

Appendix A Supplementary Material

In the Appendix, we present essential supplementary information, detailing GPS points, road link counts, total speeding events by speed limits, maps for speeding events in road links across various British cities, and statistical modelling results.

A.1 GPS points, road links, and speeding events by speed limits in British cities

Table A1 Speeding events and road links in British cities by speed limits

	Total	20 Mph	30 Mph	40 Mph	50 Mph	60 Mph	70 Mph
Total points	118321296	33540011	44491799	15721247	13225655	1169652	10172932
Percent(%)	100	28.35	37.6	13.29	11.18	0.99	8.6
Speeding events	9267597	4540560	2182272	860949	1305345	65439	313032
Percent(%)	100	48.99	23.55	9.29	14.09	0.71	3.38
Link count	263075	144383	109921	5880	2153	402	336
Percent(%)	100	54.88	41.78	2.24	0.82	0.15	0.13
London	35190309	1988507	12201539	3091523	1162686	616064	16130071
	100	5.65	34.67	8.79	3.3	1.75	45.84
	2428917	413100	1170342	210971	91144	29274	514086
	100	17.01	48.18	8.69	3.75	1.21	21.17
	117584	43566	67800	3734	631	742	1111
Manchester	100	37.05	57.66	3.18	0.54	0.63	0.94
	3714943	1488944	1174686	127541	581739	56449	285584
	100	40.08	31.62	3.43	15.66	1.52	7.69
	274944	160628	47200	7368	58030	0	1718
	100	58.42	17.17	2.68	21.11	0	0.62
Oxford	7630	6318	1015	84	114	46	53
	100	82.8	13.3	1.1	1.49	0.6	0.69
	1005794	306115	538651	69211		3674	88143
	100	30.44	53.55	6.88		0.37	8.76
	82033	46838	30210	2863		0	2122
Cambridge	100	57.10	36.83	3.49		0	2.59
	5381	3858	1411	91		12	9
	100	71.7	26.22	1.69		0.22	0.17
	3468509	166144	1001716	402783	327548	32097	1538221
	100	4.79	28.88	11.61	9.44	0.93	44.35
Cardiff	241079	23260	48096	27960	62098	24	79641
	100	9.65	19.95	11.60	25.76	0.01	33.04
	12192	2589	8766	303	95	256	183
	100	21.24	71.9	2.49	0.78	2.1	1.5
	17352934	1907289	4433678	2592503	1304869	1008248	6106347
West of England	100	10.99	25.55	14.94	7.52	5.81	35.19
	1769513	489329	575235	263790	117358	5632	318169
	100	27.65	32.51	14.91	6.63	0.32	17.98
	42557	22638	14569	2075	574	2325	376
	100	53.19	34.23	4.88	1.35	5.46	0.88
West Midlands	37461592	1796133	15306186	5864867	1766415	416035	12311956
	100	4.79	40.86	15.66	4.72	1.11	32.87
	2674793	434674	1511094	408475	226932	3955	89663
	100	16.25	56.49	15.27	8.48	0.15	3.35
	114221	18421	88516	5673	781	346	484
Liverpool	100	16.13	77.5	4.97	0.68	0.3	0.42
	21430620	1341731	8235624	3696994	610078	1256790	6289403
	100	6.26	38.43	17.25	2.85	5.86	29.35
	1971589	316514	1010836	259982	51200	57878	275179
	100	16.05	51.27	13.19	2.60	2.94	13.96
West Yorkshire	70435	27407	38339	2997	380	809	503
	100	38.91	54.43	4.25	0.54	1.15	0.71
	38685062	1495379	11393316	4574270	1728737	1251314	18242046
	100	3.87	29.45	11.82	4.47	3.23	47.16
	2597756	353354	1141149	319886	198701	6450	578216
South Yorkshire	100	13.60	43.93	12.31	7.65	0.25	22.26
	107639	30177	66746	5822	1038	2979	877
	100	28.04	62.01	5.41	0.96	2.77	0.81
	23629615	346458	4333109	2758890	1094450	2021846	13074862
	100	1.47	18.34	11.68	4.63	8.56	55.33
Newcastle	1289514	100502	535445	204360	88843	9701	350663
	100	7.79	41.52	15.85	6.89	0.75	27.19
	55446	7375	38534	4880	706	3408	543
	100	13.3	69.5	8.8	1.27	6.15	0.98
	7961628	657383	2590069	767855	1223020	355236	2368065
Edinburgh	100	8.26	32.53	9.64	15.36	4.46	29.74
	677586	152584	307932	44460	127975	1058	43577
	100	22.52	45.45	6.56	18.89	0.16	6.43
	45255	16021	24856	1866	761	843	908
	100	35.4	54.92	4.12	1.68	1.86	2.01
Glasgow	8754424	2133474	1543827	1147975	307671	55548	3565929
	100	24.37	17.63	13.11	3.51	0.63	40.73
	899431	460807	197663	114279	65358	515	60809
	100	51.23	21.98	12.71	7.27	0.06	6.76
	19585	14633	3665	723	114	252	198
	100	74.72	18.71	3.69	0.58	1.29	1.01
	13661728	673811	6129993	672077	3628321	732033	1825493
	100	4.93	44.87	4.92	26.56	5.36	13.36
	2194105	106673	607994	53502	1249323	114984	61629
	100	4.86	27.71	2.44	56.94	5.24	2.81
	31934	4522	26163	637	377	131	104
	100	14.16	81.93	1.99	1.18	0.41	0.33

Note: Road links in Cambridge do not have a posted speed limit at 50 mph

A.2 Speeding events on road links

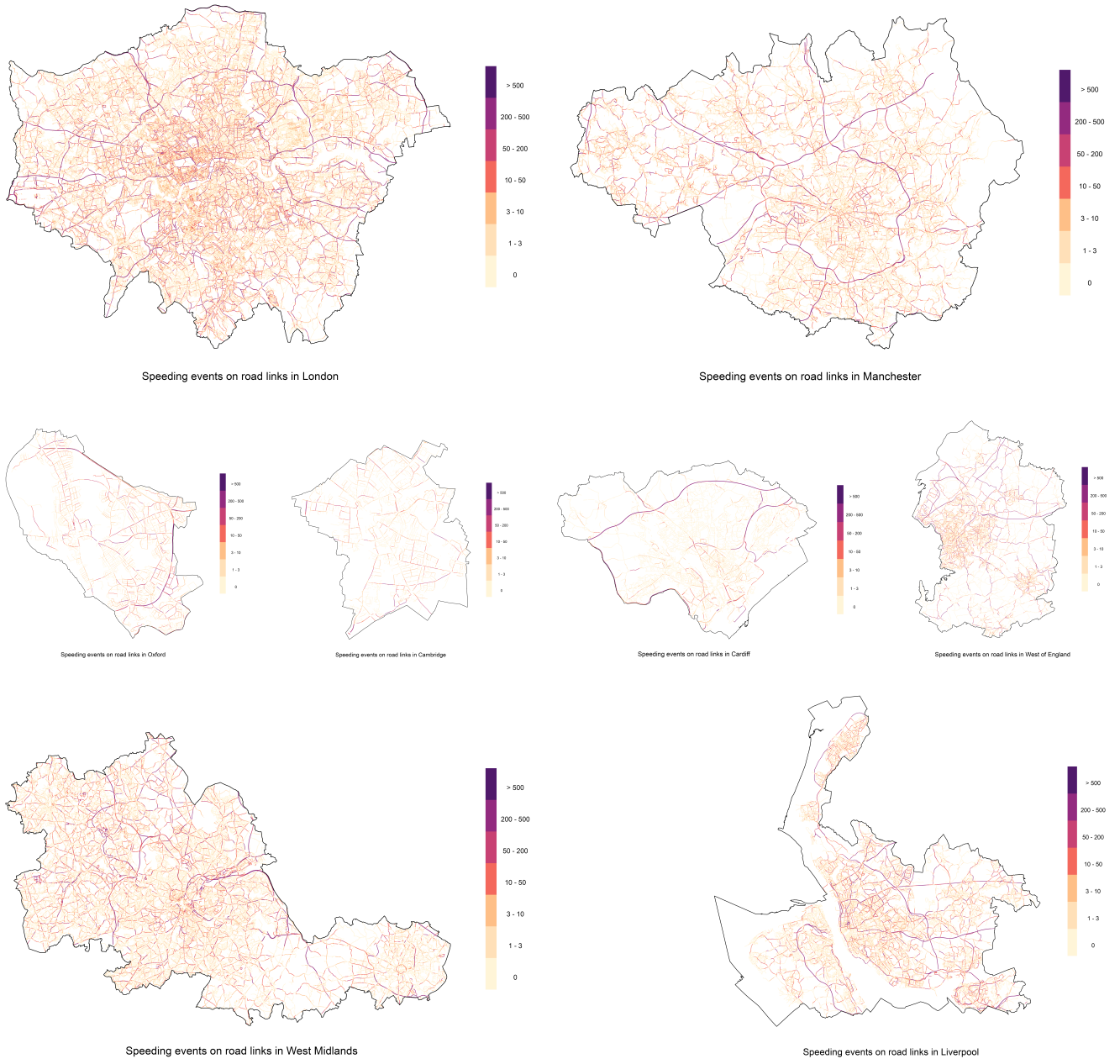


Fig. A1 Speeding events at road link level in British cities. Note that road mapping only includes road links with matched GPS point more than 5. There are 871524 road links used in plots. For the bands of 0, [1,3), [3-10), [10-50), [50-200), [200-500), [500, +), there are 420252, 122854, 123341, 125870, 55687, 14908, 8612 road links, respectively, in British cities

