

Madison BRT Transit Corridor Study O&M Cost Estimates

This paper presents annual O&M cost estimates for possible BRT service in the Madison area. O&M costs have been estimated for BRT service and for potential modifications to background Metro bus service. O&M cost estimates follow methodology specified in a prior working paper.

BRT Operating Statistics

This project has evaluated potential BRT service in four corridors (East, North, South and West). Two alignment options have been carried forward for the West Corridor (Mineral Point Road and Odana Road). Table 1 presents estimates of BRT operating statistics (peak/fleet vehicles, annual revenue bus-hours and bus-miles of service) for each individual corridor.

In addition to annual revenue bus-hours and bus-miles of service (provided in Table 1 for each corridor), the BRT O&M cost methodology requires the number of directional BRT stops and the number of Ticket Vending Machines (TVMs) as input. Estimated TVMs and directional BRT stops are based on alignment plans, and do not include stops at Transfer Points (since BRT service would likely utilize an existing bay at those locations). Estimated TVMs and new BRT stops are noted below:

Corridor	TVMs	Directional BRT Stops
East	13	29
North	12	20
South	10	31
West: Mineral Pt. Road	21	33
West: Odana Road	23	37

Background Bus Operating Statistics

A separate paper described proposed changes to the background bus system. This was used to estimate changes in background bus operating statistics. Table 2 summarizes changes in bus statistics by corridor. Appendix A presents estimated changes in bus statistics by bus route.

O&M Cost Estimates

Tables 3 through 7 present estimates of bus O&M costs by corridor. These tables present anticipated bus cost savings from proposed changes to the background bus network, and anticipated new O&M costs for BRT operations, with the anticipated net change in O&M costs. None of the cost estimates assume additional O&M costs that may be incurred with relocating a Transfer Point. Those costs could include additional bus operations costs associated with route alignment adjustments to the new Transfer Point and/or additional facility maintenance costs.

Costs presented in Tables 3 through 7 assume BRT service in individual corridors. Costs for all four corridors operating as a system are slightly less than the cumulative costs presented in Tables 3 through 7, for there are BRT stations and TVMs in the central area that are common to two or more corridors. Tables 8 and 9 present system O&M cost estimates (Table 8 presents system costs when assuming a West Corridor Mineral Point Road alignment and Table 9 with a West Corridor Odana Road alignment).

**Table 1
BRT Operating Statistics by Corridor**

Individual Corridors

Corridor	From	To	One-Way		Day	Service Frequency				Daily Rev.		Annual Rev.		Bus Requirements			
			Time (min)	Dist (mi)		AM	Mid	PM	Eve	Bus-Mi's	Bus-Hrs	Bus-Miles	Bus-Hrs	AM	Mid	PM	Eve
East	East Towne	Capital Square	25.65	6.28	M-F	10	15	10	30	929	74	237,000	18,900	6.0	4.0	6.0	2.0
					Sat	30	15	15	30	653	52	34,000	2,700	2.0	4.0	4.0	2.0
					Sun	30	30	30	30	402	32	23,300	1,900	2.0	2.0	2.0	2.0
					Totals for East Corridor									294,300	23,500	6.0	4.0
South	Caddis Bend	Capital Square	29.32	5.50	M-F	10	15	10	30	814	93	207,600	23,700	7.0	5.0	7.0	3.0
					Sat	30	15	15	30	572	68	29,700	3,500	3.0	5.0	5.0	3.0
					Sun	30	30	30	30	352	48	20,400	2,800	3.0	3.0	3.0	3.0
					Totals for South Corridor									257,700	30,000	7.0	5.0
North	Warner Park/ Airport	Capital Square	24.58	5.91	M-F	20	30	20	60	437	37	111,500	9,400	3.0	2.0	3.0	1.0
					Sat	60	30	30	60	307	26	16,000	1,400	1.0	2.0	2.0	1.0
					Sun	60	60	60	60	189	16	11,000	900	1.0	1.0	1.0	1.0
	Warner Park/ Troy Drive	Capital Square	26.98	6.51	M-F	20	30	20	60	482	37	122,800	9,400	3.0	2.0	3.0	1.0
					Sat	60	30	30	60	339	26	17,600	1,400	1.0	2.0	2.0	1.0
					Sun	60	60	60	60	208	16	12,100	900	1.0	1.0	1.0	1.0
Totals for North Corridor											291,000	23,400	6.0	4.0	6.0	2.0	
West Min. Pt. Option	High Point	Capital Square	36.43	7.76	M-F	10	15	10	30	1,148	111	292,900	28,300	9.0	6.0	9.0	3.0
					Sat	30	15	15	30	807	78	42,000	4,100	3.0	6.0	6.0	3.0
					Sun	30	30	30	30	497	48	28,800	2,800	3.0	3.0	3.0	3.0
					Totals for West Corridor - Min Pt. Rd. Alignment									363,700	35,200	9.0	6.0
West Odana Rd. Option	High Point	Capital Square	39.43	8.61	M-F	10	15	10	30	1,274	111	324,900	28,300	9.0	6.0	9.0	3.0
					Sat	30	15	15	30	895	78	46,600	4,100	3.0	6.0	6.0	3.0
					Sun	30	30	30	30	551	48	32,000	2,800	3.0	3.0	3.0	3.0
					Totals for West Corridor - Odana Rd. Alignment									403,500	35,200	9.0	6.0

