EAST WEST BRT

a feasibility study

MILWAUKEE COUNTY EAST-WEST BUS RAPID TRANSIT

Tech Memo #2: Transportation

REVISION #1

DATE June 28, 2016

Prepared for:
Milwaukee County
10320 W. Watertown Plank Rd.
Wauwatosa, WI 53226

Prepared by:
AECOM

REVISIONS

REVISION NO.	DATE	PREPARED BY
0	June 17, 2016	AECOM – Koontz, Poston, Stevenson
1	June 28, 2016	AECOM - Suprock

CONTENTS

FIGURES

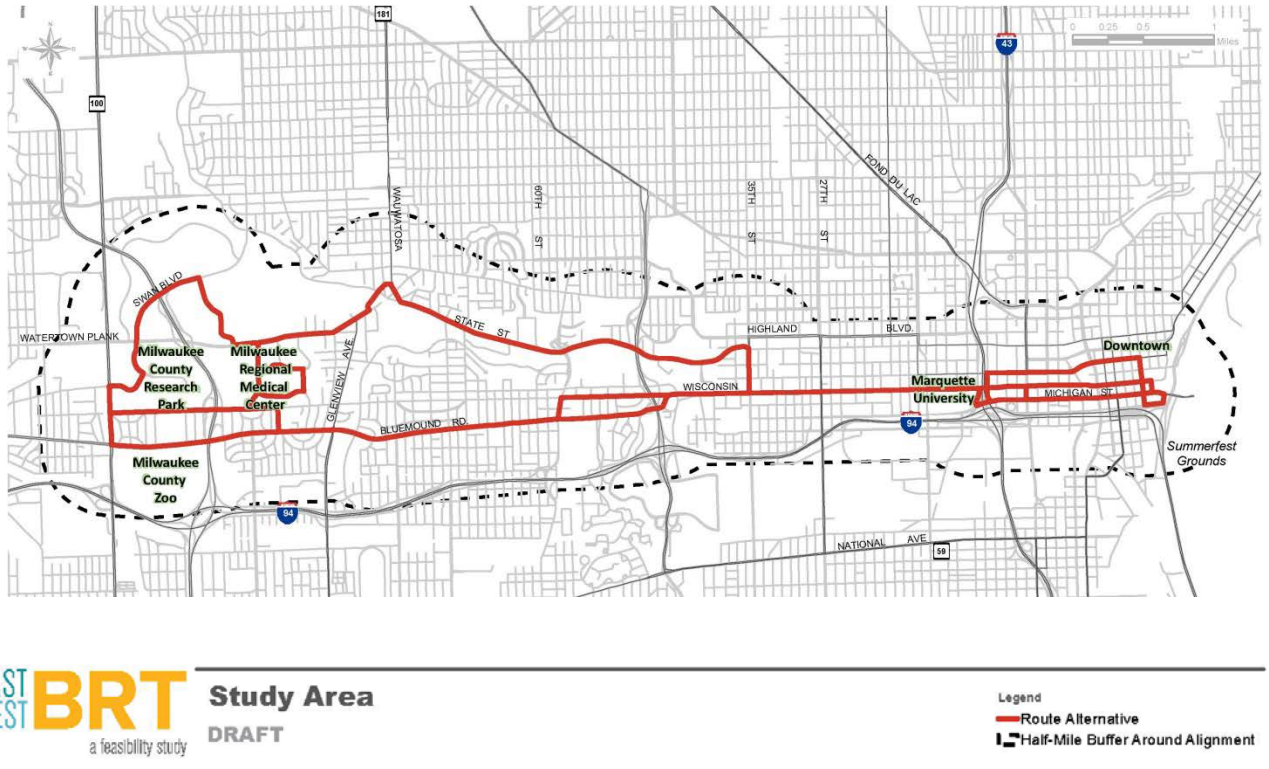
TABLES

1. INTRODUCTION

1.1 Project Description

Milwaukee County and its partners have initiated a feasibility study to evaluate transit investment in the seven-mile East-West Corridor connecting major employment and activity centers between downtown Milwaukee, the Milwaukee Regional Medical Center (MRMC), and Milwaukee County Research Park (MCRP). Completing the feasibility study is a first step towards applying for funding through the Federal Transit Administration's (FTA) Small Starts program.

Figure 1-1: East-West Study Corridor



EAST WEST BRT a feasibility study

Study Area

DRAFT

Legend
Route Alternative
Half-Mile Buffer Around Alignment

2. OVERVIEW OF PROJECT EVALUATION PROCESS

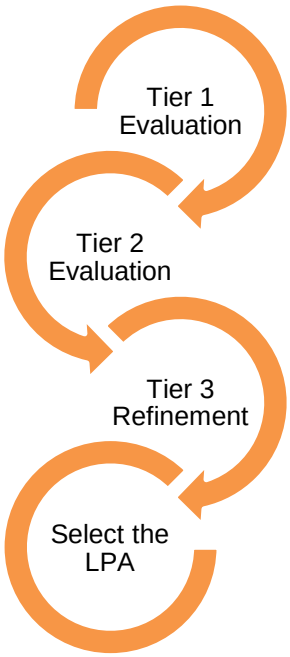
In order to evaluate the initial group of transit modes and alignment options and identify the appropriate mode-alignment pairings that will comprise the detailed alternatives, the East-West Corridor Study will follow a three-step method.

- The first step ("Tier 1 Evaluation") will entail the assessment of each mode and alignment relative to overall implementation viability.
- The second step ("Tier 2 Evaluation") will assess the mode/alignment pairings that passed the Tier 1 Evaluation and compare the benefits and impacts of each.
- The alternative(s) that fare(s) best against the detailed criteria in this second step will be identified as Preferred Alternative(s) and further refined in the third step ("Tier 3"). The Locally Preferred Alternative will be identified at the conclusion of the third step.

The evaluation criteria associated with each step are a combination of quantitative and qualitative performance measures.