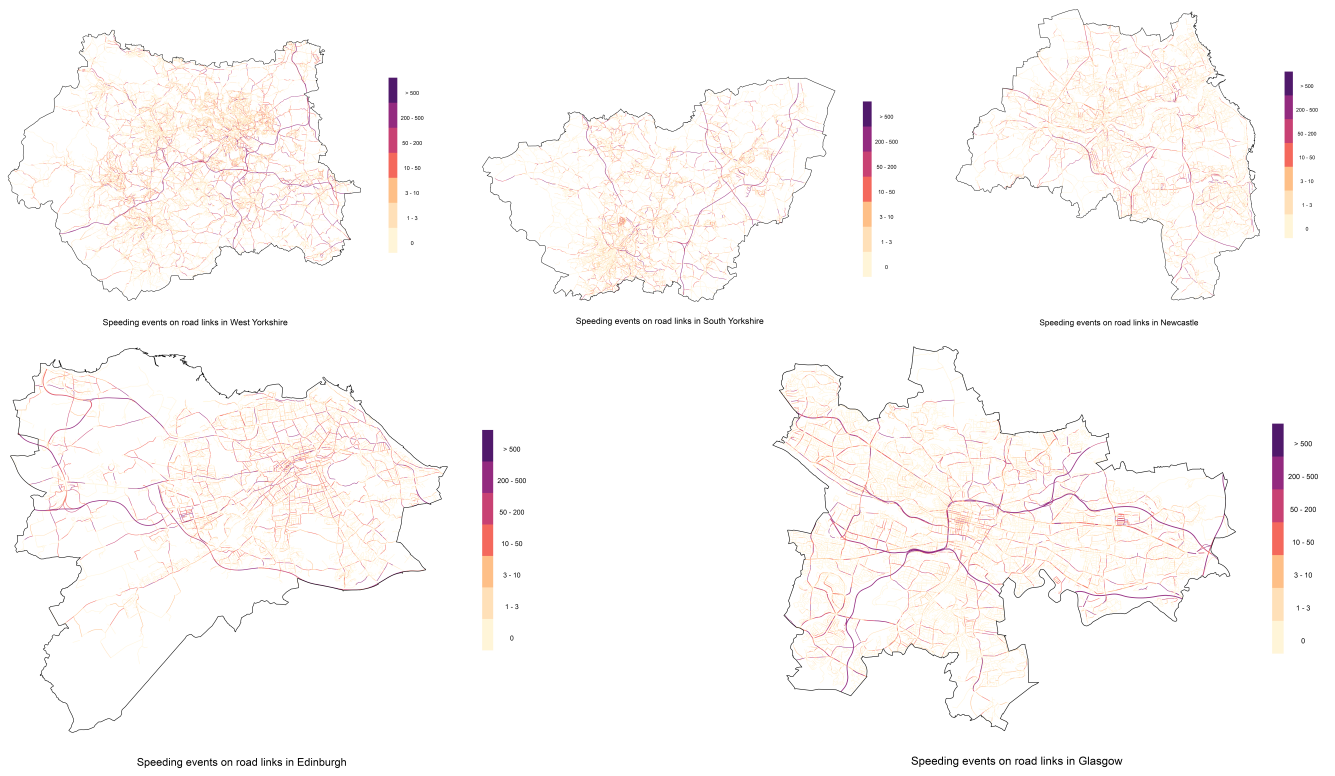


Fig. A2 Speeding events at road link level in British cities. Note that road mapping only includes road links with matched GPS point more than 5. There are 871524 road links used in plots. For the bands of 0, [1,3), [3-10), [10-50), [50-200), [200-500), [500, +), there are 420252, 122854, 123341, 125870, 55687, 14908, 8612 road links, respectively, in British cities

A.3 Negative binomial model results

Table A2 Model results for all road links across different road network distances (400 m, 800 m, 2 km, and 5 km) showing the impact of road engineering features, road attributes, and network metrics on speeding events

Independent variables	Speeding events (Coefficients, 95% CI, p-value, IRR, 95% CI)			
	50m.400m	50m.800m	50m.2km	50m.5km
Traffic Calming	-0.401 (-0.418, -0.385), 0.000***, 0.669 (0.659, 0.680)	-0.408 (-0.424, -0.392), 0.000***, 0.665 (0.654, 0.676)	-0.408 (-0.424, -0.392), 0.000***, 0.665 (0.655, 0.676)	-0.377 (-0.393, -0.361), 0.000***, 0.686 (0.675, 0.697)
Choker	-0.176 (-0.234, -0.118), 0.000***, 0.839 (0.792, 0.889)	-0.193 (-0.251, -0.134), 0.000***, 0.825 (0.778, 0.874)	-0.190 (-0.247, -0.133), 0.000***, 0.827 (0.781, 0.875)	-0.177 (-0.233, -0.122), 0.000***, 0.838 (0.792, 0.886)
Island	0.620 (0.597, 0.642), 0.000***, 1.858 (1.817, 1.900)	0.566 (0.544, 0.589), 0.000***, 1.762 (1.723, 1.801)	0.540 (0.519, 0.562), 0.000***, 1.717 (1.680, 1.754)	0.465 (0.443, 0.486), 0.000***, 1.592 (1.558, 1.626)
Signalised Crossing	0.281 (0.260, 0.301), 0.000***, 1.324 (1.297, 1.351)	0.303 (0.283, 0.324), 0.000***, 1.354 (1.327, 1.382)	0.246 (0.226, 0.266), 0.000***, 1.279 (1.253, 1.305)	0.155 (0.135, 0.175), 0.000***, 1.168 (1.144, 1.192)
Marked Crossing	0.158 (0.124, 0.191), 0.000***, 1.171 (1.132, 1.211)	0.198 (0.164, 0.232), 0.000***, 1.219 (1.179, 1.261)	0.142 (0.109, 0.175), 0.000***, 1.152 (1.115, 1.191)	0.107 (0.075, 0.139), 0.000***, 1.113 (1.077, 1.150)
Uncontrolled Crossing	0.292 (0.267, 0.317), 0.000***, 1.339 (1.306, 1.373)	0.297 (0.272, 0.322), 0.000***, 1.346 (1.313, 1.380)	0.217 (0.193, 0.242), 0.000***, 1.243 (1.213, 1.273)	0.197 (0.173, 0.221), 0.000***, 1.218 (1.189, 1.247)
Roundabout	0.500 (0.468, 0.532), 0.000***, 1.649 (1.597, 1.702)	0.503 (0.471, 0.534), 0.000***, 1.653 (1.602, 1.706)	0.366 (0.335, 0.397), 0.000***, 1.442 (1.398, 1.487)	0.190 (0.160, 0.220), 0.000***, 1.209 (1.174, 1.246)
Mini Roundabout	-0.103 (-0.137, -0.069), 0.000***, 0.902 (0.872, 0.934)	-0.126 (-0.160, -0.092), 0.000***, 0.882 (0.852, 0.912)	-0.252 (-0.285, -0.219), 0.000***, 0.777 (0.752, 0.803)	-0.268 (-0.301, -0.235), 0.000***, 0.765 (0.740, 0.790)
Motorway Junction	0.424 (0.341, 0.506), 0.000***, 1.527 (1.406, 1.659)	0.453 (0.370, 0.536), 0.000***, 1.573 (1.448, 1.709)	0.566 (0.486, 0.647), 0.000***, 1.762 (1.626, 1.910)	0.426 (0.347, 0.505), 0.000***, 1.532 (1.415, 1.658)
Traffic Signal	-0.178 (-0.197, -0.159), 0.000***, 0.837 (0.821, 0.853)	-0.188 (-0.208, -0.169), 0.000***, 0.828 (0.813, 0.845)	-0.191 (-0.210, -0.171), 0.000***, 0.826 (0.811, 0.842)	-0.279 (-0.299, -0.260), 0.000***, 0.756 (0.742, 0.771)
Speed Camera	0.222 (0.143, 0.300), 0.000***, 1.248 (1.154, 1.350)	0.356 (0.276, 0.435), 0.000***, 1.427 (1.318, 1.545)	0.371 (0.294, 0.448), 0.000***, 1.449 (1.342, 1.565)	0.305 (0.229, 0.380), 0.000***, 1.356 (1.258, 1.462)
Link Bidirection	-0.787 (-0.804, -0.770), 0.000***, 0.455 (0.447, 0.463)	-0.711 (-0.728, -0.694), 0.000***, 0.491 (0.483, 0.499)	-1.114 (-1.131, -1.097), 0.000***, 0.328 (0.323, 0.334)	-1.054 (-1.071, -1.038), 0.000***, 0.348 (0.343, 0.354)
Link Average Width	0.820 (0.812, 0.828), 0.000***, 2.271 (2.253, 2.289)	0.810 (0.802, 0.818), 0.000***, 2.248 (2.230, 2.266)	0.757 (0.750, 0.765), 0.000***, 2.132 (2.117, 2.148)	0.684 (0.677, 0.691), 0.000***, 1.982 (1.967, 1.997)
Link Length	1.056 (1.045, 1.066), 0.000***, 2.874 (2.844, 2.904)	1.252 (1.242, 1.262), 0.000***, 3.498 (3.464, 3.533)	1.397 (1.388, 1.406), 0.000***, 4.043 (4.006, 4.081)	1.405 (1.396, 1.414), 0.000***, 4.074 (4.037, 4.111)
Link Angular Curvature	-0.391 (-0.398, -0.385), 0.000***, 0.676 (0.672, 0.681)	-0.488 (-0.494, -0.482), 0.000***, 0.614 (0.610, 0.618)	-0.508 (-0.514, -0.502), 0.000***, 0.602 (0.598, 0.605)	-0.510 (-0.516, -0.504), 0.000***, 0.600 (0.597, 0.604)
Link Degree	0.034 (0.028, 0.040), 0.000***, 1.035 (1.029, 1.041)	-0.056 (-0.062, -0.051), 0.000***, 0.945 (0.940, 0.951)	-0.112 (-0.117, -0.107), 0.000***, 0.894 (0.889, 0.899)	-0.090 (-0.095, -0.085), 0.000***, 0.914 (0.909, 0.918)
Connectivity	-0.086 (-0.096, -0.076), 0.000***, 0.917 (0.908, 0.927)	-0.514 (-0.523, -0.505), 0.000***, 0.598 (0.593, 0.603)	-0.817 (-0.824, -0.810), 0.000***, 0.442 (0.439, 0.445)	-0.664 (-0.670, -0.657), 0.000***, 0.515 (0.512, 0.518)
Betweenness	0.133 (0.122, 0.144), 0.000***, 1.142 (1.129, 1.155)	0.531 (0.521, 0.542), 0.000***, 1.701 (1.683, 1.720)	1.074 (1.065, 1.083), 0.000***, 2.927 (2.900, 2.955)	1.142 (1.134, 1.151), 0.000***, 3.134 (3.109, 3.160)
Closeness	2.375 (2.317, 2.433), 0.000***, 10.752 (10.150, 11.390)	0.929 (0.859, 0.998), 0.000***, 2.531 (2.361, 2.713)	0.395 (0.358, 0.432), 0.000***, 1.485 (1.431, 1.541)	0.466 (0.422, 0.509), 0.000***, 1.593 (1.526, 1.664)
Average Shortest Path	0.764 (0.755, 0.773), 0.000***, 2.147 (2.128, 2.165)	0.516 (0.509, 0.522), 0.000***, 1.675 (1.663, 1.686)	0.337 (0.331, 0.342), 0.000***, 1.401 (1.393, 1.408)	0.257 (0.252, 0.262), 0.000***, 1.293 (1.286, 1.299)
Diversion Ratio	0.007 (-0.009, 0.022), 0.388, 1.007 (0.991, 1.022)	-0.040 (-0.045, -0.035), 0.000***, 0.960 (0.956, 0.965)	-0.246 (-0.251, -0.242), 0.000***, 0.782 (0.778, 0.785)	-0.173 (-0.178, -0.168), 0.000***, 0.841 (0.837, 0.845)
Speed Limit 20 mph	3.029 (2.961, 3.096), 0.000***, 20.667 (19.313, 22.115)	3.088 (3.020, 3.156), 0.000***, 21.939 (20.500, 23.478)	3.098 (3.031, 3.165), 0.000***, 22.155 (20.719, 23.691)	2.975 (2.910, 3.041), 0.000***, 19.599 (18.351, 20.931)
Speed Limit 30 mph	2.276 (2.209, 2.342), 0.000***, 9.734 (9.109, 10.402)	2.321 (2.254, 2.387), 0.000***, 10.183 (9.529, 10.882)	2.173 (2.108, 2.239), 0.000***, 8.788 (8.231, 9.383)	1.819 (1.754, 1.883), 0.000***, 6.163 (5.780, 6.572)
Speed Limit 40 mph	1.933 (1.864, 2.002), 0.000***, 6.909 (6.450, 7.401)	2.021 (1.953, 2.090), 0.000***, 7.549 (7.048, 8.085)	1.896 (1.829, 1.964), 0.000***, 6.662 (6.227, 7.127)	1.594 (1.528, 1.661), 0.000***, 4.926 (4.610, 5.263)
Speed Limit 50 mph	2.119 (2.037, 2.200), 0.000***, 8.320 (7.666, 9.029)	2.260 (2.178, 2.342), 0.000***, 9.584 (8.833, 10.399)	2.194 (2.115, 2.274), 0.000***, 8.974 (8.286, 9.720)	2.042 (1.964, 2.120), 0.000***, 7.705 (7.125, 8.332)
Speed Limit 60 mph	-1.210 (-1.290, -1.131), 0.000***, 0.298 (0.275, 0.323)	-0.966 (-1.045, -0.887), 0.000***, 0.381 (0.352, 0.412)	-1.171 (-1.249, -1.094), 0.000***, 0.310 (0.287, 0.335)	-1.201 (-1.277, -1.125), 0.000***, 0.301 (0.279, 0.325)
Random effect - City	0.17	0.17	0.16	0.15
ICC	0.09	0.08	0.08	0.08
Marginal R ² / Conditional R ²	0.801 / 0.818	0.635 / 0.665	0.632 / 0.662	0.655 / 0.682