Table 2
Estimated Change in Background Operating Statistics by Corridor

Corridor	Day	Change in Rev. Miles	Change in Rev. Hrs.	Change in Peak Buses
East	Wkdy	-505.9	-33.9	-1
	Sat	-43.3	-0.8	n/a
	Sun	-38.5	-0.5	n/a
	Annual	-133,481	-8,724	-1
North	Wkdy	-471.5	-33.6	-6
	Sat	-128.3	-8.7	n/a
	Sun	-120.7	-8.2	n/a
	Annual	-133,901	-9,482	-6
South	Wkdy	-321.7	-28.5	-3
	Sat	-112.2	-11.0	n/a
	Sun	-108.8	-10.7	n/a
	Annual	-94,168	-8,469	-3
West (Odana Road Alignment)	Wkdy	-442.1	-34.6	-5
	Sat	-97.6	-7.3	n/a
	Sun	-91.5	-6.9	n/a
	Annual	-123,118	-9,609	-5
West (Mineral Road Alignment)	Wkdy	-451.9	-35.5	-5.0
	Sat	-104.2	-7.9	n/a
	Sun	-97.7	-7.4	n/a
	Annual	-126,320	-9,876	-5
Total	Wkdy	-1,741.1	-130.7	-15
	Sat	-381.4	-27.8	n/a
	Sun	-359.5	-26.2	n/a
	Annual	-484,669	-36,284	-15

**Table 3
East Corridor O&M Cost Estimates**

O&M Costs for Background Bus Service Changes

Cost Item	Type of Unit	Units	Unit Cost	Cost Estimate
Vehicle Operations-Related Costs	Ann. Rev. Bus-Hrs.	-8,724	\$75.61	-\$659,642
Vehicle Maint.-Related Costs	Ann. Rev. Bus-Mi's.	-133,481	\$1.39	-\$185,044
Non-Veh. Maint. & G&A Costs	% of Above Items		18.07%	-\$152,651
Total Change in O&M Costs (2011\$)				-\$997,338
Total Change in O&M Costs (2012\$)			1.021	-\$1,018,282
<i>Cost per Rev. Bus-Hr.</i>				\$116.72

O&M Costs for BRT Service

Cost Item	Type of Unit	Units	Unit Cost	Cost Estimate
Vehicle Operations-Related Costs	BRT Rev. Bus-Hrs.	23,500	\$75.61	\$1,776,890
Vehicle Maint.-Related Costs	BRT Rev. Bus-Mi's.	294,300	\$1.39	\$407,988
Non-Veh. Maint. & G&A Costs	% of Above Items		18.07%	\$394,850
Articulated Bus Premium	BRT Rev. Bus-Mi's.	294,300	\$0.35	\$101,997
TVM Maintenance	TVM Machines	13	\$6,500	\$84,500
Station/Stop Maintenance	Directional BRT Stop	29	\$2,000	\$58,000
Police/Fare Enforcement	BRT Rev. Bus-Hrs.	23,500	\$6.38	\$149,930
Total Change in O&M Costs (2011\$)				\$2,974,155
Total Change in O&M Costs (2012\$)			1.021	\$3,036,612
<i>Cost per Rev. Bus-Hr.</i>				\$129.22