- The Tier 1 Evaluation will apply fewer and broader measures, including information from previous corridor/area studies. The analysis will largely rely on order-of-magnitude estimates and the outcomes of similar transit projects from around the country.
- The Tier 2 Evaluation will apply more detailed and alternative-specific evaluation results.
- The Tier 3 Evaluation will evaluate the Preferred Alternative(s) against federal criteria to identify and refine the Locally Preferred Alternative.

This three-step process will result in the identification of an LPA that not only meets locally-identified project purpose and needs, but is also competitive for federal funding.



3. TECH MEMO #2 OVERVIEW

This report is the second in a series of technical memoranda (tech memos) that report the results of the Tier 2 Detailed Evaluation of Alternatives; the five other tech memos are available under separate cover:

- Tech Memo #1: Station Area
- Tech Memo #2 (this memo): Transportation
- Tech Memo #3: Environmental Impacts
- Tech Memo #4: Capital Costs
- Tech Memo #5: Operating and Maintenance Costs
- Tech Memo #6: Ridership

Results contained in the six tech memos are summarized in the Detailed Evaluation of Alternatives Report, also available under separate cover.

This tech memo includes the results of four sub-criteria that were used to evaluate the performance of the BRT alternatives that are under consideration as part of the Tier 2 evaluation.

The Tier 2 alternatives and station locations under evaluation are described in Section 4.

The four transportation evaluation sub-criteria are:

- Right-of-way impacts
- Parking impacts
- Traffic impacts
- Bicycle and pedestrian impacts

A summary of the station area evaluation results can be found in Section 5; the methodology, data sources, and results of the evaluation are presented in Section 6 through 9.

4. THE ALTERNATIVES

Four modes are being evaluated as part of Tier 2:

- No Build
- BRT in Mixed Traffic
- BRT in Dedicated Center Lane
- BRT in Dedicated Curb Lane

Three routes are being evaluated as part of Tier 2; any of the modes listed above (or combination of the modes) could operate on these routes:

- Alternative 1: from Swan Park-and-Ride lot to the Downtown Transit Center via Wisconsin Avenue through downtown Milwaukee
- Alternative 2: from Swan Park-and-Ride lot to the Downtown transit Center via Wells Avenue
- Alternative 3: from Swan Park-and-Ride lot to the Downtown Transit Center via a hybrid of Wisconsin Avenue and Wells Street through downtown Milwaukee (called the Hybrid alternative)

The routes and station locations are shown in Figure 4-1; the station locations for each alternative are listed in Table 4-1. Additional detail regarding these alternatives can be found in the Tier 2: Detailed Definition of Alternative Reports, which is available on the project website (eastwestbrt.org).

Figure 4-1: Alternative Alignments and Stations

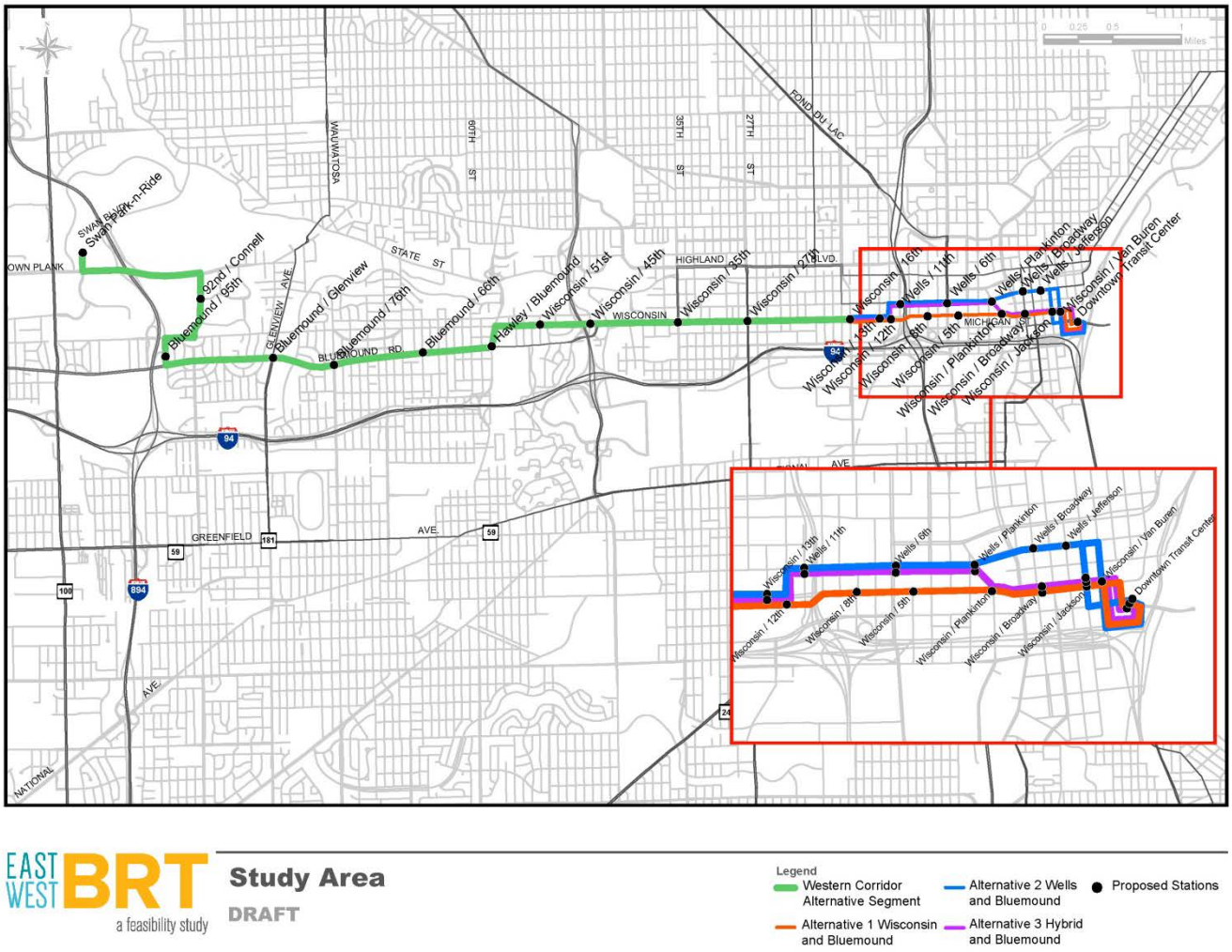


Table 4-1: Stop Location by Route Alternative

Stop Locations	Route Alternatives		
	Wisconsin	Wells	Wells/Wisconsin Hybrid
Downtown Transit Center	X	X	X
Van Buren/Wisconsin		X	