Note: This table summarizes the model results analysing how road engineering features, road attributes, and network metrics influence speeding events, evaluated at 400 m, 800 m, 2 km, and 5 km road network distances for all road links. Independent variables, including connectivity, betweenness, closeness, average shortest path, and diversion ratio, are adjusted for these network distances. Results are reported as coefficients, 95% confidence intervals, p-values, and incidence rate ratios (IRR, 95% CI). The reference group for fixed effects of speed limit groups is 70 mph.

Table A3 Model results for 20 mph road links across different road network distances (400 m, 800 m, 2 km, and 5 km) showing the impact of road engineering features, road attributes, and network metrics on speeding events

Independent variables	Speeding events (Coefficients, 95% CI, p-value, IRR, 95% CI)			
	50m-400m	50m-800m	50m-2km	50m-5km
Traffic Calming	-0.379 (-0.397, -0.361), 0.000***, 0.684 (0.672, 0.697)	-0.399 (-0.417, -0.381), 0.000***, 0.671 (0.659, 0.683)	-0.416 (-0.433, -0.399), 0.000***, 0.660 (0.648, 0.671)	-0.342 (-0.359, -0.325), 0.000***, 0.710 (0.698, 0.722)
Choker	-0.013 (-0.077, 0.051), 0.684, 0.987 (0.926, 1.052)	-0.047 (-0.110, 0.017), 0.152, 0.954 (0.896, 1.017)	-0.087 (-0.148, -0.027), 0.005**, 0.916 (0.863, 0.973)	-0.050 (-0.109, 0.009), 0.099, 0.951 (0.897, 1.009)
Island	0.840 (0.807, 0.873), 0.000***, 2.317 (2.242, 2.394)	0.778 (0.745, 0.810), 0.000***, 2.176 (2.107, 2.248)	0.666 (0.636, 0.697), 0.000***, 1.947 (1.888, 2.008)	0.610 (0.579, 0.640), 0.000***, 1.840 (1.785, 1.896)
Signalised Crossing	0.469 (0.434, 0.505), 0.000***, 1.599 (1.543, 1.657)	0.496 (0.460, 0.531), 0.000***, 1.733 (1.584, 1.701)	0.371 (0.337, 0.406), 0.000***, 1.450 (1.400, 1.501)	0.220 (0.184, 0.255), 0.000***, 1.246 (1.202, 1.291)
Marked Crossing	0.431 (0.382, 0.479), 0.000***, 1.538 (1.466, 1.615)	0.459 (0.410, 0.507), 0.000***, 1.582 (1.507, 1.660)	0.360 (0.314, 0.406), 0.000***, 1.433 (1.369, 1.501)	0.364 (0.319, 0.409), 0.000***, 1.439 (1.376, 1.506)
Uncontrolled Crossing	0.550 (0.519, 0.582), 0.000***, 1.734 (1.681, 1.789)	0.550 (0.519, 0.581), 0.000***, 1.733 (1.680, 1.788)	0.425 (0.396, 0.455), 0.000***, 1.530 (1.486, 1.576)	0.370 (0.341, 0.399), 0.000***, 1.448 (1.406, 1.491)
Roundabout	1.086 (1.020, 1.152), 0.000***, 2.962 (2.772, 3.166)	1.072 (1.006, 1.138), 0.000***, 2.922 (2.735, 3.122)	0.755 (0.693, 0.817), 0.000***, 2.127 (1.999, 2.263)	0.656 (0.596, 0.717), 0.000***, 1.928 (1.814, 2.048)
Mini Roundabout	0.414 (0.368, 0.460), 0.000***, 1.513 (1.444, 1.584)	0.367 (0.321, 0.413), 0.000***, 1.443 (1.378, 1.511)	0.160 (0.117, 0.204), 0.000***, 1.174 (1.124, 1.226)	0.152 (0.109, 0.195), 0.000***, 1.164 (1.115, 1.215)
Motorway Junction	0.748 (0.293, 1.202), 0.001**, 2.112 (1.341, 3.326)	0.699 (0.245, 1.153), 0.003**, 2.011 (1.278, 3.166)	0.569 (0.142, 0.997), 0.009**, 1.767 (1.152, 2.710)	0.841 (0.418, 1.263), 0.000***, 2.318 (1.520, 3.536)
Traffic Signal	0.243 (0.209, 0.277), 0.000***, 1.275 (1.233, 1.320)	0.213 (0.179, 0.247), 0.000***, 1.237 (1.196, 1.280)	0.190 (0.156, 0.223), 0.000***, 1.209 (1.169, 1.250)	0.089 (0.055, 0.123), 0.000***, 1.093 (1.056, 1.131)
Speed Camera	0.056 (-0.127, 0.239), 0.548, 1.058 (0.881, 1.270)	-0.005 (-0.187, 0.178), 0.958, 0.995 (0.829, 1.194)	0.097 (-0.075, 0.269), 0.267, 1.102 (0.928, 1.309)	-0.205 (-0.376, -0.034), 0.019*, 0.815 (0.687, 0.966)
Link Bidirection	-0.420 (-0.447, -0.392), 0.000***, 0.657 (0.640, 0.675)	-0.334 (-0.361, -0.307), 0.000***, 0.716 (0.697, 0.736)	-0.639 (-0.666, -0.612), 0.000***, 0.528 (0.514, 0.542)	-0.476 (-0.501, -0.451), 0.000***, 0.621 (0.606, 0.637)
Link Average Width	0.770 (0.759, 0.780), 0.000***, 2.159 (2.137, 2.181)	0.762 (0.751, 0.772), 0.000***, 2.142 (2.120, 2.164)	0.658 (0.648, 0.667), 0.000***, 1.930 (1.913, 1.948)	0.602 (0.593, 0.612), 0.000***, 1.826 (1.810, 1.843)
Link Length	0.638 (0.625, 0.650), 0.000***, 1.892 (1.869, 1.915)	0.811 (0.799, 0.822), 0.000***, 2.250 (2.223, 2.276)	0.909 (0.898, 0.919), 0.000***, 2.482 (2.456, 2.508)	0.886 (0.876, 0.896), 0.000***, 2.425 (2.401, 2.450)
Link Angular Curvature	-0.105 (-0.115, -0.095), 0.000***, 0.901 (0.892, 0.910)	-0.208 (-0.218, -0.199), 0.000***, 0.812 (0.804, 0.820)	-0.237 (-0.246, -0.229), 0.000***, 0.789 (0.782, 0.796)	-0.259 (-0.267, -0.251), 0.000***, 0.772 (0.766, 0.778)
Link Degree	-0.079 (-0.089, -0.070), 0.000***, 0.924 (0.915, 0.933)	-0.174 (-0.183, -0.165), 0.000***, 0.840 (0.833, 0.848)	-0.174 (-0.182, -0.167), 0.000***, 0.840 (0.833, 0.846)	-0.117 (-0.124, -0.109), 0.000***, 0.890 (0.883, 0.897)
Connectivity	0.006 (-0.009, 0.022), 0.419, 1.006 (0.991, 1.022)	-0.443 (-0.458, -0.429), 0.000***, 0.642 (0.633, 0.651)	-0.771 (-0.780, -0.761), 0.000***, 0.463 (0.458, 0.467)	-0.499 (-0.508, -0.490), 0.000***, 0.607 (0.602, 0.612)
Betweenness	0.241 (0.223, 0.259), 0.000***, 1.272 (1.250, 1.295)	0.775 (0.757, 0.793), 0.000***, 2.171 (2.132, 2.209)	1.314 (1.301, 1.327), 0.000***, 3.721 (3.674, 3.768)	1.210 (1.199, 1.222), 0.000***, 3.355 (3.317, 3.393)
Closeness	0.363 (0.350, 0.377), 0.000***, 1.438 (1.418, 1.458)	0.148 (0.134, 0.162), 0.000***, 1.160 (1.143, 1.176)	0.004 (0.000, 0.007), 0.033*, 1.004 (1.000, 1.007)	0.009 (0.004, 0.013), 0.000***, 1.009 (1.004, 1.013)
Average Shortest Path	0.687 (0.674, 0.699), 0.000***, 1.987 (1.963, 2.011)	0.419 (0.408, 0.429), 0.000***, 1.520 (1.504, 1.536)	0.167 (0.159, 0.174), 0.000***, 1.181 (1.172, 1.190)	0.163 (0.155, 0.170), 0.000***, 1.177 (1.168, 1.185)
Diversion Ratio	-0.007 (-0.015, 0.001), 0.077, 0.993 (0.985, 1.001)	-0.161 (-0.172, -0.150), 0.000***, 0.851 (0.842, 0.861)	-0.374 (-0.386, -0.362), 0.000***, 0.688 (0.680, 0.696)	-0.112 (-0.120, -0.104), 0.000***, 0.894 (0.887, 0.901)
Random effect - City	0.22	0.22	0.23	0.21
ICC	0.12	0.11	0.13	0.12
Marginal R ² / Conditional R ²	0.485 / 0.545	0.496 / 0.553	0.596 / 0.647	0.592 / 0.641

