Optimising Eccles Interchange for Traffic Flow from the M602 to the M60

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1 Introduction

The Eccles Interchange, shown in Figure 1, connects the M60 (Manchester Outer Ring Road) with the M62 and M602 [1]. In rush hour, the route from the M602 to the M60 northbound experiences congestion that forms an often stationary queue extending a significant distance back on the M602. This blocks vehicles from accessing the M60 southbound, and is a safety risk on the M602 as the left lane is stationary, while the right two lines are going at 70mph.

The M60 is not congested beyond the interchange, so the main cause of traffic is the interchange itself. There are three lanes joining the M60, one from the M602 and two from the M62, followed shortly by traffic on the M60 moving left to exit at the next junction. One lane from the M62 continues onto the M60 with a dedicated lane, while the other lane from the M62 and the lane from the M602 must merge with existing traffic.

This report explores the potential of removing a lane from the M60 through the Eccles Interchange, so that the traffic from the M602 can join with a dedicated lane. The junction layout was extracted from Open Street Maps (OSM) [2] and converted into a Simulation of Urban MObility (SUMO) traffic simulation [3]. This simulation was conducted both with and without the third lane on the M60. The removal of the third lane reduced journey times from the M602 to the M60 by up to 15%.

2 Methodology

The road layout was extracted from OSM, cleaned with Java Open Street Map Editor (JOSM) [4] and converted to SUMO network. The quantity of lanes was then verified with the satellite view in Google Maps. A second network was created with a lane on the M60 removed, so that the M602 joins with a dedicated lane.

The average duration to pass through the networks was tested from 100 cars per 100 seconds, in steps of 100, up to 1,000 cars per 100 seconds. Traffic densities were estimated and these estimates are provided in Table 1. The source code for these calculations, as well as the simulations themselves, is available in the GitHub repository [5].

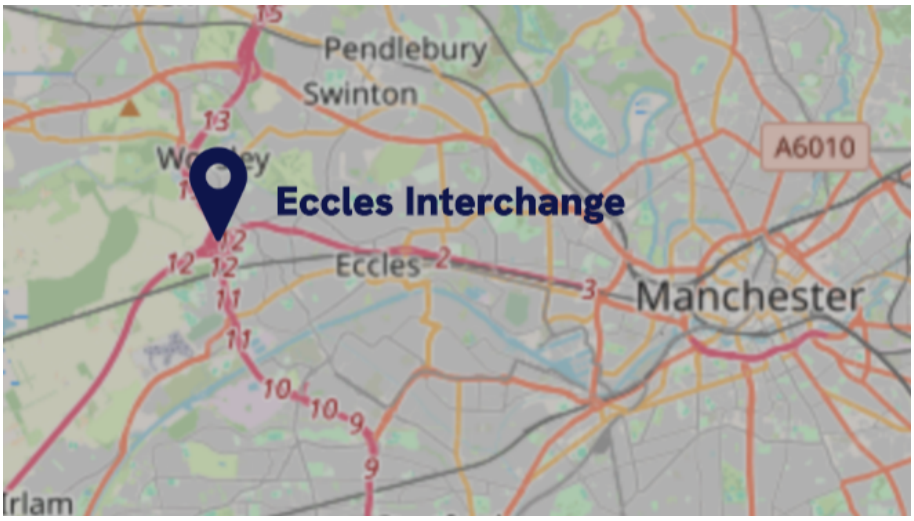

Figure 1: Location of Eccles Interchange in Manchester

Direction	Density
M62 - M60 northbound	1
M602 - M60 northbound	1
M60 northbound	2
M60 northbound - J13	0.5

Table 1: Traffic Densities Used for Simulation

3 Limitations

This project was undertaken as a personal initiative, so the scope, resources, and methodologies applied are reflective of its status as an independent exploration. Traffic densities are estimated based on the design of the intersection and the simulation only covers Eccles Interchange and Worsley Interchange, making the effect of these changes on the wider network less clear.