Stop Locations	Route Alternatives		
	Wisconsin	Wells	Wells/Wisconsin Hybrid
Wisconsin/Jefferson	X	X	X
Wisconsin/Broadway	X		X
Wells/Jefferson		X	
Wells/Broadway		X	
Wisconsin/Plankinton	X		
Wells/Plankinton		X	X
Wisconsin/5th St.	X		
Wells/6th St.		X	X
Wisconsin/8th St.	X		
Wells/11th St.		X	X
Wisconsin/12th St.	X		
Wisconsin/13th St.		X	X
Wisconsin/16th St.	X	X	X
Wisconsin/27th St.	X	X	X
Wisconsin/35th St.	X	X	X
Wisconsin/45th St.	X	X	X
Wisconsin/51st St.	X	X	X
Hawley/Bluemound	X	X	X
Bluemound/66th St.	X	X	X
Bluemound/76th St.	X	X	X
Bluemound/Glenview	X	X	X
Bluemound/95th St.	X	X	X
92nd & Connell (MRMC)	X	X	X
Swan Road Park & Ride	X	X	X

5. SUMMARY OF RESULTS

5.1 Right-of-Way Impacts

There would be no impacts to the right-of-way. All infrastructure associated with the BRT would be within the existing right-of-way.

5.2 Parking Impacts

Generally, the Mixed Traffic option had the least number of parking impacts. The Dedicated Curb Lane option had more impacts, typically eliminating parking at the station locations or on only one side of the road. The Dedicated Center Lane option had a higher impact downtown due to the median station within the roadway that impacted parking on both sides of the road. This option did have a lower impact on roads that have an existing median.

5.3 Traffic Impacts

The current capacity analysis results indicate there will likely be significant level of service issues at many intersections if a lane is repurposed for dedicated BRT use. Of particular concern are the Bluemound Road intersections which all have demand traffic volumes much greater than the available capacity with a single through traffic lane. Of equal concern is Wisconsin Avenue from Hawley Road to 27th Street. The capacity analysis for this study was necessarily a high level evaluation of overall intersection capacity. Many variables identified in further analysis could affect the intersection operations and the available capacity.

As intersections are the critical capacity locations within each roadway segment, the segments can be estimated to have the same capacity and service level as the intersection(s) which are located within the segment.

5.4 Bike and Pedestrian Mobility Impacts

Sidewalks

Sidewalks exist on at least one side of all roadways for each of the three route alternatives. No changes to the overall widths of the roadways are planned for the three proposed configurations. Sidewalk improvements will be included at the proposed station locations, but overall the existing pedestrian access will remain unchanged on the three routes under each of the proposed configurations.

Bike Routes and Bike Lanes

The three route alternatives all have sections that fall under one of the following categories:

- Contain existing bicycle lanes
- Marked as an existing bicycle route
- Proposed bicycle route
- Proposed bicycle lanes

The impacts on bicycles will depend on the final configuration selected. The Mixed Traffic configuration will have the least impact on any existing or proposed bicycle facilities. In isolated areas eliminating travel lanes with the Dedicated Curb and Dedicated Center Lane options may impact existing or proposed bicycle lanes. Further study will be required once a final configuration is selected, but if the proposed configuration does impact existing or proposed bicycle facilities mitigation measures that can be studied to lessen the impacts include, but are not limited to, an off street multi-use path, signing the route, but not marking the bicycle lane, or possibly using a parallel roadway for the proposed improvements.

6. RIGHT-OF-WAY IMPACTS

6.1 Methodology

Impacts to the existing right-of-way were determined by identifying locations where the project would require additional area beyond the current right-of-way limits for required BRT

infrastructure. The design approach was to add the transit elements for the BRT within the existing right-of-way. Median stations for the Dedicated Center Lane option would be constructed within the roadway or existing median. Proposed stations for the Dedicated Curb Lane and Mixed Traffic options would be constructed at the curb, typically reducing the width of the existing sidewalk behind the station. The sidewalk may be reconstructed behind the station if necessary to provide at least five feet of sidewalk. The size of the station or platform may also be modified to best fit within the available width where existing right-of-way is limited.

6.2 Data Sources

Data sources used for determining the existing right-of-way:

- "MCAMLIS" Interactive GIS Mapping, Milwaukee County Land Information Office, 2016 (http://county.milwaukee.gov/mclio)
- Google Maps and Street View

6.3 Summary of Results

The proposed project would have no right-of-way impacts. The infrastructure associated with the BRT, including the guideway, stations and traffic signals would all be within the existing right-of-way.

Table 6-1: Summary of Potential Right-of-Way Impacts

	Alternative 1: Wisconsin	Alternative 2: Wells	Alternative 3: Hybrid
Mixed Traffic	None	None	None
Dedicated Curb Lane	None	None	None
Dedicated Center Lane	None	None	None

7. PARKING IMPACTS

7.1 Methodology

Existing parking locations were determined for the Tier 2 routes in two sections: east and west of IH 43. Tables 7-1 and 7-2 summarizes the parking inventory for west of IH 43 (Swan Boulevard to IH 43). Tables 7-3, 7-4 and 7-5 summarizes the parking inventory for east of IH 43 (IH 43 to the Downtown Transit Center).

West of IH 43

Existing curbside parking locations were determined using AECOM field videos of the proposed BRT routes, supplemented with Google Street View. Each parking regulation sign was viewed and the message and parking limits recorded on 200 scale orthophotos. Unrestricted parking, restricted parking, and loading zones were separately recorded. Restricted parking is time of day, day of week, and bus only regulations. Parking lengths were measured on the orthophotos and the number of parking spaces was calculated using a length of 22 feet per space.