Note: This table summarizes the model results analysing how road engineering features, road attributes, and network metrics influence speeding events, evaluated at 400 m, 800 m, 2 km, and 5 km road network distances for 20 mph road links. Independent variables, including connectivity, betweenness, closeness, average shortest path, and diversion ratio, are adjusted for these network distances. Results are reported as coefficients, 95% confidence intervals, p-values, and incidence rate ratios (IRR, 95% CI).

Table A4 Model results for 30 mph road links across different road network distances (400 m, 800 m, 2 km, and 5 km) showing the impact of road engineering features, road attributes, and network metrics on speeding events

Independent variables	Speeding events (Coefficients, 95% CI, p-value, IRR, 95% CI)			
	50m.400m	50m.800m	50m.2km	50m.5km
Traffic Calming	-0.492 (-0.523, -0.461), 0.000***, 0.611 (0.593, 0.631)	-0.468 (-0.500, -0.437), 0.000***, 0.626 (0.607, 0.646)	-0.485 (-0.516, -0.454), 0.000***, 0.616 (0.597, 0.635)	-0.449 (-0.479, -0.419), 0.000***, 0.638 (0.619, 0.658)
Choker	-0.471 (-0.582, -0.359), 0.000***, 0.625 (0.559, 0.698)	-0.452 (-0.563, -0.340), 0.000***, 0.637 (0.569, 0.712)	-0.426 (-0.536, -0.316), 0.000***, 0.653 (0.585, 0.729)	-0.448 (-0.556, -0.340), 0.000***, 0.639 (0.574, 0.712)
Island	0.466 (0.434, 0.497), 0.000***, 1.593 (1.543, 1.645)	0.393 (0.361, 0.425), 0.000***, 1.482 (1.435, 1.530)	0.386 (0.355, 0.417), 0.000***, 1.471 (1.426, 1.518)	0.313 (0.283, 0.343), 0.000***, 1.368 (1.327, 1.410)
Signalised Crossing	0.217 (0.189, 0.245), 0.000***, 1.242 (1.208, 1.277)	0.239 (0.211, 0.266), 0.000***, 1.270 (1.235, 1.305)	0.215 (0.187, 0.242), 0.000***, 1.239 (1.206, 1.274)	0.141 (0.113, 0.168), 0.000***, 1.151 (1.120, 1.183)
Marked Crossing	-0.016 (-0.064, 0.032), 0.502, 0.984 (0.938, 1.032)	0.063 (0.015, 0.111), 0.010*, 1.065 (1.015, 1.118)	0.038 (-0.009, 0.086), 0.113, 1.039 (0.991, 1.089)	-0.095 (-0.142, -0.049), 0.000***, 0.909 (0.868, 0.952)
Uncontrolled Crossing	-0.152 (-0.191, -0.113), 0.000***, 0.859 (0.826, 0.893)	-0.153 (-0.192, -0.114), 0.000***, 0.858 (0.825, 0.892)	-0.220 (-0.258, -0.181), 0.000***, 0.803 (0.773, 0.834)	-0.181 (-0.218, -0.143), 0.000***, 0.835 (0.804, 0.867)
Roundabout	0.041 (-0.002, 0.085), 0.062, 1.042 (0.998, 1.088)	0.088 (0.045, 0.132), 0.000***, 1.092 (1.046, 1.141)	-0.016 (-0.059, 0.026), 0.444, 0.984 (0.943, 1.026)	-0.119 (-0.160, -0.078), 0.000***, 0.888 (0.852, 0.925)
Mini Roundabout	-0.909 (-0.958, -0.860), 0.000***, 0.403 (0.384, 0.423)	-0.931 (-0.980, -0.882), 0.000***, 0.394 (0.375, 0.414)	-1.009 (-1.058, -0.961), 0.000***, 0.364 (0.347, 0.383)	-1.002 (-1.050, -0.955), 0.000***, 0.367 (0.350, 0.385)
Motorway Junction	0.671 (0.492, 0.849), 0.000***, 1.955 (1.636, 2.337)	0.719 (0.536, 0.902), 0.000***, 2.052 (1.709, 2.464)	1.002 (0.821, 1.183), 0.000***, 2.725 (2.274, 3.265)	0.939 (0.765, 1.113), 0.000***, 2.558 (2.150, 3.044)
Traffic Signal	-0.473 (-0.499, -0.447), 0.000***, 0.623 (0.607, 0.639)	-0.468 (-0.495, -0.442), 0.000***, 0.626 (0.610, 0.643)	-0.478 (-0.504, -0.452), 0.000***, 0.620 (0.604, 0.636)	-0.569 (-0.595, -0.543), 0.000***, 0.566 (0.552, 0.581)
Speed Camera	0.299 (0.193, 0.404), 0.000***, 1.348 (1.213, 1.498)	0.282 (0.176, 0.388), 0.000***, 1.326 (1.193, 1.474)	0.289 (0.185, 0.392), 0.000***, 1.335 (1.203, 1.480)	0.276 (0.174, 0.377), 0.000***, 1.317 (1.190, 1.458)
Link Bidirection	-1.079 (-1.104, -1.053), 0.000***, 0.340 (0.332, 0.349)	-1.002 (-1.027, -0.977), 0.000***, 0.367 (0.358, 0.376)	-1.502 (-1.528, -1.476), 0.000***, 0.223 (0.217, 0.229)	-1.493 (-1.517, -1.468), 0.000***, 0.225 (0.219, 0.230)
Link Average Width	0.831 (0.819, 0.842), 0.000***, 2.295 (2.268, 2.321)	0.813 (0.801, 0.824), 0.000***, 2.254 (2.228, 2.281)	0.782 (0.771, 0.793), 0.000***, 2.186 (2.161, 2.210)	0.714 (0.703, 0.725), 0.000***, 2.042 (2.020, 2.064)
Link Length	1.111 (1.098, 1.124), 0.000***, 3.039 (2.999, 3.079)	1.272 (1.259, 1.284), 0.000***, 3.568 (3.523, 3.613)	1.386 (1.374, 1.398), 0.000***, 3.998 (3.951, 4.046)	1.409 (1.397, 1.420), 0.000***, 4.091 (4.044, 4.138)
Link Angular Curvature	-0.747 (-0.758, -0.735), 0.000***, 0.474 (0.468, 0.479)	-0.867 (-0.878, -0.856), 0.000***, 0.420 (0.415, 0.425)	-0.911 (-0.922, -0.900), 0.000***, 0.402 (0.398, 0.407)	-0.862 (-0.873, -0.852), 0.000***, 0.422 (0.418, 0.427)
Link Degree	0.058 (0.049, 0.067), 0.000***, 1.060 (1.050, 1.069)	-0.044 (-0.052, -0.036), 0.000***, 0.957 (0.949, 0.965)	-0.133 (-0.140, -0.125), 0.000***, 0.876 (0.869, 0.883)	-0.127 (-0.135, -0.120), 0.000***, 0.881 (0.874, 0.887)
Connectivity	-0.032 (-0.045, -0.018), 0.000***, 0.969 (0.956, 0.982)	-0.437 (-0.451, -0.424), 0.000***, 0.646 (0.637, 0.655)	-0.808 (-0.819, -0.798), 0.000***, 0.446 (0.441, 0.450)	-0.761 (-0.770, -0.753), 0.000***, 0.467 (0.463, 0.471)
Betweenness	0.010 (-0.005, 0.025), 0.184, 1.010 (0.995, 1.026)	0.329 (0.314, 0.345), 0.000***, 1.390 (1.368, 1.412)	0.896 (0.882, 0.910), 0.000***, 2.450 (2.415, 2.485)	1.118 (1.106, 1.130), 0.000***, 3.058 (3.021, 3.095)
Closeness	1.093 (1.061, 1.124), 0.000***, 2.983 (2.890, 3.079)	0.718 (0.645, 0.792), 0.000***, 2.051 (1.906, 2.207)	0.294 (0.247, 0.340), 0.000***, 1.342 (1.281, 1.405)	0.401 (0.341, 0.460), 0.000***, 1.493 (1.407, 1.584)
Average Shortest Path	0.789 (0.777, 0.801), 0.000***, 2.201 (2.175, 2.227)	0.580 (0.570, 0.590), 0.000***, 1.786 (1.769, 1.804)	0.408 (0.400, 0.416), 0.000***, 1.503 (1.492, 1.515)	0.312 (0.305, 0.319), 0.000***, 1.366 (1.356, 1.376)
Diversion Ratio	0.004 (0.000, 0.008), 0.026*, 1.004 (1.000, 1.008)	-0.006 (-0.007, -0.004), 0.000***, 0.994 (0.993, 0.996)	-0.210 (-0.217, -0.204), 0.000***, 0.810 (0.805, 0.815)	-0.221 (-0.228, -0.214), 0.000***, 0.802 (0.796, 0.807)
Random effect - City	0.29	0.28	0.28	0.27
ICC	0.13	0.13	0.13	0.13
Marginal R ² / Conditional R ²	0.626 / 0.676	0.586 / 0.638	0.589 / 0.642	0.624 / 0.672

Note: This table summarizes the model results analysing how road engineering features, road attributes, and network metrics influence speeding events, evaluated at 400 m, 800 m, 2 km, and 5 km road network distances for 30 mph road links. Independent variables, including connectivity, betweenness, closeness, average shortest path, and diversion ratio, are adjusted for these network distances. Results are reported as coefficients, 95% confidence intervals, p-values, and incidence rate ratios (IRR, 95% CI).

