Madison's Bus Redesign: The Statistical Effect

March 2024

Introduction

This is the first of these reports showing the advocacy side of the Eliot Deviation Index and utilizes a number of tools and data from our growth in 2023. This particular report on the recent bus network redesign in Madison, Wisconsin has been on the back burner for a while and we're happy that this has finally came to fruition with the extensive data we have now. Stay tuned for more of these advocacy reports soon!

The City of Madison and Metro Transit began this network redesign process in early 2021 and developed a draft plan through 2021 and into early 2022. The final redesign was approved by the city on June 7, 2022, and the new network came into effect at the beginning of service on June 11, 2023.

Definitions

This is the first of these kinds of reports using the Eliot Deviation Index data, so it's helpful to define some of the terminology used throughout this report.

- "Route" refers to each entry included in the Eliot Deviation Index database, one for each qualifying service pattern operated. Qualifying service patterns operate at least one-third of trips on the same route name and meet all eligibility requirements. A handful of routes were excluded from this report for these reasons.
- "EDI" refers to the Eliot Deviation Index value (those reading this are likely familiar with this term), which is the ratio between the distance travelled on a route compared to the distance between the first and last stops.

- The lengths of each route may not be accurate to the exact distance a bus travels on its route, due to the calculation method used, finding the straight-line distance between stops along the route rather than the actual road distance. These discrepancies are found to be within an acceptable range for all relevant purposes. These discrepancies also serve as a neutralizer within the greater database to account for routes with geographical challenges.
- All EDI data mentioned in this report is accurate as of the beginning of service on June 11, 2023. Any subsequent changes to the system may not be included in this report.
- "Population served" refers to the population living in the US Census blocks within ¼ mile of a bus stop as of the 2020 US Census.

Pre-Redesign Network

The network before the redesign contained 55 routes, and the initial findings from Metro Transit pointed out that there was a lack of frequent bus routes within Madison. A large portion of the city's bus routes ran every 30 or 60 minutes during the day and relied on a transfer point system to connect riders across the network. There were 5 main transfer points scattered across the city at major points where routes would meet. In addition, only 11% of the city's population lived within ¼ mile from a frequent bus route (defined as arriving every 15 minutes or better). 79% of Madison residents were within ¼ mile of a bus stop with all-day service.[1]

The median route in Madison was just 6.4 miles long with an Eliot Deviation Index of 1.54. While no routes met the threshold to be rethought, which stands at 3.0, the 68 was the most deviatory with a 2.41, and the 7 was the least deviatory with a 1.12. Route lengths also varied from the 36 at 1.01 miles long, to the branch of the 70 to JQ Hammons & Greenway at 14.58 miles long.[2]

In 2021, Metro Transit surveyed a wide array of riders seeking their input on the network redesign and what should be prioritized. One option was a "coverage" plan, to try and cover the greatest portion of the city with bus stops less than a ¼ mile away from homes. This plan would lead to more routes overall, but those would be less frequent. The other option was a "ridership" plan, which would give more frequent service overall, but some

[1] City of Madison, p. 4.
[2] Eliot Deviation Index.

people would have to walk a little longer to reach a bus route. The survey found that 65% of respondents heavily preferred the "ridership" alternative, with 57% of respondents also desiring some service to be designed for coverage as well. A second survey later in 2021 indicated that 61% of respondents found the "ridership" alternative to be beneficial to them and their families.[3]

Post-Redesign Network

With a mix of both alternatives chosen, mostly the "ridership" alternative, here are the improvements that would come with the new network. The median Madison resident would see an 80% increase in jobs reachable within 45 minutes by transit. While there would be a decrease in the number of residents near all-day bus service, down from 79% to 73%, 42% of residents would now be near frequent bus service, compared to 11% before. Most routes run every 30 minutes or better during the day.[4] Note that the 80, 81, 82, and 84, which are the routes primarily serving the University of Wisconsin, were not affected by the redesign.

Metro Transit's draft plan states benefits of the new plan being that there would be "less confusion, fewer loops, straighter paths, and the same routes would run every day" and that "longer routes would take people directly Downtown and across town."[5]

This new plan includes 25 routes, with the median route being 10.02 miles long with an Eliot Deviation Index of a 1.39. There did end up being a couple of more deviatory routes, with the F having a 2.7, a bit shy of the 3.0 threshold to be rethought, but the least deviatory was the A1 at 1.15, and overall, the median EDI did drop from a 1.54 before the redesign. The shortest route in the new network is the 80 at 2.22 miles long, and the longest is the A2 at 17.23 miles. This data matches up with Metro Transit's claims, with less deviatory routes that are longer on average.[6]

The new system also does a better job at effectively serving where people live, with the new network focusing on the denser corridors in Madison. Before the redesign, the average route directly served 3,176 people for every mile it travelled. There was a lot of variety, with the 20, 26, and 31 all serving less than 1,000 people per mile, while the 2, 4, 5, 15, 28, 38, 44,

[3] City of Madison, p. 10-11.

[4] City of Madison, p. 31.

[5] City of Madison, p. 8.