East of IH 43

Existing curbside parking quantities for each block were obtained from the City of Milwaukee map *Capacity of Existing Parking Facilities*, Summer 2014. The length of parking, types of parking, and signed regulations were not available from this map.

7.2 Data Sources

Data sources used for determining the existing curbside parking inventory included:

- AECOM videos, filmed in the field on March 29, 2016, of the proposed BRT routes as designated as of that date. Each two-way street was videoed in each travel direction.
- Google Street View
- City of Milwaukee map *Capacity of Existing Parking Facilities*, Summer 2014, Central Business District

7.3 Summary of Results

Tables 7-1, 7-2, 7-3, 7-4 and 7-5 include the locations and number of eliminated parking spaces per segment and service plan. Tables 7-1 and 7-2 includes parking inventory for west of IH 43 (Swan Boulevard to IH 43). Tables 7-3, 7-4 and 7-5 includes parking inventory for east of IH 43 (IH 43 to the Downtown Transit Center). Tables 7-6, 7-7, 7-8, 7-9 and 7-10 list the parking impacts in Wauwatosa, Milwaukee west of IH43 and downtown Milwaukee for each of the three service plans. Table 7-11 is a summary of all parking impacts.

Table 7-1: Parking Inventory - Wauwatosa

					Linear Parking (feet)				Number of Spaces		
Road Segment	From	To	Length (miles)	Direction of Travel	URP	RP	LZ	Segment Total (feet)	URP	RP	Segment Total (spaces)
Swan Rd		Watertown Plank Rd	0.1	NB/SB	0	0	0	0	0	0	0
Watertown Plank Rd	Swan Rd	92nd St	0.9	EB/WB	0	0	0	0	0	0	0
92nd St	Wisconsin Ave	Watertown Plank Rd	0.5	NB/SB	0	0	0	0	0	0	0
Wisconsin Ave	95th St	92nd St	0.2	EB	625	175	0	800	28	8	36
				WB	0	0	0	0	0	0	0
95th	Wisconsin Ave	Bluemound Rd	0.2	NB	360	0	0	360	16	0	16
				SB	0	0	0	0	0	0	0
Bluemound Rd	95th St	76th ST	1.2	EB	1,285	1,355	0	2,640	60	61	121
				WB	2,630	840	0	3,470	119	33	152
Bluemound Rd	76th St	Hawley Rd	1.2	EB	2,395	865	100	3,360	108	39	147
				WB	2,170	290	0	2,460	97	13	110
		Sub Totals	**4.3**		**9,465**	**3,525**	**100**	**13,090**	**428**	**154**	**582**

URP = Unrestricted Parking , RP = Restricted Parking by Time of Day or Day of Week, LZ = Loading Zone

Source: AECOM Videos and Google Streetview

Table 7-2: Parking Inventory - Wauwatosa

					Linear Parking (feet)				Number of Spaces		
Road Segment	From	To	Length (miles)	Direction of Travel	URP	RP	LZ	Segment Total (feet)	URP	RP	Segment Total (spaces)
Hawley Rd	Bluemound Rd	Wisconsin Ave	0.2	NB	0	290	0	290	0	13	13
				SB	0	0	0	0	0	0	0
Wisconsin Ave	Hawley Rd	STH 175	0.6	EB	1,755	635	0	2,390	80	28	108
				WB	2,065	340	0	2,405	93	15	108
Wisconsin Ave	STH 175	16th St	1.9	EB	1,345	2,320	0	3,665	61	103	164
				WB	1,150	2,410	335	3,895	52	109	161
Wisconsin Ave	16th St	12th St	0.3	EB	0	465	0	465	0	21	21
				WB	0	190	0	190	0	8	8
12th St	Wisconsin St	Wells St	0.1	NB	0	250	40	290	0	11	11
				SB	0	335	0	335	0	15	15
Wells St	12th St	IH 43	0.1	EB	0	280	0	280	0	12	12
				WB	0	210	75	285	0	9	9
		Sub Totals	**3.2**		**6,315**	**7,725**	**450**	**14,490**	**286**	**344**	**630**
		Grand Totals	**7.5**		**15,780**	**11,250**	**550**	**27,580**	**714**	**498**	**1,212**

URP = Unrestricted Parking , RP = Restricted Parking by Time of Day or Day of Week, LZ = Loading Zone

Source: AECOM Videos and Google Streetview

Table 7-3: Parking Inventory – Milwaukee: Alternative 1 via Wisconsin

Road Segment	From	To	Side of Street	Parking Capacity	LZ (feet)
Wisconsin Ave	12th St	IH 43	South Side/North Side	0	0’
Wisconsin Ave	IH 43	Plankinton Ave	South Side	60	320’
			North Side	61	70’
Wisconsin Ave	Plankinton Ave	Van Buren St	South Side	18	0’
			North Side	12	40’
Wisconsin Ave	Plankinton Ave	Cass St	South Side	25	60’
			North Side	12	40’
Cass St	Wisconsin Ave	Michigan St	East Side	14	0’
			West Side	0	180’
Michigan St	Cass St	Downtown Transit Center	South Side/ North Side	0	0’
Clybourn St	Downtown Transit Center	Van Buren St	South Side	8	0’
			North Side	7	0’
Van Buren St	Clybourn St	Wisconsin Ave	East Side	0	0’
			West Side	26	0’
		Totals		**242**	**710’**

Source: City of Milwaukee, Parking Information received 2016

Table 7-4: Parking Inventory– Milwaukee: Alternative 2 via Wells

Road Segment	From	To	Side of Street	Parking Capacity	LZ (feet)
Wells St	IH 43	Plankinton Ave	South Side	42	550’
			North Side	55	120’
Wells St	Plankinton Ave	Jackson St	South Side	37	205’
			North Side	40	140’
Jackson St	Wells St	Michigan St	East Side	28	0’
			West Side	25	0’
Michigan St	Jackson St	Downtown Transit Center	North Side	11	0’
			South Side	10	0’
Clybourn St	Downtown Transit Center	Van Buren St	South Side	8	0’
			North Side	7	0’
Van Buren St	Clybourn St	Wells St	East Side	14	0’
			West Side	47	0’
		Totals		**324**	**1,015’**