Table A5 Model results for 40 mph road links across different road network distances (400 m, 800 m, 2 km, and 5 km) showing the impact of road engineering features, road attributes, and network metrics on speeding events

Independent variables	Speeding events (Coefficients, 95% CI, p-value, IRR, 95% CI)			
	50m_400m	50m_800m	50m_2km	50m_5km
Traffic Calming	-0.437 (-0.585, -0.290), 0.000***, 0.646 (0.557, 0.748)	-0.423 (-0.571, -0.275), 0.000***, 0.655 (0.565, 0.760)	-0.374 (-0.522, -0.226), 0.000***, 0.688 (0.594, 0.798)	-0.406 (-0.554, -0.258), 0.000***, 0.666 (0.574, 0.773)
Choker	-1.236 (-1.752, -0.720), 0.000***, 0.291 (0.173, 0.487)	-1.247 (-1.769, -0.726), 0.000***, 0.287 (0.171, 0.484)	-1.281 (-1.800, -0.761), 0.000***, 0.278 (0.165, 0.467)	-1.381 (-1.900, -0.861), 0.000***, 0.251 (0.150, 0.423)
Island	0.014 (-0.057, 0.086), 0.697, 1.014 (0.944, 1.089)	-0.029 (-0.100, 0.042), 0.426, 0.971 (0.904, 1.043)	-0.038 (-0.109, 0.034), 0.301, 0.963 (0.897, 1.034)	-0.067 (-0.139, 0.005), 0.067, 0.935 (0.870, 1.005)
Signalised Crossing	-0.378 (-0.433, -0.323), 0.000***, 0.685 (0.648, 0.724)	-0.370 (-0.426, -0.315), 0.000***, 0.691 (0.653, 0.730)	-0.364 (-0.420, -0.309), 0.000***, 0.695 (0.657, 0.734)	-0.370 (-0.426, -0.315), 0.000***, 0.690 (0.653, 0.730)
Marked Crossing	0.175 (0.042, 0.307), 0.010**, 1.191 (1.043, 1.359)	0.142 (0.010, 0.274), 0.036*, 1.152 (1.010, 1.315)	0.132 (-0.000, 0.264), 0.050, 1.141 (1.000, 1.302)	0.084 (-0.049, 0.217), 0.213, 1.088 (0.953, 1.243)
Uncontrolled Crossing	-0.461 (-0.566, -0.355), 0.000***, 0.631 (0.568, 0.701)	-0.417 (-0.523, -0.312), 0.000***, 0.659 (0.593, 0.732)	-0.415 (-0.520, -0.309), 0.000***, 0.661 (0.594, 0.734)	-0.465 (-0.571, -0.360), 0.000***, 0.628 (0.565, 0.698)
Roundabout	0.111 (0.039, 0.182), 0.002**, 1.117 (1.040, 1.200)	0.143 (0.071, 0.214), 0.000***, 1.153 (1.074, 1.239)	0.168 (0.097, 0.239), 0.000***, 1.183 (1.102, 1.270)	0.118 (0.047, 0.190), 0.001**, 1.126 (1.048, 1.209)
Mini Roundabout	-1.334 (-1.662, -1.005), 0.000***, 0.264 (0.190, 0.366)	-1.230 (-1.557, -0.902), 0.000***, 0.292 (0.211, 0.406)	-1.093 (-1.423, -0.763), 0.000***, 0.335 (0.241, 0.466)	-1.440 (-1.768, -1.113), 0.000***, 0.574 (0.471, 0.329)
Motorway Junction	0.929 (0.796, 1.061), 0.000***, 2.531 (2.217, 2.890)	0.944 (0.811, 1.077), 0.000***, 2.570 (2.251, 2.935)	0.992 (0.859, 1.125), 0.000***, 2.696 (2.361, 3.079)	0.936 (0.802, 1.069), 0.000***, 2.549 (2.230, 2.913)
Traffic Signal	-0.536 (-0.590, -0.481), 0.000***, 0.585 (0.554, 0.618)	-0.535 (-0.590, -0.481), 0.000***, 0.585 (0.554, 0.618)	-0.525 (-0.580, -0.471), 0.000***, 0.591 (0.560, 0.624)	-0.555 (-0.610, -0.500), 0.000***, 0.574 (0.544, 0.607)
Speed Camera	-0.204 (-0.341, -0.068), 0.003**, 0.815 (0.711, 0.934)	-0.265 (-0.402, -0.129), 0.000***, 0.767 (0.669, 0.879)	-0.245 (-0.382, -0.109), 0.000***, 0.782 (0.682, 0.897)	-0.304 (-0.441, -0.166), 0.000***, 0.738 (0.643, 0.847)
Link Bidirection	-0.675 (-0.724, -0.625), 0.000***, 0.509 (0.485, 0.535)	-0.842 (-0.891, -0.793), 0.000***, 0.431 (0.410, 0.452)	-0.857 (-0.911, -0.804), 0.000***, 0.424 (0.402, 0.448)	-0.765 (-0.819, -0.711), 0.000***, 0.465 (0.441, 0.491)
Link Average Width	-0.038 (-0.062, -0.015), 0.002**, 0.962 (0.940, 0.986)	-0.050 (-0.073, -0.026), 0.000***, 0.951 (0.929, 0.974)	-0.050 (-0.074, -0.027), 0.000***, 0.951 (0.929, 0.974)	-0.056 (-0.080, -0.033), 0.000***, 0.945 (0.923, 0.968)
Link Length	1.666 (1.631, 1.702), 0.000***, 5.293 (5.110, 5.482)	1.739 (1.703, 1.774), 0.000***, 5.689 (5.491, 5.895)	1.724 (1.690, 1.759), 0.000***, 5.607 (5.417, 5.804)	1.751 (1.717, 1.785), 0.000***, 5.760 (5.566, 5.961)
Link Angular Curvature	-0.665 (-0.692, -0.637), 0.000***, 0.514 (0.500, 0.529)	-0.683 (-0.710, -0.656), 0.000***, 0.505 (0.492, 0.519)	-0.687 (-0.714, -0.660), 0.000***, 0.503 (0.490, 0.517)	-0.674 (-0.701, -0.648), 0.000***, 0.509 (0.496, 0.523)
Link Degree	0.149 (0.127, 0.171), 0.000***, 1.161 (1.136, 1.186)	0.149 (0.128, 0.170), 0.000***, 1.160 (1.136, 1.185)	0.129 (0.109, 0.149), 0.000***, 1.137 (1.115, 1.161)	0.119 (0.099, 0.140), 0.000***, 1.127 (1.104, 1.150)
Connectivity	-0.359 (-0.384, -0.334), 0.000***, 0.699 (0.681, 0.716)	-0.334 (-0.359, -0.310), 0.000***, 0.716 (0.699, 0.734)	-0.289 (-0.317, -0.261), 0.000***, 0.749 (0.728, 0.770)	-0.187 (-0.218, -0.155), 0.000***, 0.830 (0.804, 0.857)
Betweenness	0.096 (0.070, 0.123), 0.000***, 1.101 (1.072, 1.131)	0.063 (0.037, 0.090), 0.000***, 1.065 (1.037, 1.094)	-0.007 (-0.034, 0.020), 0.604, 0.993 (0.967, 1.020)	0.096 (0.068, 0.123), 0.000***, 1.100 (1.070, 1.131)
Closeness	0.256 (0.117, 0.395), 0.000***, 1.291 (1.124, 1.484)	0.020 (-0.017, 0.056), 0.285, 1.020 (0.984, 1.058)	0.199 (0.069, 0.330), 0.003**, 1.221 (1.071, 1.391)	0.467 (0.312, 0.622), 0.000***, 1.595 (1.366, 1.862)
Average Shortest Path	0.147 (0.123, 0.171), 0.000***, 1.159 (1.131, 1.186)	0.135 (0.114, 0.156), 0.000***, 1.145 (1.121, 1.169)	0.206 (0.186, 0.225), 0.000***, 1.228 (1.204, 1.253)	0.145 (0.126, 0.163), 0.000***, 1.156 (1.134, 1.178)
Diversion Ratio	0.059 (0.039, 0.079), 0.000***, 1.060 (1.039, 1.082)	-0.064 (-0.082, -0.046), 0.000***, 0.938 (0.921, 0.955)	0.017 (-0.007, 0.042), 0.170, 1.018 (0.993, 1.043)	0.185 (0.160, 0.210), 0.000***, 1.203 (1.173, 1.234)
Random effect - City	0.19	0.19	0.18	0.19
ICC	0.12	0.12	0.12	0.12
Marginal R ² / Conditional R ²	0.652 / 0.695	0.648 / 0.690	0.646 / 0.688	0.655 / 0.698

Note: This table summarizes the model results analysing how road engineering features, road attributes, and network metrics influence speeding events, evaluated at 400 m, 800 m, 2 km, and 5 km road network distances for 40 mph road links. Independent variables, including connectivity, betweenness, closeness, average shortest path, and diversion ratio, are adjusted for these network distances. Results are reported as coefficients, 95% confidence intervals, p-values, and incidence rate ratios (IRR, 95% CI).