[6] Eliot Deviation Index.

and 48 all served well over 4,500 people per mile. The new system brings that average up to 4,053 people per mile, with the lowest being the L, serving 1,196 people per mile, higher than 6 of the old routes. The C, 28, and 38 each serve over 5,000 people per route mile through dense corridors, and the A and B, which are planned to become BRT routes in the near future, both serve 3,000 to 4,000 people per mile along their longer than average routes. While the densest of routes weren't made denser, a lot of the less dense routes were modified with this redesign to better utilize the capacity of the buses. Full charts with more detailed data are available at the end of this report.

Conclusion

Overall, Metro Transit succeeded with the redesign of the Madison bus network. This new network gives a major service upgrade to the residents of Madison, with the growth of frequent bus corridors and effective routing to both serve the greatest amount of density, as well as make the system less confusing and more direct. The elimination of transfer points throughout the system gives more passengers a direct trip across the city, and the 2023 redesign set the city up to debut BRT later this year.

Sources

City of Madison, "Metro Transit Network Redesign: Draft Plan Report." January 28, 2022. https://www.cityofmadison.com/metro/documents/network-redesign/draftplan/TransitNetworkRedesign_DraftPlanReport.pdf

Eliot Deviation Index. July 4, 2023. https://www.eliotindex.org/stats.html#wi-metro

U.S. Census Bureau. https://data.census.gov (US Census Bureau, data as of 2020 US Census)

Appendix: Population Charts for Metro Transit

Old System				New System				Stats	
Route	Population (2020)	Length (Miles)	Population / Mile	Route	Population (2020)	Length (Miles)	Population / Mile	Stats	
2-fordem	48,640	10.13	4,802	A1	55,600	17.19	3,234	**Old System**	
2-sherman	48,327	10.20	4,738	A2	55,816	17.23	3,239	Average Pop.	23,575
4	45,785	8.58	5,336	B	52,204	12.31	4,241	Minimum Pop.	1,195
5	34,928	7.26	4,811	C	42,696	7.74	5,516	Maximum Pop.	58,001
6-hayes	58,001	14.07	4,122	C1	49,316	10.23	4,821	Avg. Pop / Mile	3,176
6-madison	54,099	12.41	4,359	C2	48,306	10.59	4,561	Min. Pop / Mile	741
7	40,571	9.30	4,362	D1	61,321	16.94	3,620	Max. Pop / Mile	10,242
8	41,859	6.12	6,840	D2	56,381	15.48	3,642		
11	45,323	13.42	3,377	E	45,187	11.06	4,086	**New System**	
12	39,497	11.80	3,347	F	18,528	9.27	1,999	Average Pop.	34,655
13	17,220	4.80	3,588	G	21,278	13.36	1,593	Minimum Pop.	8,338
15	49,528	9.98	4,963	H	28,173	10.02	2,812	Maximum Pop.	61,321
16	15,202	9.89	1,537	J	19,731	8.28	2,383	Avg. Pop / Mile	4,053
17	3,530	2.76	1,279	L	18,168	15.19	1,196	Min. Pop / Mile	1,196
18-coho	17,131	7.39	2,318	O	16,748	4.59	3,649	Max. Pop / Mile	10,242
18-hammersley	13,830	6.92	1,999	R1	40,080	8.91	4,498		
18-midvale	14,928	7.36	2,028	R2	43,618	9.69	4,501		
20	4,634	5.68	816	28	36,126	5.24	6,894		
21	9,098	3.62	2,513	38	32,019	4.31	7,429		
22	9,271	3.33	2,784	55	8,656	5.92	1,462		
23	18,706	10.33	1,811	65	38,398	10.24	3,750		
26-city-view	2,881	3.89	741	75	21,778	12.74	1,709		
26-washington	2,692	3.08	874	80	22,737	2.22	10,242		
28	49,272	10.09	4,883	80-eagle	25,180	3.61	6,975		
30	7,574	3.80	1,993	84	8,338	2.55	3,270		
30-swanton	8,921	3.50	2,549						
31	8,385	8.80	953						
32	10,547	3.90	2,704						
33	9,173	3.85	2,383						
36	1,195	1.01	1,183						
38-dempsey	49,227	9.55	5,155						
38-ingersoll	41,721	6.10	6,840						
38-plafum	54,104	12.78	4,233						
39	5,554	4.31	1,289						
44	21,531	4.58	4,701						
48	17,489	3.71	4,714						
50	8,202	2.81	2,919						
51	10,795	3.86	2,797						
52	6,607	3.46	1,910						
55	9,355	7.89	1,186						
59	12,280	7.39	1,662						
63	7,035	4.08	1,724						
67	6,062	2.98	2,034						
68	11,485	6.36	1,806						
70-discovery	48,021	13.32	3,605						
70-terrace	51,850	14.58	3,556						
72-allen	43,032	11.98	3,592						
72-branch	47,539	13.44	3,537						
73-deming	10,532	6.40	1,646						
73-fourier	10,064	5.96	1,689						
75	21,778	12.74	1,709						
78	15,370	8.08	1,902						
80	22,737	2.22	10,242						
80-eagle	25,180	3.61	6,975						
84	8,338	2.55	3,270						