TOTAL O&M COST IMPACT FOR EAST CORRIDOR	\$2,018,330
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**Table 4
North Corridor O&M Cost Estimates**

O&M Costs for Background Bus Service Changes

Cost Item	Type of Unit	Units	Unit Cost	Cost Estimate
Vehicle Operations-Related Costs	Ann. Rev. Bus-Hrs.	-9,482	\$75.61	-\$716,956
Vehicle Maint.-Related Costs	Ann. Rev. Bus-Mi's.	-133,901	\$1.39	-\$185,627
Non-Veh. Maint. & G&A Costs	% of Above Items		18.07%	-\$163,114
Total Change in O&M Costs (2011\$)				-\$1,065,697
Total Change in O&M Costs (2012\$)			1.021	-\$1,088,077
<i>Cost per Rev. Bus-Hr.</i>				\$114.75

O&M Costs for BRT Service

Cost Item	Type of Unit	Units	Unit Cost	Cost Estimate
Vehicle Operations-Related Costs	BRT Rev. Bus-Hrs.	23,400	\$75.61	\$1,769,329
Vehicle Maint.-Related Costs	BRT Rev. Bus-Mi's.	291,000	\$1.39	\$403,413
Non-Veh. Maint. & G&A Costs	% of Above Items		18.07%	\$392,657
Articulated Bus Premium	BRT Rev. Bus-Mi's.	291,000	\$0.35	\$100,853
TVM Maintenance	TVM Machines	12	\$6,500	\$78,000
Station/Stop Maintenance	Directional BRT Stop	20	\$2,000	\$40,000
Police/Fare Enforcement	BRT Rev. Bus-Hrs.	23,400	\$6.38	\$149,292
Total Change in O&M Costs (2011\$)				\$2,933,544
Total Change in O&M Costs (2012\$)			1.021	\$2,995,148
<i>Cost per Rev. Bus-Hr.</i>				\$128.00

TOTAL O&M COST IMPACT FOR NORTH CORRIDOR	\$1,907,071
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**Table 5
South Corridor O&M Cost Estimates**

O&M Costs for Background Bus Service Changes

Cost Item	Type of Unit	Units	Unit Cost	Cost Estimate
Vehicle Operations-Related Costs	Ann. Rev. Bus-Hrs.	-8,469	\$75.61	-\$640,361
Vehicle Maint.-Related Costs	Ann. Rev. Bus-Mi's.	-94,168	\$1.39	-\$130,545
Non-Veh. Maint. & G&A Costs	% of Above Items		18.07%	-\$139,318
Total Change in O&M Costs (2011\$)				-\$910,224
Total Change in O&M Costs (2012\$)			1.021	-\$929,338
<i>Cost per Rev. Bus-Hr.</i>				\$109.73

O&M Costs for BRT Service

Cost Item	Type of Unit	Units	Unit Cost	Cost Estimate
Vehicle Operations-Related Costs	BRT Rev. Bus-Hrs.	30,000	\$75.61	\$2,268,370
Vehicle Maint.-Related Costs	BRT Rev. Bus-Mi's.	257,700	\$1.39	\$357,249
Non-Veh. Maint. & G&A Costs	% of Above Items		18.07%	\$474,501
Articulated Bus Premium	BRT Rev. Bus-Mi's.	257,700	\$0.35	\$89,312
TVM Maintenance	TVM Machines	10	\$6,500	\$65,000
Station/Stop Maintenance	Directional BRT Stop	31	\$2,000	\$62,000
Police/Fare Enforcement	BRT Rev. Bus-Hrs.	30,000	\$6.38	\$191,400
Total Change in O&M Costs (2011\$)				\$3,507,832
Total Change in O&M Costs (2012\$)			1.021	\$3,581,497
<i>Cost per Rev. Bus-Hr.</i>				\$119.38