Table A6 Model results for 50 mph road links across different road network distances (400 m, 800 m, 2 km, and 5 km) showing the impact of road engineering features, road attributes, and network metrics on speeding events

Independent variables	Speeding events (Coefficients, 95% CI, p-value, IRR, 95% CI)											
	50m.400m			50m.800m			50m.2km			50m.5km		
Traffic Calming	0.329 (-0.153, 0.812), 0.181, 1.390 (0.858, 2.252)			0.359 (-0.123, 0.841), 0.145, 1.432 (0.884, 2.319)			0.387 (-0.099, 0.873), 0.119, 1.473 (0.906, 2.394)			0.243 (-0.242, 0.728), 0.327, 1.275 (0.785, 2.071)		
Choker	-0.341 (-1.731, 1.050), 0.631, 0.711 (0.177, 2.857)			-0.356 (-1.742, 1.030), 0.615, 0.700 (0.175, 2.801)			-0.381 (-1.778, 1.015), 0.592, 0.683 (0.169, 2.760)			-0.485 (-1.883, 0.913), 0.497, 0.616 (0.152, 2.492)		
Island	-0.728 (-0.942, -0.514), 0.000***, 0.483 (0.390, 0.598)			-0.684 (-0.900, -0.469), 0.000***, 0.505 (0.407, 0.626)			-0.704 (-0.920, -0.487), 0.000***, 0.495 (0.398, 0.614)			-0.718 (-0.935, -0.501), 0.000***, 0.488 (0.392, 0.606)		
Signalised Crossing	-0.583 (-0.770, -0.396), 0.000***, 0.558 (0.463, 0.673)			-0.560 (-0.747, -0.373), 0.000***, 0.571 (0.474, 0.689)			-0.607 (-0.799, -0.415), 0.000***, 0.545 (0.450, 0.660)			-0.614 (-0.806, -0.422), 0.000***, 0.541 (0.447, 0.656)		
Marked Crossing	-1.005 (-1.420, -0.591), 0.000***, 0.366 (0.242, 0.554)			-0.928 (-1.341, -0.514), 0.000***, 0.396 (0.261, 0.598)			-0.966 (-1.382, -0.549), 0.000***, 0.381 (0.251, 0.577)			-1.015 (-1.433, -0.596), 0.000***, 0.363 (0.239, 0.551)		
Uncontrolled Crossing	-0.332 (-0.638, -0.027), 0.033*, 0.717 (0.528, 0.973)			-0.316 (-0.620, -0.011), 0.043*, 0.729 (0.538, 0.989)			-0.301 (-0.609, 0.006), 0.055, 0.740 (0.544, 1.006)			-0.287 (-0.595, 0.022), 0.068, 0.751 (0.552, 1.022)		
Roundabout	0.059 (-0.096, 0.215), 0.455, 1.061 (0.908, 1.240)			0.096 (-0.060, 0.252), 0.229, 1.101 (0.942, 1.287)			0.191 (0.033, 0.349), 0.018*, 1.211 (1.034, 1.418)			0.190 (0.032, 0.348), 0.019*, 1.209 (1.032, 1.416)		
Mini Roundabout	0.169 (-0.408, 0.746), 0.565, 1.184 (0.665, 2.109)			0.072 (-0.505, 0.649), 0.806, 1.075 (0.604, 1.914)			0.126 (-0.453, 0.706), 0.669, 1.135 (0.636, 2.025)			0.116 (-0.465, 0.696), 0.696, 1.123 (0.628, 2.006)		
Motorway Junction	0.523 (0.361, 0.686), 0.000***, 1.688 (1.434, 1.986)			0.512 (0.349, 0.675), 0.000***, 1.668 (1.417, 1.964)			0.517 (0.353, 0.681), 0.000***, 1.677 (1.424, 1.976)			0.492 (0.328, 0.656), 0.000***, 1.635 (1.388, 1.926)		
Traffic Signal	-0.231 (-0.390, -0.073), 0.004**, 0.793 (0.677, 0.930)			-0.252 (-0.411, -0.092), 0.002***, 0.778 (0.663, 0.912)			-0.272 (-0.435, -0.109), 0.001**, 0.762 (0.648, 0.897)			-0.298 (-0.460, -0.135), 0.000***, 0.743 (0.631, 0.874)		
Speed Camera	0.308 (-0.045, 0.660), 0.087, 1.360 (0.956, 1.935)			0.290 (-0.062, 0.643), 0.106, 1.337 (0.940, 1.902)			0.354 (-0.001, 0.709), 0.051, 1.425 (0.999, 2.031)			0.318 (-0.037, 0.672), 0.079, 1.374 (0.964, 1.959)		
Link Bidirection	-1.469 (-1.605, -1.332), 0.000***, 0.230 (0.201, 0.264)			-1.618 (-1.751, -1.484), 0.000***, 0.198 (0.174, 0.227)			-1.672 (-1.814, -1.530), 0.000***, 0.188 (0.163, 0.217)			-1.755 (-1.905, -1.606), 0.000***, 0.173 (0.149, 0.201)		
Link Average Width	0.332 (0.269, 0.395), 0.000***, 1.394 (1.308, 1.485)			0.330 (0.267, 0.393), 0.000***, 1.391 (1.306, 1.481)			0.335 (0.272, 0.399), 0.000***, 1.398 (1.312, 1.490)			0.331 (0.267, 0.395), 0.000***, 1.392 (1.306, 1.484)		
Link Length	1.921 (1.833, 2.009), 0.000***, 6.828 (6.255, 7.455)			1.878 (1.793, 1.964), 0.000***, 6.543 (6.005, 7.129)			1.972 (1.887, 2.056), 0.000***, 7.182 (6.602, 7.812)			1.994 (1.910, 2.078), 0.000***, 7.346 (6.754, 7.989)		
Link Angular Curvature	-0.769 (-0.830, -0.707), 0.000***, 0.464 (0.436, 0.493)			-0.748 (-0.810, -0.687), 0.000***, 0.473 (0.445, 0.503)			-0.772 (-0.833, -0.710), 0.000***, 0.462 (0.435, 0.492)			-0.764 (-0.825, -0.703), 0.000***, 0.466 (0.438, 0.495)		
Link Degree	0.266 (0.215, 0.316), 0.000***, 1.304 (1.240, 1.372)			0.211 (0.158, 0.263), 0.000***, 1.235 (1.171, 1.301)			0.229 (0.181, 0.277), 0.000***, 1.258 (1.198, 1.319)			0.219 (0.171, 0.267), 0.000***, 1.245 (1.187, 1.306)		
Connectivity	-0.288 (-0.344, -0.233), 0.000***, 0.750 (0.709, 0.793)			-0.317 (-0.376, -0.258), 0.000***, 0.729 (0.687, 0.773)			-0.137 (-0.207, -0.067), 0.000***, 0.872 (0.813, 0.935)			-0.221 (-0.304, -0.138), 0.000***, 0.801 (0.738, 0.871)		
Betweenness	-0.058 (-0.127, 0.010), 0.096, 0.943 (0.881, 1.010)			0.130 (0.068, 0.192), 0.000***, 1.139 (1.071, 1.212)			-0.052 (-0.117, 0.013), 0.114, 0.949 (0.889, 1.013)			0.083 (0.015, 0.151), 0.016*, 1.086 (1.015, 1.163)		
Closeness	0.073 (-0.039, 0.184), 0.200, 1.075 (0.962, 1.202)			0.354 (0.171, 0.536), 0.000***, 1.424 (1.187, 1.709)			0.172 (0.026, 0.319), 0.021*, 1.188 (1.026, 1.376)			0.107 (-0.020, 0.234), 0.098, 1.113 (0.981, 1.264)		
Average Shortest Path	0.117 (0.055, 0.179), 0.000***, 1.124 (1.056, 1.196)			0.113 (0.055, 0.171), 0.000***, 1.119 (1.056, 1.186)			0.054 (0.007, 0.102), 0.024*, 1.056 (1.007, 1.107)			0.013 (-0.031, 0.057), 0.565, 1.013 (0.969, 1.059)		
Diversion Ratio	0.129 (0.080, 0.178), 0.000***, 1.138 (1.083, 1.195)			0.182 (0.126, 0.239), 0.000***, 1.200 (1.134, 1.270)			-0.004 (-0.064, 0.055), 0.885, 0.996 (0.938, 1.056)			0.032 (-0.027, 0.090), 0.293, 1.032 (0.973, 1.094)		
Random effect - City	0.47			0.44			0.41			0.39		
ICC	0.24			0.23			0.22			0.21		
Marginal R ² / Conditional R ²	0.670 / 0.750			0.676 / 0.750			0.671 / 0.742			0.675 / 0.743		

Note: This table summarizes the model results analysing how road engineering features, road attributes, and network metrics influence speeding events, evaluated at 400 m, 800 m, 2 km, and 5 km road network distances for 50 mph road links. Independent variables, including connectivity, betweenness, closeness, average shortest path, and diversion ratio, are adjusted for these network distances. Results are reported as coefficients, 95% confidence intervals, p-values, and incidence rate ratios (IRR, 95% CI).