Motorway entry ramps are treated as zipper merges in the simulations, where vehicles alternate merging in a one-by-one pattern. This assumes a level of driver co-operation above what can be expected at rush hour. However, this method was chosen to present the best case for the existing lane structure that includes more lane merges.

4 Results

The average duration of traffic through the intersection for each route at each traffic density is shown in Table 2. The proposed changes reduce journey time for the M602 - M60 connection by more than they increase journey time for the M60 northbound. Journey time for the M62 - M60 connection is also reduced at higher traffic densities.

Route	100 Vehicles Current	Proposed	Difference	200 Vehicles Current	Proposed	Difference
M602 - M60	111.75	108.97	-2.77	128.83	121.15	-7.68
M62 - M60	100.15	103.99	3.84	104.54	108.32	3.78
M60 - J13	111.10	106.00	-5.10	116.04	118.26	2.22
M60 North	101.75	100.71	-1.04	118.18	116.22	-1.97

Route	300 Vehicles Current	Proposed	Difference	400 Vehicles Current	Proposed	Difference
M602 - M60	167.89	160.75	-7.14	205.83	181.74	-24.09
M62 - M60	111.07	118.24	7.18	119.88	146.87	26.99
M60 - J13	141.47	147.15	5.67	144.73	151.58	6.85
M60 North	134.16	138.39	4.23	141.87	145.68	3.81

Route	500 Vehicles Current	Proposed	Difference	600 Vehicles Current	Proposed	Difference
M602 - M60	233.61	211.62	-21.99	269.47	233.42	-36.05
M62 - M60	143.64	139.94	-3.70	148.43	149.93	1.50
M60 - J13	161.93	168.31	6.38	166.18	188.65	22.47
M60 North	150.11	158.62	8.51	158.39	170.13	11.73

Route	700 Vehicles Current	Proposed	Difference	800 Vehicles Current	Proposed	Difference
M602 - M60	291.81	240.12	-51.69	318.92	278.28	-40.64
M62 - M60	174.32	160.40	-13.92	184.59	194.22	9.63
M60 - J13	171.19	179.55	8.36	178.88	204.45	25.56
M60 North	158.57	168.61	10.03	167.87	187.17	19.30

Route	900 Vehicles Current	Proposed	Difference	1000 Vehicles Current	Proposed	Difference
M602 - M60	350.44	322.89	-27.55	392.36	335.66	-56.69
M62 - M60	198.09	187.86	-10.23	213.51	208.02	-5.50
M60 - J13	185.48	192.68	7.19	208.24	208.33	0.09
M60 North	167.97	178.80	10.83	168.55	196.83	28.28