Source: City of Milwaukee, Parking Information received 2016

Table 7-5: Parking Inventory– Milwaukee: Alternative 3 Hybrid via Wisconsin/Wells

Road Segment	From	To	Side of Street	Parking Capacity	LZ (feet)
Wells St	IH 43	Plankinton Ave	South Side	42	550’
			North Side	55	120’
Plankinton Ave	Wells St	Wisconsin Ave	East Side	0	90’
			West Side	15	80’
Wisconsin Ave	Plankinton Ave	Cass St	South Side	25	60’
			North Side	12	40’
Cass St	Wisconsin Ave	Michigan St	East Side	14	0’
			West Side	0	180’
Michigan St	Cass St	Downtown Transit Center	South Side/ North Side	0	0’
Clybourn St	Downtown Transit Center	Van Buren St	South Side	8	0’
			North Side	7	0’
Van Buren St	Clybourn St	Wisconsin Ave	East Side	0	0’
			West Side	26	0’
		Totals		**204**	**1,120’**

Source: City of Milwaukee, Parking Information received 2016

Table 7-6: Parking Inventory and Impacts - Wauwatosa

		Mixed		Curbside		Center	
Location	**Existing**	**Loss**	**% Loss**	**Loss**	**% Loss**	**Loss**	**% Loss**
Swan Blvd – Underwood Pkwy to Watertown Plank Rd	0	0	0%	0	0%	0	0%
Watertown Plank Rd – Swan Blvd to 92nd St.	0	0	0%	0	0%	0	0%
92nd St. – Watertown Plank Rd to Wisconsin Ave.	0	0	0%	0	0%	0	0%
Wisconsin Ave – 92nd St. to 95th St.	36	0	0%	36	100%	36	100%
95th – Wisconsin Ave. to Bluemound Rd.	16	5	31%	5	31%	11	69%
Bluemound Rd – 95th St. to 76th St.	273	10	4%	10	4%	46	17%
Bluemound Rd – 76th St. to Hawley Rd.	257	10	4%	10	4%	146	57%
Hawley Rd – Bluemound Rd. to Wisconsin Ave.	13	0	0%	13	100%	13	100%
Wisconsin Ave. – Hawley St. to South 175	216	10	5%	10	5%	22	10%
Total	**811**	**35**	**4%**	**84**	**10%**	**274**	**34%**

Table 7-7: Parking Inventory and Impacts - Milwaukee

		Mixed		Curbside		Center	
Location	**Existing**	**Loss**	**% Loss**	**Loss**	**% Loss**	**Loss**	**% Loss**
Wisconsin Ave south 175 to 16th St.	325	22	7%	22	7%	22	7%
Wisconsin Ave. – 16th St. to 12th St.	29	5	17%	5	17%	5	17%
12th St. – Wisconsin Ave. to Wells St.	26	0	0%	26	100%	26	100%
Wells St 0 12th St. to IH43	21	3	14%	9	43%	21	100%
Total	**401**	**30**	**7%**	**62**	**15%**	**74**	**18%**

Table 7-8: Downtown Milwaukee: Alternative 1 via Wisconsin Parking Impacts

		Mixed		Curbside		Center	
Location	**Existing**	**Loss**	**% Loss**	**Loss**	**% Loss**	**Loss**	**% Loss**
Wisconsin Ave. – 12th St to IH43	0	0	0%	0	0%	0	0%
Wisconsin Ave. – IH43 to Plankinton	121	25	21%	86	71%	86	71%
Wisconsin Ave. – Plankinton to Van Buren St.	30	5	17%	5	17%	30	100%
Wisconsin Ave – Plankinton Ave. to Cass St.	37	0	0%	0	0%	37	100%
Cass St. – Wisconsin Ave. to Michigan St.	14	0	0%	0	0%	0	0%
Michigan St. – Cass St. to Downtown Transit Center	0	0	0%	0	0%	0	0%

		Mixed		Curbside		Center	
Location	**Existing**	**Loss**	**% Loss**	**Loss**	**% Loss**	**Loss**	**% Loss**
Clybourn St. – Downtown Transit Center to Van Buren St.	15	0	0%	0	0%	0	0%
Van Buren St. – Clybourn St. to Wisconsin Ave.	26	0	0%	0	0%	0	0%
Total	**213**	**25**	**12%**	**86**	**40%**	**123**	**58%**

Table 7-9: Downtown Milwaukee: Alternative 2 via Wells Parking Impacts

		Mixed		Curbside		Center	
Location	**Existing**	**Loss**	**% Loss**	**Loss**	**% Loss**	**Loss**	**% Loss**
Wells St – IH43 to Plankinton Ave.	97	13	13%	55	57%	97	100%
Well St. – Plankinton Ave. to Jackson St.	77	7	9%	77	100%	77	100%
Jackson St. – Wells St. to Michigan St.	53	0	0%	0	0%	0	0%
Michigan St. – Jackson St. to Downtown Transit Center	21	0	0%	0	0%	0	0%
Clynourn St. – Downtown Transit Center to Van Buren St.	15	0	0%	0	0%	0	0%
Van Buren St. – Clybourn St. to Wells St.	61	0	0%	0	0%	0	0%
Total	**324**	**20**	**6%**	**132**	**41%**	**174**	**54%**

Table 7-10: Downtown Milwaukee: Alternative 3 Hybrid via Wisconsin/Wells Parking Impacts

		Mixed		Curbside		Center	
Location	**Existing**	**Loss**	**% Loss**	**Loss**	**% Loss**	**Loss**	**% Loss**
Wells St – IH43 to Plankinton Ave.	97	10	10%	55	57%	97	100%
Plankinton Ave. – Wells St. to Wisconsin Ave.	15	0	0%	15	100%	15	100%
Wisconsin Ave. – Plankinton Ave. to Cass St.	37	5	14%	0	0%	0	0%
Cass St. – Wisconsin Ave. to Michigan St.	14	0	0%	0	0%	0	0%
Michigan St. – Cass St. to Downtown Transit Center	0	0	0%	0	0%	0	0%
Clybourn St. – Downtown Transit Center to Van Buren St.	15	0	0%	0	0%	0	0%
Van Buren St. – Clybourn St. to Wisconsin Ave.	26	0	0%	0	0%	0	0%
Total	**204**	**15**	**7%**	**70%**	**34%**	**112**	**55%**