TOTAL O&M COST IMPACT FOR SOUTH CORRIDOR **\$2,652,158**

**Table 6
West Corridor: Mineral Pt. Rd. O&M Cost Estimates**

O&M Costs for Background Bus Service Changes

Cost Item	Type of Unit	Units	Unit Cost	Cost Estimate
Vehicle Operations-Related Costs	Ann. Rev. Bus-Hrs.	-9,876	\$75.61	-\$746,747
Vehicle Maint.-Related Costs	Ann. Rev. Bus-Mi's.	-126,320	\$1.39	-\$175,117
Non-Veh. Maint. & G&A Costs	% of Above Items		18.07%	-\$166,599
Total Change in O&M Costs (2011\$)				-\$1,088,464
Total Change in O&M Costs (2012\$)			1.021	-\$1,111,321
<i>Cost per Rev. Bus-Hr.</i>				\$112.53

O&M Costs for BRT Service

Cost Item	Type of Unit	Units	Unit Cost	Cost Estimate
Vehicle Operations-Related Costs	BRT Rev. Bus-Hrs.	35,200	\$75.61	\$2,661,554
Vehicle Maint.-Related Costs	BRT Rev. Bus-Mi's.	363,700	\$1.39	\$504,197
Non-Veh. Maint. & G&A Costs	% of Above Items		18.07%	\$572,113
Articulated Bus Premium	BRT Rev. Bus-Mi's.	363,700	\$0.35	\$126,049
TVM Maintenance	TVM Machines	21	\$6,500	\$136,500
Station/Stop Maintenance	Directional BRT Stop	33	\$2,000	\$66,000
Police/Fare Enforcement	BRT Rev. Bus-Hrs.	35,200	\$6.38	\$224,576
Total Change in O&M Costs (2011\$)				\$4,290,989
Total Change in O&M Costs (2012\$)			1.021	\$4,381,100
<i>Cost per Rev. Bus-Hr.</i>				\$124.46

TOTAL O&M COST IMPACT FOR WEST CORRIDOR: Min. Pt. Road Option **\$3,269,779**

Table 7
West Corridor: Odana Rd. O&M Cost Estimates

O&M Costs for Background Bus Service Changes

Cost Item	Type of Unit	Units	Unit Cost	Cost Estimate
Vehicle Operations-Related Costs	Ann. Rev. Bus-Hrs.	-9,609	\$75.61	-\$726,559
Vehicle Maint.-Related Costs	Ann. Rev. Bus-Mi's.	-123,118	\$1.39	-\$170,678
Non-Veh. Maint. & G&A Costs	% of Above Items		18.07%	-\$162,148
Total Change in O&M Costs (2011\$)				-\$1,059,386
Total Change in O&M Costs (2012\$)			1.021	-\$1,081,633
<i>Cost per Rev. Bus-Hr.</i>				\$112.56

O&M Costs for BRT Service

Cost Item	Type of Unit	Units	Unit Cost	Cost Estimate
Vehicle Operations-Related Costs	BRT Rev. Bus-Hrs.	35,200	\$75.61	\$2,661,554
Vehicle Maint.-Related Costs	BRT Rev. Bus-Mi's.	403,500	\$1.39	\$559,371
Non-Veh. Maint. & G&A Costs	% of Above Items		18.07%	\$582,085
Articulated Bus Premium	BRT Rev. Bus-Mi's.	403,500	\$0.35	\$139,843
TVM Maintenance	TVM Machines	23	\$6,500	\$149,500
Station/Stop Maintenance	Directional BRT Stop	37	\$2,000	\$74,000
Police/Fare Enforcement	BRT Rev. Bus-Hrs.	35,200	\$6.38	\$224,576
Total Change in O&M Costs (2011\$)				\$4,390,929
Total Change in O&M Costs (2012\$)			1.021	\$4,483,138
<i>Cost per Rev. Bus-Hr.</i>				\$127.36