Table 2: Results of Traffic Simulation

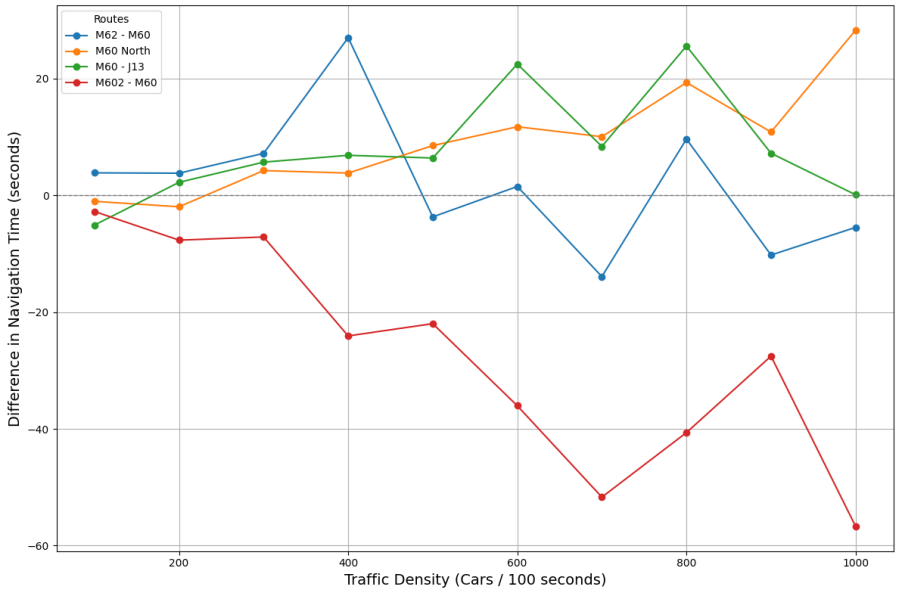

Figure 2: Effect of Proposal on Trip Duration

Figure 2 shows the difference in average travel time after changing to the new network layout. The drop in travel time for the M602 - M60 connection is shown in red.

5 Conclusion

The proposed layout requires no additional infrastructure. The left lane of the M60 before the intersection would be redirected to the exit ramp for J12 and the remaining left lane through the intersection would be marked over. This improves traffic flow for the M602 - M60 connection by replacing a merge with a dedicated lane, shown at point B Figure 3. Despite no changes to the M62 - M60 connection, shown at point A in Figure 3, traffic flow improves in this area under higher traffic densities.

Overall, trip duration for the M602 - M60 connection can be reduced by up to 15% with only slightly increased congestion on the M60 northbound. However, this may have negative effects on the wider network as only the Eccles Interchange was modelled for the report. This approach has potential, but further research is required to determine if this approach provides a viable solution.

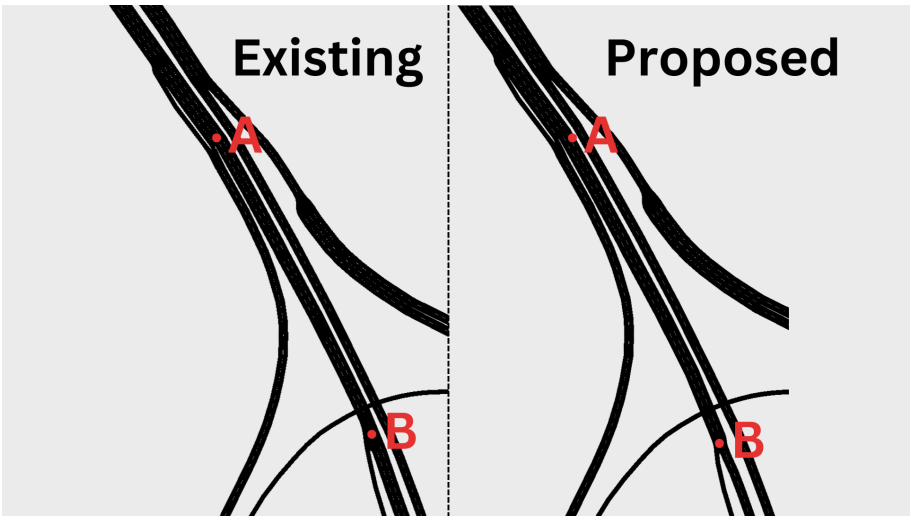

Figure 3: Lane Removal on M60

References

[1] Roads.org.uk. *M60 Motorway (Junction 12-10)*. Accessed: 2024-12-10. 2024. URL: https://www.roads.org.uk/motorway/m60/120.

[2] OpenStreetMap contributors. *OpenStreetMap*. Accessed: 2024-12-10. 2024. URL: https://www.openstreetmap.org.

[3] Pablo Alvarez Lopez et al. "Microscopic Traffic Simulation using SUMO". In: *2019 IEEE Intelligent Transportation Systems Conference (ITSC)*. IEEE, Nov. 2018, pp. 2575–2582. URL: https://elib.dlr.de/127994/.

[4] JOSM contributors. *JOSM - Java OpenStreetMap Editor*. Accessed: 2024-12-10. 2024. URL: https://josm.openstreetmap.de.

[5] Matthew McNee. *Simulated Eccles Interchange*. Accessed: 2024-12-10. 2024. URL: https://github.com/mattmcnee/simulated-eccles-interchange.