Table 7-11: Parking Impacts Summary

			Mixed		Curbside		Center	
Service Plan	Location	Existing	Loss	% Loss	Loss	% Loss	Loss	% Loss
1	Downtown Milwaukee	213	25	12%	86	40%	123	58%
2	Downtown Milwaukee	324	20	6%	132	41%	174	54%
3	Downtown Milwaukee	204	15	7%	70	34%	112	55%
1, 2, 3	Wisconsin Ave. – 45th to 12th St.	401	30	7%	62	15%	74	18%
1, 2, 3	Wauwatosa: Swan Blvd to 45th St.	811	35	4%	84	10%	274	34%

On-street parking impacts were determined from the proposed changes in the roadway to accommodate the BRT for three different guideway options along the three different service plan routes. Impacts were calculated based on the following:

Curbside Station (Mixed Traffic and Dedicated Curb Lane options)

- These BRT stations are typically located in two corners of an intersection; one corner for inbound service and one for outbound service. Existing on-street parking would be eliminated in front of these stations for approximately 100 feet to provide the space needed for the BRT to merge from the outside lane or guideway, pull up to the station platform, then merge back into the lane. This typically removed three to six existing parking spaces at each platform.

Median Station (Dedicated Center Lane option)

- These BRT stations are located within the road with lanes running on both sides of the platform. Some intersections would have a platform on two legs of the intersection. Some locations would have one larger platform that provided BRT service for both inbound and outbound passengers. Two lanes in each direction would transition around a center platform and then transition back together, impacting parking on both sides of the street.

There would be nine to 15 parking spaces eliminated from each block where a median station was located. The number would vary depending on the width of the road.

Changes to Dedicated Guideway

- Where feasible for the dedicated guideway options, all roads on each route option would a minimum of two lanes in each direction, which includes a dedicated guideway and one travel lane. If the road is wide enough the on-street parking would be retained. For some of the narrower downtown streets, providing four lanes required the parking to be eliminated on one or both sides for the entire block to provide the space needed for travel lanes. The number of spaces lost was based on the length of the block or blocks with the narrow width.

Generally, the Mixed Traffic option had the least number of parking impacts. The Dedicated Curb Lane option had more impacts, typically eliminating parking at the station locations or on only one side of the road. The Dedicated Center Lane option had a higher impact downtown due to the median station within the roadway that impacted parking on both sides of the road. This option did have a lower impact on roads that have an existing median.

The project would not eliminate any off-street parking spaces such as public or private parking lots or decks. The proposed improvements on the route for BRT would be within the existing curb width or on the sidewalk.

8. TRAFFIC IMPACTS

8.1 Methodology

The BRT scenario analyzed for traffic impacts was the repurposing of an existing traffic lane for dedicated BRT guideway use. For the conditions analyzed, the BRT guideway could be either on the inside or the outside of the street. All existing intersection turning movements were assumed to remain in operation. A primary effect of repurposing a travel lane will be a reduction in capacity for remaining traffic. For the purposes of this analysis, it was assumed there will be no reduction in traffic volumes with the addition of the BRT.

The critical location for capacity on the BRT routes will be the intersections. Planning level capacity analysis was performed on 21 BRT route intersections selected to be representative

of the intersections where sufficient capacity for remaining traffic may not be available with BRT dedicated guideways. Capacity analysis was performed for the initial BRT service year of 2019 and the design year of 2039.

Traffic volumes were obtained from several sources. The WisDOT SE Freeways group and the City of Milwaukee provided existing AM and PM peak hour intersection traffic counts. AECOM performed one-hour AM and PM peak hour intersection turning movement counts for the remaining intersections. WisDOT provided a traffic forecast for the intersections that are part of the Zoo Interchange reconstruction. SEWRPC provided annual percent traffic growth factors for the Tier 2 BRT routes. AECOM used this data to calculate AM and PM intersection turning movement volumes for years 2019 and 2039.

Intersection capacity was determined following the Highway Capacity Manual guidelines. Due to lack of data and the fast track nature of the BRT evaluation study, it was not feasible to use Synchro or Highway Capacity Software to determine the level of service at the intersections. The traditional G/C (Green signal time/ Total cycle time) percentages approach was used to determine available capacity for each intersection. The forecasted traffic volumes were compared to the available capacity to determine if sufficient capacity will be available to carry the existing traffic when a lane is repurposed to a dedicated BRT guideway.

When the volume (v) is greater than the capacity (c), or v/c>1.0, the intersection operations will fail. The result in this analysis is a Pass/Fail for the intersection as a whole. By Highway Capacity Manual definition, when v/c>1.0, the Level of Service is LOS=E or LOS=F.

The G/C approach included the following steps:

1. Determine the controlling lane group for capacity analysis at each intersection. Determine the remaining number of lanes after one lane is repurposed for dedicated BRT use. Where there is currently only one lane, that lane was assumed to remain. Controlling lane groups were determined for both the mainline BRT route and the side street.

2. Calculate the analysis intersection turning movement traffic volumes. A peak hour factor of 0.9 was used.

3. Determine adjusted saturation flow. This was obtained directly from a preliminary Synchro model of the intersections. An average adjusted saturation flow of 1,750 vehicles/lane/hour of green was determined.

4. Calculate the percentage G/C available for the controlling lane group. Yellow and All Red clearance intervals were assigned 15 percent of the cycle. Each conflicting protected left turn phase was assigned 15 percent of the cycle. The remaining cycle percentage was then proportioned between the mainline and the side street based on a ratio of the approach volume by lane.

5. Calculate the available capacity for each of the mainline and side street controlling lane groups. This was the G/C percentage available for each direction times the adjusted saturation flow.