TOTAL O&M COST IMPACT FOR WEST CORRIDOR: Odana Rd. Option **\$3,401,506**

Table 8
System O&M Cost Estimates: With Mineral Pt. Road Alignment Option

O&M Costs for Background Bus Service Changes

Cost Item	Type of Unit	Units	Unit Cost	Cost Estimate
Vehicle Operations-Related Costs	Ann. Rev. Bus-Hrs.	-36,551	\$75.61	-\$2,763,706
Vehicle Maint.-Related Costs	Ann. Rev. Bus-Mi's.	-487,870	\$1.39	-\$676,333
Non-Veh. Maint. & G&A Costs	% of Above Items		18.07%	-\$621,683
Total Change in O&M Costs (2011\$)				-\$4,061,722
Total Change in O&M Costs (2012\$)			1.021	-\$4,147,019
<i>Cost per Rev. Bus-Hr.</i>				\$113.46

O&M Costs for BRT Service

Cost Item	Type of Unit	Units	Unit Cost	Cost Estimate
Vehicle Operations-Related Costs	BRT Rev. Bus-Hrs.	112,000	\$75.61	\$8,468,581
Vehicle Maint.-Related Costs	BRT Rev. Bus-Mi's.	1,206,700	\$1.39	\$1,672,846
Non-Veh. Maint. & G&A Costs	% of Above Items		18.07%	\$1,832,755
Articulated Bus Premium	BRT Rev. Bus-Mi's.	1,206,700	\$0.35	\$418,211
TVM Maintenance	TVM Machines	41	\$6,500	\$266,500
Station/Stop Maintenance	Directional BRT Stop	93	\$2,000	\$186,000
Police/Fare Enforcement	BRT Rev. Bus-Hrs.	112,000	\$6.38	\$714,560
Total Change in O&M Costs (2011\$)				\$13,559,454
Total Change in O&M Costs (2012\$)			1.021	\$13,844,203
<i>Cost per Rev. Bus-Hr.</i>				\$123.61

TOTAL O&M COST IMPACT FOR SOUTH CORRIDOR **\$9,697,184**

Table 9
System O&M Cost Estimates: With Odana Road Alignment Option

O&M Costs for Background Bus Service Changes

Cost Item	Type of Unit	Units	Unit Cost	Cost Estimate
Vehicle Operations-Related Costs	Ann. Rev. Bus-Hrs.	-36,284	\$75.61	-\$2,743,518
Vehicle Maint.-Related Costs	Ann. Rev. Bus-Mi's.	-484,668	\$1.39	-\$671,894
Non-Veh. Maint. & G&A Costs	% of Above Items		18.07%	-\$617,232
Total Change in O&M Costs (2011\$)				-\$4,032,644
Total Change in O&M Costs (2012\$)			1.021	-\$4,117,330
<i>Cost per Rev. Bus-Hr.</i>				\$113.48

O&M Costs for BRT Service

Cost Item	Type of Unit	Units	Unit Cost	Cost Estimate
Vehicle Operations-Related Costs	BRT Rev. Bus-Hrs.	112,000	\$75.61	\$8,468,581
Vehicle Maint.-Related Costs	BRT Rev. Bus-Mi's.	1,246,500	\$1.39	\$1,728,021
Non-Veh. Maint. & G&A Costs	% of Above Items		18.07%	\$1,842,727
Articulated Bus Premium	BRT Rev. Bus-Mi's.	1,246,500	\$0.35	\$432,005
TVM Maintenance	TVM Machines	43	\$6,500	\$279,500
Station/Stop Maintenance	Directional BRT Stop	97	\$2,000	\$194,000
Police/Fare Enforcement	BRT Rev. Bus-Hrs.	112,000	\$6.38	\$714,560
Total Change in O&M Costs (2011\$)				\$13,659,394
Total Change in O&M Costs (2012\$)			1.021	\$13,946,241
<i>Cost per Rev. Bus-Hr.</i>				\$124.52

