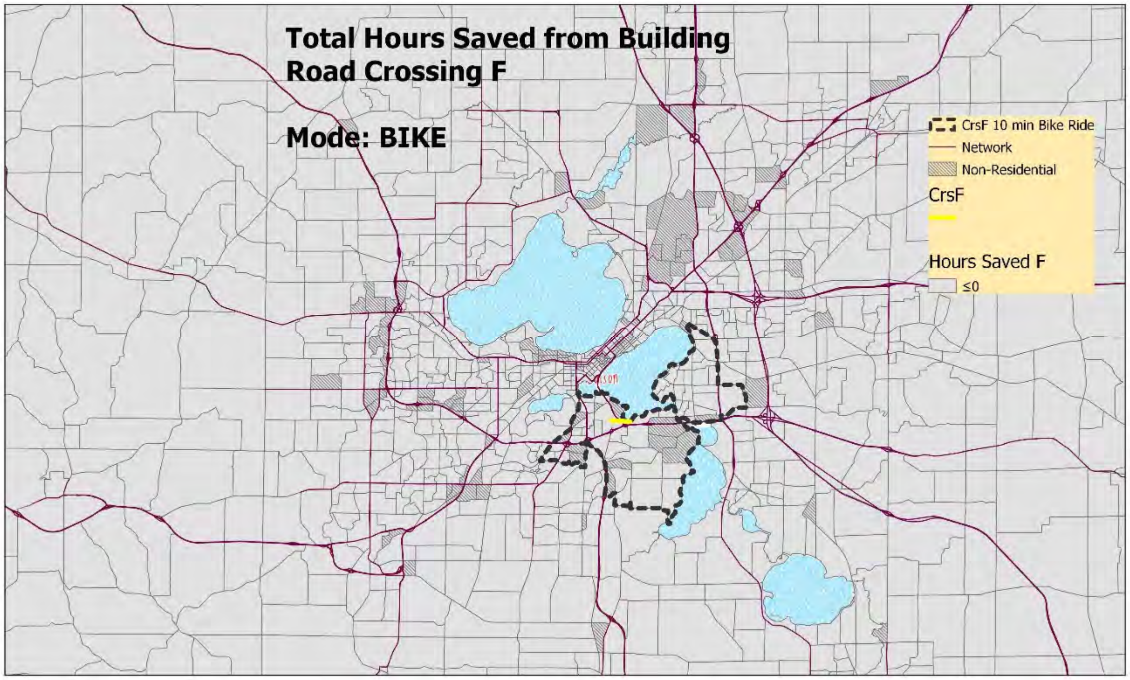

Figure C5   Total hours saved from building a PedBike facility on road crossing F for bicycling