Table A7 Model results for 60 mph road links across different road network distances (400 m, 800 m, 2 km, and 5 km) showing the impact of road engineering features, road attributes, and network metrics on speeding events

Independent variables	Speeding events (Coefficients, 95% CI, p-value, IRR, 95% CI)			
	50m-400m	50m-800m	50m-2km	50m-5km
Traffic Calming	-1.681 (-2.742, -0.620), 0.002**, 0.186 (0.064, 0.538)	-1.834 (-2.960, -0.708), 0.001**, 0.160 (0.052, 0.492)	-1.723 (-2.804, -0.643), 0.002**, 0.178 (0.061, 0.526)	-1.701 (-2.766, -0.637), 0.002**, 0.182 (0.063, 0.529)
Choker Island	/	/	/	/
Signalised Crossing	0.547 (-0.028, 1.121), 0.062, 1.727 (0.973, 3.067)	0.609 (0.029, 1.189), 0.040*, 1.838 (1.029, 3.282)	0.699 (0.076, 1.321), 0.028*, 2.011 (1.079, 3.748)	0.670 (0.051, 1.289), 0.034*, 1.955 (1.053, 3.630)
Marked Crossing	-2.292 (-2.866, -1.718), 0.000***, 0.101 (0.057, 0.180)	-2.083 (-2.651, -1.515), 0.000***, 0.125 (0.071, 0.220)	-2.171 (-2.749, -1.592), 0.000***, 0.114 (0.064, 0.203)	-2.291 (-2.873, -1.709), 0.000***, 0.101 (0.057, 0.181)
Uncontrolled Crossing	/	/	/	/
Roundabout	-0.610 (-1.559, 0.339), 0.208, 0.543 (0.210, 1.404)	-0.515 (-1.457, 0.428), 0.284, 0.598 (0.233, 1.534)	-0.053 (-0.992, 0.886), 0.912, 0.948 (0.371, 2.425)	-0.173 (-1.126, 0.781), 0.723, 0.841 (0.324, 2.184)
Mini Roundabout	0.624 (0.216, 1.031), 0.003**, 1.866 (1.241, 2.804)	0.857 (0.451, 1.263), 0.000***, 2.355 (1.569, 3.535)	0.878 (0.451, 1.306), 0.000***, 2.407 (1.570, 3.690)	0.609 (0.181, 1.038), 0.005**, 1.839 (1.199, 2.823)
Motorway Junction	-1.491 (-2.432, -0.550), 0.002**, 0.225 (0.088, 0.577)	-1.252 (-2.197, -0.307), 0.009***, 0.286 (0.111, 0.735)	-1.486 (-2.434, -0.537), 0.002**, 0.226 (0.088, 0.584)	-1.094 (-2.030, -0.157), 0.022*, 0.335 (0.131, 0.855)
Traffic Signal	-0.148 (-0.642, 0.347), 0.558, 0.863 (0.526, 1.414)	-0.205 (-0.694, 0.283), 0.410, 0.814 (0.500, 1.327)	-0.098 (-0.591, 0.395), 0.698, 0.907 (0.554, 1.485)	-0.011 (-0.513, 0.490), 0.965, 0.989 (0.599, 1.633)
Speed Camera	1.008 (0.604, 1.412), 0.000***, 2.740 (1.829, 4.106)	1.037 (0.641, 1.433), 0.000***, 2.821 (1.899, 4.191)	1.312 (0.914, 1.710), 0.000***, 3.714 (2.495, 5.529)	1.471 (1.070, 1.871), 0.000***, 4.352 (2.915, 6.497)
Link Bidirection	1.947 (0.650, 3.244), 0.003**, 7.006 (1.915, 25.630)	1.465 (0.247, 2.684), 0.018*, 4.329 (1.280, 14.641)	1.452 (0.211, 2.692), 0.022*, 4.270 (1.235, 14.767)	1.293 (0.048, 2.539), 0.042*, 3.645 (1.049, 12.670)
Link Average Width	-3.000 (-3.305, -2.696), 0.000***, 0.050 (0.037, 0.067)	-3.264 (-3.564, -2.964), 0.000***, 0.038 (0.028, 0.052)	-3.366 (-3.684, -3.047), 0.000***, 0.035 (0.025, 0.048)	-3.474 (-3.802, -3.147), 0.000***, 0.031 (0.022, 0.043)
Link Length	1.235 (1.136, 1.334), 0.000***, 3.438 (3.113, 3.796)	1.254 (1.155, 1.353), 0.000***, 3.504 (3.175, 3.868)	1.263 (1.163, 1.363), 0.000***, 3.536 (3.199, 3.909)	1.272 (1.171, 1.374), 0.000***, 3.570 (3.226, 3.950)
Link Angular Curvature	1.807 (1.688, 1.926), 0.000***, 6.091 (5.406, 6.862)	1.830 (1.724, 1.936), 0.000***, 6.233 (5.608, 6.929)	1.958 (1.854, 2.063), 0.000***, 7.086 (6.383, 7.866)	2.035 (1.932, 2.139), 0.000***, 7.656 (6.903, 8.491)
Link Degree	-2.529 (-2.683, -2.376), 0.000***, 0.080 (0.068, 0.093)	-2.432 (-2.584, -2.280), 0.000***, 0.088 (0.076, 0.102)	-2.397 (-2.551, -2.243), 0.000***, 0.091 (0.078, 0.106)	-2.427 (-2.581, -2.273), 0.000***, 0.088 (0.076, 0.103)
Connectivity	0.232 (0.166, 0.299), 0.000***, 1.262 (1.181, 1.348)	0.168 (0.102, 0.234), 0.000***, 1.183 (1.107, 1.263)	0.075 (0.011, 0.139), 0.022*, 1.078 (1.011, 1.150)	0.028 (-0.033, 0.089), 0.367, 1.028 (0.968, 1.093)
Betweenness	-0.486 (-0.585, -0.387), 0.000***, 0.615 (0.557, 0.679)	-0.438 (-0.524, -0.351), 0.000***, 0.646 (0.592, 0.704)	-0.294 (-0.374, -0.215), 0.000***, 0.745 (0.688, 0.807)	-0.494 (-0.594, -0.395), 0.000***, 0.610 (0.552, 0.674)
Closeness	-0.087 (-0.186, 0.013), 0.087, 0.917 (0.831, 1.013)	-0.054 (-0.141, 0.033), 0.226, 0.948 (0.868, 1.034)	0.031 (-0.059, 0.120), 0.500, 1.031 (0.943, 1.127)	0.276 (0.183, 0.369), 0.000***, 1.318 (1.201, 1.446)
Average Shortest Path	0.304 (0.015, 0.593), 0.039*, 1.355 (1.015, 1.809)	0.149 (-0.137, 0.435), 0.306, 1.161 (0.872, 1.545)	0.132 (-0.081, 0.345), 0.226, 1.141 (0.922, 1.412)	0.012 (-0.110, 0.134), 0.844, 1.012 (0.896, 1.143)
Diversion Ratio	0.353 (0.248, 0.458), 0.000***, 1.424 (1.282, 1.581)	0.427 (0.357, 0.498), 0.000***, 1.533 (1.429, 1.645)	0.405 (0.339, 0.472), 0.000***, 1.500 (1.404, 1.602)	0.279 (0.226, 0.332), 0.000***, 1.322 (1.254, 1.393)
Random effect - City	0.095 (0.020, 0.170), 0.013*, 1.100 (1.020, 1.185)	-0.042 (-0.101, 0.017), 0.162, 0.959 (0.904, 1.017)	-0.139 (-0.193, -0.086), 0.000***, 0.870 (0.825, 0.918)	-0.092 (-0.164, -0.021), 0.011*, 0.912 (0.849, 0.979)
ICC	2.67	1.97	2.35	2.51
Marginal R ² / Conditional R ²	0.56	0.49	0.53	0.55
	0.674 / 0.858	0.709 / 0.852	0.682 / 0.851	0.671 / 0.851

Note: This table summarizes the model results analysing how road engineering features, road attributes, and network metrics influence speeding events, evaluated at 400 m, 800 m, 2 km, and 5 km road network distances for 60 mph road links. Independent variables, including connectivity, betweenness, closeness, average shortest path, and diversion ratio, are adjusted for these network distances. Results are reported as coefficients, 95% confidence intervals, p-values, and incidence rate ratios (IRR, 95% CI).

Table A8 Model results for 70 mph road links across different road network distances (400 m, 800 m, 2 km, and 5 km) showing the impact of road engineering features, road attributes, and network metrics on speeding events