6. Compare the traffic volume demand for the controlling lane group to the available capacity. If the volume is less than the capacity, v/c<1.0, and the intersection capacity is rated as OK. If the volume is greater than the capacity, v/c>1.0, and the intersection capacity is rated as fail.

8.2 Data Sources

- Wisconsin Department of Transportation Southeast Freeways Zoo Interchange Team:
    - Signalized intersection traffic turning movement counts
    - Future (2035) Intersection Peak Hour Volumes – "Center", September 5, 2012
    - Zoo Interchange final layout, July 2014
    - Plans for new 95th St between Bluemound Rd and Wisconsin Ave, April 2015
- Wisconsin Department of Transportation Southeast Freeways East-West Team:
    - Signalized intersection traffic turning movement counts
- Southeastern Wisconsin Regional Planning Commission (SEWRPC)
    - Average Weekday Traffic (AWDT) Annual Percent Growth map, May 3, 2016
- City of Milwaukee
    - Traffic Design Data for W. Wisconsin Ave., N. 20th St to N. 35th St.
    - Traffic volumes and counts for W. Wisconsin Ave., N. 20th St to N. 35th St.

- City of Wauwatosa
    - Existing traffic signal timing
    - AADT traffic volumes
- AECOM
    - Videos of proposed BRT routes, filmed on March 29, 2016

8.3 Summary of Results

Capacity Analysis

See Appendix 1 for figures showing volumes, capacities, and capacity check results for the 21 critical intersections along the Tier 2 BRT routes for the AM and PM peak hours of years 2019 and 2039.

As the intersections are the typical limiting capacity location within each route segment, the capacity results at the intersection within each segment are considered to represent the segment service level with the dedicated BRT guideway.

Capacity check results follow below for the alternative BRT route segments. Where the results say the intersection has adequate capacity, the equivalent level of service is LOS=D or better. Where the results say the intersection fails in capacity, the equivalent level of service is LOS=E or LOS=F.

AM Peak

- In the Milwaukee Regional Medical Center area, all intersections except Watertown Plank Road & 92nd Street will have adequate capacity through 2039
- Watertown Plank Road & 92nd Street fails in capacity starting in 2019
- All intersections on Bluemound Road fail in capacity starting in 2019
- Wisconsin Ave & Hawley Rd and Wisconsin Ave and Bluemound Rd fail in capacity starting in 2019
- All remaining intersections on Wisconsin Avenue have adequate capacity through 2039
- In 2019, the Wells Street & 12th Street intersection and all intersections on all alternative BRT routes east of IH 43 will have adequate capacity

- In 2039, the Wells Street & 12th Street intersection and all intersections on all alternative BRT routes east of IH 43, except Wells Street & 6th Street, will have adequate capacity

PM Peak

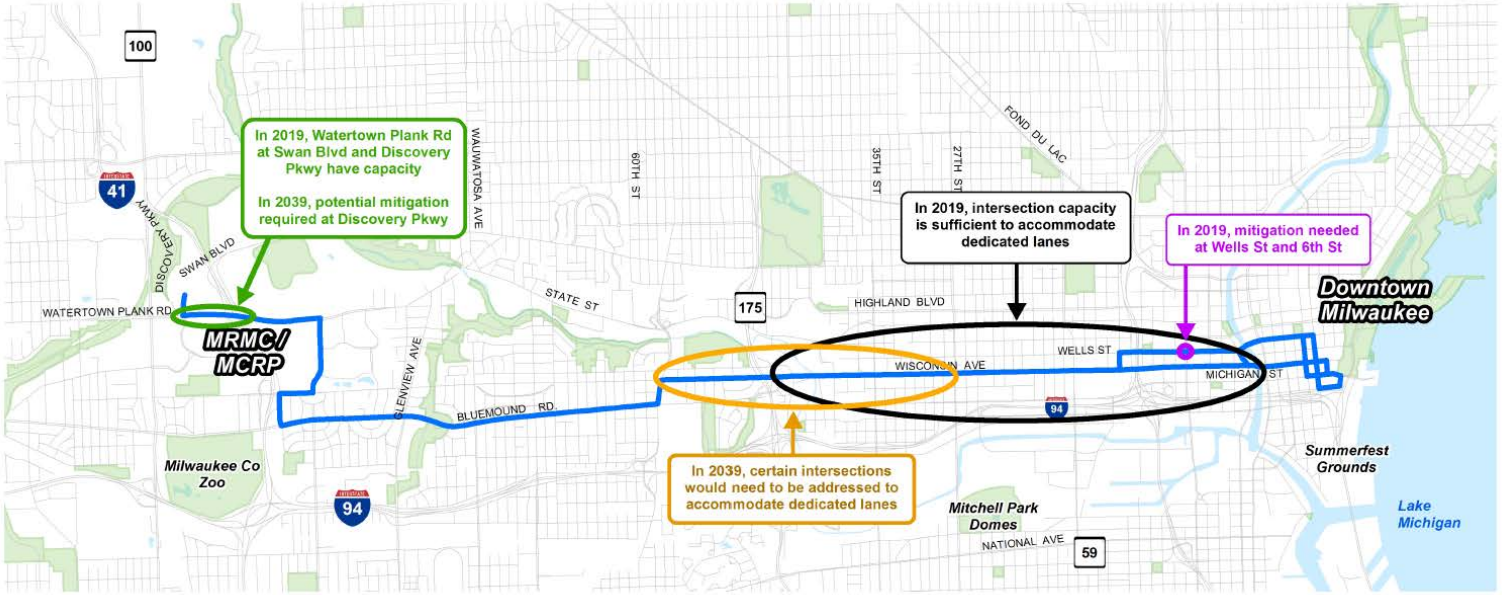
- In the Milwaukee Regional Medical Center area, the only intersections that will have adequate capacity through 2039 are Watertown Plank Road & Swan Boulevard and Wisconsin Avenue & 95th Street.
- Both Watertown Plank Road & Discovery Pkwy and Watertown Plank Road & 92nd Street fail in capacity starting in 2019
- All intersections on Bluemound Road fail in capacity starting in 2019
- All intersections on Wisconsin Avenue from Hawley Road to IH 43 fail in capacity starting in 2019, except Wisconsin Avenue & 12th Street
- All intersections on Wisconsin Avenue east of IH 43 have adequate capacity through 2039 except Wisconsin Avenue & 6th Street which fails in 2039
- All intersections on Wells Street east of IH 43 have adequate capacity through 2039 except Wells Street & 6th Street which fails in capacity starting in 2019