TOTAL O&M COST IMPACT FOR SOUTH CORRIDOR	\$9,828,911
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APPENDIX A
ESTIMATED CHANGE IN BUS STATISTICS FOR
BACKGROUND BUS ROUTES

Corridor	Route	Route Change	Day	Change in Rev. Miles	Change in Rev. Hrs.	Change in Peak Buses
East	6	Eliminate service between Cap. Sq. and East Towne Mall	Wkdy	-790.0	-56.7	-5
			Sat	-238.0	-17.0	n/a
			Sun	-224.0	-16.0	n/a
			Annual	-226,818	-16,262	-5
	13	Realign route to East Washington Ave. & Milwaukee Street	Wkdy	135.0	11.3	2
			Sat	86.4	7.2	n/a
			Sun	81.0	6.8	n/a
			Annual	43,616	3,635	2
	20	Eliminate airport service and add Kinsman/Bartolo and Portege/Hayes service	Wkdy	123.5	10.3	1
			Sat	108.3	9.0	n/a
			Sun	104.5	8.7	n/a
			Annual	43,185	3,599	1
	25	Eliminate route	Wkdy	-46.0	-2.9	0
			Sat	0.0	0.0	n/a
			Sun	0.0	0.0	n/a
			Annual	-11,730	-742	0
	26	Add peak period service Increase peak period headways	Wkdy	71.6	4.1	1
			Sat	0.0	0.0	n/a
			Sun	0.0	0.0	n/a
Annual			18,266	1,047	1	
34	Minor route alignment to provide service on East Washington Ave.	No significant change in statistics				
North	22	Eliminate route	Wkdy	-339.6	-23.0	-2
			Sat	-128.3	-8.7	n/a
			Sun	-120.7	-8.2	n/a
			Annual	-100,267	-6,794	-2
	27	Eliminate route	Wkdy	-85.1	-7.4	-2
			Sat	0.0	0.0	n/a
			Sun	0.0	0.0	n/a
			Annual	-21,708	-1,882	-2
	29	Eliminate route	Wkdy	-46.8	-3.2	-2
			Sat	0.0	0.0	n/a
			Sun	0.0	0.0	n/a
			Annual	-11,926	-806	-2

Corridor	Route	Route Change	Day	Change in Rev. Miles	Change in Rev. Hrs.	Change in Peak Buses
South	5	Eliminate service between Cap. Sq. and South Transfer Point	Wkdy	-217.6	-21.3	-1
			Sat	-112.2	-11.0	n/a
			Sun	-108.8	-10.7	n/a
			Annual	-67,633	-6,631	-1
	44/48	Turn back route at Caddis Bend	Wkdy	-104.1	-7.2	-2
			Sat	0.0	0.0	n/a
			Sun	0.0	0.0	n/a
			Annual	-26,535	-1,839	-2
	47	Minor route alignment to Mills Street	No significant change in statistics			
	West	2	Eliminate supplemental a.m. trips on West Side	Wkdy	-36.4	-3.3
Sat				0.0	0.0	n/a
Sun				0.0	0.0	n/a
Annual				-9,282	-833	-2
14		Minor route alignment change in Hill Farms area	No significant change in statistics			
37		Eliminate service west of UW Campus (3 trips)	Wkdy	-5.7	-0.4	0
			Sat	0.0	0.0	n/a
			Sun	0.0	0.0	n/a
			Annual	-1,454	-102	0
67		Eliminate route	Wkdy	-299.6	-22.6	-2
	Sat		-104.2	-7.9	n/a	
	Sun		-97.7	-7.4	n/a	
	Annual		-87,483	-6,599	-2	
70	Turn back route at Hill Farms	Wkdy	-110.2	-9.2	-1	
		Sat	0.0	0.0	n/a	
		Sun	0.0	0.0	n/a	
		Annual	-28,101	-2,342	-1	
73/63	Realign to Mineral Point Road (Odana Road alignment option only)	Wkdy	9.8	0.8	0	
		Sat	6.6	0.6	n/a	
		Sun	6.2	0.5	n/a	
		Annual	3,202	267	0	