Independent variables	Speeding events (Coefficients, 95% CI, p-value, IRR, 95% CI)											
	50m_400m			50m_800m			50m_2km			50m_5km		
Traffic Calming	-0.397 0.277, 1.375)	(-1.112, 0.673 (0.329,	0.319),	-0.337 0.362, 1.472)	(-1.060, 0.714 (0.347,	0.387),	-0.271 0.468, 1.586)	(-1.004, 0.762 (0.367,	0.461),	-0.159 0.668, 1.763)	(-0.885, 0.853 (0.413,	0.567),
Choker Island	/			/			/			/		
Signalised Crossing	-0.071 0.723, 1.380)	(-0.464, 0.931 (0.629,	0.322),	-0.122 0.554, 1.325)	(-0.524, 0.885 (0.592,	0.281),	-0.128 0.536, 1.320)	(-0.534, 0.880 (0.586,	0.277),	0.093 0.654, 1.652)	(-0.315, 1.098 (0.730,	0.502),
Marked Crossing	-0.500 0.000***, 0.795)	(-0.770, 0.607 (0.463,	-0.230),	-0.495 0.001***, 0.806)	(-0.774, 0.610 (0.461,	-0.216),	-0.465 0.001**, 0.832)	(-0.746, 0.628 (0.474,	-0.184),	-0.455 0.002***, 0.841)	(-0.736, 0.635 (0.479,	-0.173),
Uncontrolled Crossing	-0.385 0.273, 1.354)	(-1.073, 0.681 (0.342,	0.303),	-0.204 0.569, 1.646)	(-0.907, 0.815 (0.404,	0.498),	-0.212 0.560, 1.649)	(-0.924, 0.809 (0.397,	0.500),	-0.275 0.447, 1.543)	(-0.985, 0.759 (0.374,	0.434),
Roundabout	-1.038 0.000***, 0.551)	(-1.479, 0.354 (0.228,	-0.597),	-0.859 0.000***, 0.667)	(-1.314, 0.423 (0.269,	-0.405),	-0.951 0.000***, 0.612)	(-1.410, 0.386 (0.244,	-0.492),	-0.914 0.000***, 0.636)	(-1.375, 0.401 (0.253,	-0.453),
Mini Roundabout	0.114 0.091, 1.280)	(-0.018, 1.121 (0.982,	0.247),	0.083 0.227, 1.242)	(-0.051, 1.086 (0.950,	0.216),	0.096 0.172, 1.262)	(-0.041, 1.100 (0.959,	0.233),	0.111 0.101, 1.277)	(-0.022, 1.118 (0.978,	0.244),
Motorway Junction	-0.728 0.030*, 0.933)	(-1.387, 0.483 (0.250,	-0.069),	-0.822 0.016*, 0.858)	(-1.492, 0.439 (0.225,	-0.153),	-0.560 0.107, 1.128)	(-1.240, 0.571 (0.289,	0.120),	-0.567 0.100, 1.114)	(-1.241, 0.568 (0.289,	0.108),
Traffic Signal	-0.051 0.379, 1.065)	(-0.166, 0.950 (0.847,	0.063),	-0.043 0.464, 1.075)	(-0.158, 0.958 (0.854,	0.072),	-0.085 0.151, 1.031)	(-0.201, 0.919 (0.818,	0.031),	-0.080 0.169, 1.035)	(-0.195, 0.923 (0.823,	0.034),
Speed Camera	-0.101 0.165, 1.042)	(-0.244, 0.904 (0.783,	0.042),	-0.082 0.271, 1.066)	(-0.229, 0.921 (0.796,	0.064),	-0.061 0.422, 1.091)	(-0.209, 0.941 (0.812,	0.087),	-0.009 0.907, 1.146)	(-0.154, 0.991 (0.857,	0.137),
Link Bidirection	-0.353 0.092, 1.059)	(-0.764, 0.703 (0.466,	0.058),	-0.457 0.033*, 0.963)	(-0.876, 0.633 (0.416,	-0.038),	-0.250 0.248, 1.190)	(-0.673, 0.779 (0.510,	0.174),	-0.248 0.255, 1.196)	(-0.674, 0.781 (0.510,	0.179),
Link Average Width	/			/			/			/		
Link Length	0.676 0.000***, 2.100)	(0.609, 1.965 (1.839,	0.742),	0.697 0.000***, 2.149)	(0.630, 2.009 (1.877,	0.765),	0.684 0.000***, 2.124)	(0.615, 1.983 (1.851,	0.754),	0.716 0.000***, 2.193)	(0.646, 2.046 (1.908,	0.785),
Link Angular Curvature	2.133 0.000***, 9.322)	(2.034, 8.442 (7.646,	2.232),	1.611 0.000***, 5.423)	(1.531, 5.006 (4.621,	1.691),	1.723 0.000***, 6.135)	(1.631, 5.599 (5.111,	1.814),	1.686 0.000***, 5.860)	(1.604, 5.397 (4.971,	1.768),
Link Degree	-0.512 0.000***, 0.635)	(-0.570, 0.599 (0.565,	-0.454),	-0.471 0.000***, 0.662)	(-0.530, 0.624 (0.589,	-0.413),	-0.445 0.000***, 0.680)	(-0.503, 0.641 (0.604,	-0.386),	-0.434 0.000***, 0.688)	(-0.493, 0.648 (0.611,	-0.375),
Connectivity	0.317 0.000***, 1.441)	(0.268, 1.373 (1.308,	0.365),	0.304 0.000***, 1.433)	(0.249, 1.355 (1.282,	0.359),	0.276 0.000***, 1.388)	(0.224, 1.318 (1.252,	0.328),	0.217 0.000***, 1.303)	(0.170, 1.243 (1.185,	0.265),
Betweenness	-0.218 0.000***, 0.852)	(-0.275, 0.804 (0.760,	-0.161),	-0.154 0.000***, 0.906)	(-0.209, 0.857 (0.811,	-0.099),	-0.124 0.000***, 0.941)	(-0.188, 0.883 (0.829,	-0.061),	-0.319 0.000***, 0.784)	(-0.394, 0.727 (0.675,	-0.243),
Closeness	-0.564 0.000***, 0.600)	(-0.618, 0.569 (0.539,	-0.511),	-0.233 0.000***, 0.848)	(-0.300, 0.792 (0.741,	-0.165),	-0.126 0.000***, 0.944)	(-0.194, 0.882 (0.824,	-0.058),	-0.081 0.023*, 0.989)	(-0.150, 0.922 (0.861,	-0.011),
Average Shortest Path	-0.075 0.002**, 0.972)	(-0.121, 0.928 (0.886,	-0.028),	-0.126 0.003**, 0.957)	(-0.209, 0.881 (0.811,	-0.044),	-0.055 0.178, 1.026)	(-0.136, 0.946 (0.873,	0.025),	-0.071 0.063, 1.004)	(-0.147, 0.931 (0.864,	0.004),
Diversion Ratio	-0.273 0.000***, 0.826)	(-0.355, 0.761 (0.701,	-0.191),	-0.016 0.552, 1.036)	(-0.067, 0.985 (0.936,	0.036),	0.024 0.318, 1.074)	(-0.023, 1.024 (0.977,	0.071),	0.080 0.001***, 1.137)	(0.031, 1.083 (1.032,	0.128),
Random effect - City	0.144 0.063, 1.345)	(-0.008, 1.155 (0.992,	0.296),	0.297 0.000***, 1.437)	(0.231, 1.346 (1.260,	0.363),	-0.149 0.000***, 0.914)	(-0.208, 0.862 (0.812,	-0.090),	-0.206 0.000***, 0.857)	(-0.258, 0.814 (0.772,	-0.154),
ICC	0.36			0.37			0.37			0.36		
Marginal R ² / Conditional R ²	0.23			0.23			0.23			0.22		
	0.651 / 0.731			0.658 / 0.737			0.666 / 0.742			0.676 / 0.747		

Note: This table summarizes the model results analysing how road engineering features, road attributes, and network metrics influence speeding events, evaluated at 400 m, 800 m, 2 km, and 5 km road network distances for 70 mph road links. Independent variables, including connectivity, betweenness, closeness, average shortest path, and diversion ratio, are adjusted for these network distances. Results are reported as coefficients, 95% confidence intervals, p-values, and incidence rate ratios (IRR, 95% CI).

A.4 Causal model results

Table A9 Causal analysis results for treatment variables across different road network distances (400 m, 800 m, 2 km, and 5 km) showing the average treatment effect (ATT) on the treated variable while controlling other confounding variables

Treatment variables	Average treatment effect (mean for binary variable, mean and +1 SD calculated from exposure response function)			
	50m.400m	50m.800m	50m.2km	50m.5km
Traffic Calming	(30.065, 20.215), -9.851	(29.833, 20.196), -9.637	(29.265, 20.176), -9.089	(28.444, 20.191), -8.253
Choker	(25.272, 20.41), -4.862	(21.517, 20.41), -1.107	(23.919, 20.41), -3.509	(23.565, 20.41), -3.155
Island	(29.983, 45.774), 15.791	(30.352, 45.774), 15.422	(31.479, 45.774), 14.295	(31.492, 45.774), 14.282
Signalised Crossing	(40.520, 51.308), 10.787	(41.007, 51.723), 10.716	(42.402, 51.072), 8.671	(42.360, 50.411), 8.051
Marked Crossing	(28.679, 30.417), 1.738	(29.420, 30.436), 1.016	(27.449, 30.418), 2.970	(28.026, 30.402), 2.376
Uncontrolled Crossing	(27.830, 36.261), 8.430	(28.044, 36.260), 8.216	(30.452, 36.260), 5.808	(31.194, 36.264), 5.071
Roundabout	(79.613, 76.754), -2.859	(85.988, 76.757), -9.231	(76.879, 76.754), -0.125	(71.754, 76.582), 4.828
Mini Roundabout	(27.703, 23.061), -4.641	(29.296, 23.058), -6.238	(30.712, 23.061), -7.651	(30.542, 23.053), -7.488
Motorway Junction	(417.064, 555.641), 138.576	(418.385, 556.131), 137.747	(400.058, 557.723), 157.666	(390.566, 555.577), 165.010
Traffic Signal	(65.548, 49.859), -15.689	(63.723, 50.292), -13.431	(62.669, 49.868), -12.801	(60.964, 49.632), -11.331
Speed Camera	(84.747, 133.550), 48.802	(90.161, 138.337), 48.177	(99.222, 137.504), 38.282	(91.812, 138.375), 46.564
Link Bidirection	(81.089, 32.521), -48.569	(70.763, 21.911), -48.852	(55.392, 27.149), -28.243	(56.356, 29.787), -26.569
Link Average Width	(27.953, 41.524), 13.571	(29.372, 44.267), 14.895	(26.846, 38.345), 11.499	(25.788, 34.240), 8.452
Link Length	(20.279, 50.416), 30.136	(20.282, 49.420), 29.138	(20.783, 50.316), 29.532	(21.050, 52.619), 31.569
Link Angular Curvature	(41.711, 31.161), -10.549	(42.973, 33.309), -9.663	(43.391, 34.222), -9.169	(42.602, 33.452), -9.149
Link Degree	(29.758, 29.956), 0.198	(29.619, 26.188), -3.431	(28.646, 25.746), -2.900	(28.843, 26.733), -2.110
Connectivity	(18.788, 16.146), -2.641	(20.414, 13.698), -6.716	(25.789, 16.484), -9.305	(24.461, 19.302), -5.159
Betweenness	(22.859, 24.052), 1.193	(20.927, 22.477), 1.550	(22.698, 32.510), 9.813	(25.772, 43.813), 18.041
Closeness	(22.071, 24.230), 2.160	(24.303, 24.222), -0.081	(24.932, 20.777), -4.155	(24.968, 20.754), -4.214
Average Shortest Path	(18.296, 24.435), 6.139	(19.136, 22.541), 3.405	(20.373, 21.963), 1.590	(21.110, 22.739), 1.629
Diversion Ratio	(19.594, 17.954), -1.639	(21.715, 18.054), -3.661	(23.726, 21.920), -1.807	(23.282, 24.383), 1.100

Note: This table summarizes the causal results analysing average treatment effects of treatment variable (ATT) on speeding events while adjusting balance of confounding factors including road engineering features, road attributes, network metrics, and speed limits, evaluated at 400 m, 800 m, 2 km, and 5 km road network distances for all road links. Propensity score matching and generalised propensity score models were utilised for binary treatment variables and continuous variables, respectively. Results are reported through mean response of speeding events for control and treatment groups for binary treatment variables; and mean and +1 standard deviation response of speeding events from exposure response function for continuous treatment variables.