Discussion of Results

The current capacity analysis results indicate there will likely be significant level of service issues at many intersections if a lane is repurposed for dedicated BRT use. Of particular concern are the Bluemound Road intersections which all have demand traffic volumes much greater than the available capacity with a single thru traffic lane. Of equal concern is Wisconsin Avenue from Hawley Road to 27th Street. The capacity analysis for this study was necessarily a high level evaluation of overall intersection capacity. Many variables identified in further analysis could affect the intersection operations and the available capacity.

As intersections are the critical capacity locations within each roadway segment, the segments can be estimated to have the same capacity and service level as the intersection(s) which are located within the segment (Figure 8-1).

Figure 8-1: Summary of Potential Traffic Impacts



Additional Traffic Impacts

Repurposing an existing travel lane to a dedicated BRT guideway will have additional traffic impacts:

- Where there is only one lane for general traffic, left turns are allowed, and there is no left turn lane or median storage area, left turning drivers stopped anywhere in the segment to turn off the mainline and waiting for a gap in opposing traffic will stop all traffic behind them, or drivers will veer into the bus lane or the parking lane to pass the stopped vehicle. This will occur both at intersections and between intersections. This could be a source of significant delay and increased crashes.
- Where there is only one lane for general traffic and there is adjacent parallel parking, there will be similar negative traffic and safety effects when a driver is parallel parking as in the left turning scenario in the above comment.
- The traffic volumes used in the capacity analysis are typical weekday volumes. With the BRT implementation and one thru travel lane remaining, there is little to no reserve capacity to accommodate variable traffic volumes. Variable traffic volumes will occur with seasonal retail shopping, special events, Brewers' games, construction on the BRT routes or on adjacent routes including the IH 94 East-West reconstruction, diversion from the interstate highways during incidents, and similar events.

Future Consideration

Since this capacity evaluation was a high level evaluation, many of the analysis inputs were standardized across all intersections based on engineering judgment. It is possible projected intersection operations could be improved from the results in this analysis with individual analysis of each intersection using appropriate Synchro or VISSIM software. Approaches for potential capacity improvements include:

- Lane Utilization Modifications – to better use existing street width
- Traffic Signal Phasing Revisions – to better allocate signal green times
- Traffic Signal Retiming – including implementing coordinated signal systems
- Traffic Signal Upgrades – to take advantage of new features in signal controllers

9. BICYCLE AND PEDESTRIAN IMPACTS

9.1 Methodology

This section presents an evaluation of impacts of the various alternatives being considered for the seven-mile East-West Corridor on non-motorized transportation (bicycles and pedestrians) within the corridor.

The evaluation of non-motorized impacts of the alternatives is based on the following criteria.

Impacts to existing bicycle and pedestrian facilities – Each of the alternatives will incorporate changes to the corridor. Ratings for the routes and configurations are based on the following scale: 0 = no impact, 1 = some positive impacts for bicycles and pedestrians, 2 = definite positive impacts for bicycles and pedestrians.

Compliance with bicycle and pedestrian plans – The City of Milwaukee and the City of Wauwatosa have bicycle and pedestrian plans that cover the three proposed routes. The plans cover existing and planned facilities for both bicycles and pedestrians. Ratings for this factor are based on whether or not the proposed routes and configurations are compliant with these plans (Yes or No).

9.2 Data Sources

Data sources used to evaluate the bicycle and pedestrian impacts included:

- City of Wauwatosa Bicycle & Pedestrian Facilities Plan (City of Wauwatosa)
- Milwaukee by Bike Master Plan City of Milwaukee)
- A Regional Transportation System Plan for Southeastern Wisconsin: 2035 (SEWRPC)

9.3 Summary of Results

Table 9-1: Bicycle and Pedestrian Impacts - Summary of Analysis

Route Alternative	Configuration	Impacts on Existing Bicycle/Pedestrian Facilities	Compliance with Bicycle/Pedestrian Plans
1, 2, 3	Mixed Traffic	1 – Some Positive Impacts. This alternative will include station location access improvements that will improve the overall bicycle and pedestrian facilities	Yes
1, 2, 3	Curbside Guideway	1 – Some Positive Impacts. This alternative will include station location access improvements that will improve the overall bicycle and pedestrian facilities	No*
1, 2, 3	Center Running	1 – Some Positive Impacts. This alternative will include station location access improvements that will improve the overall bicycle and pedestrian facilities	No*

**Possible impacts to proposed bicycle lanes proposed within the City of Milwaukee and City of Wauwatosa Bicycle Plans. Mitigation measures may be required to meet the proposed plans.*

Sidewalks

Sidewalks exist on at least one side of all roadways for each of the three route alternatives. No changes to the overall widths of the roadways are planned for the three proposed configurations. Sidewalk improvements will be included at the proposed station locations, but overall the existing pedestrian access will remain unchanged on the three routes under each of the proposed configurations.

Bike Routes and Bike Lanes

The three route alternatives all have sections that fall under one of the following categories:

- Contain existing bicycle lanes

- Marked as an existing bicycle route
- Proposed bicycle route
- Proposed bicycle lanes

The impacts on bicycles will depend on the final configuration selected. The Mixed Traffic configuration will have the least impact on any existing or proposed bicycle facilities. In isolated areas eliminating travel lanes with the Dedicated Curb Mane and Dedicated Center Lane options may impact existing or proposed bicycle lanes. Further study will be required once a final configuration is selected, but if the proposed configuration does impact existing or proposed bicycle facilities mitigation measures that can be studied to lessen the impacts include, but are not limited to, an off street multi-use path, signing the route, but not marking the bicycle lane, or possibly using a parallel roadway for the proposed improvements.