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Subject	Variation 2 Additional housing in Mosgiel	Project Name	DTM Revised Forecasts
From	Amanda Klepper	Project No.	IA234900
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1. Introduction

A number of sites in Mosgiel and East Taieri are being considered for increased housing development. To test the impact of these proposed new dwellings and the increased population that they would bring, a sensitivity test has been run in the Dunedin Transport Model (DTM, also called Citywide Model) for the 2038 forecast year with these additional dwellings included.

2. Methodology

The additional dwelling units were added to the 2038 recently revised population forecast, described in the Forecast Model Update report, Chapter 2. The number and location of the new dwelling units was based on a list of rezoning requests provided by Dunedin City Council (DCC). The boundaries of the rezoning requests were used to allocate the new dwellings to transport model zones. Where those boundaries overlapped multiple model zones, the dwellings were divided between zones approximately, based on relative densities and areas. Table 1 shows the number of new dwelling units added to each zone and the model sector that zone is in, along with the number of people and cars per household. The zones with new dwelling units are also shown in a map in Figure 1.

Table 1: Allocation of new dwelling units to zones, people and cars per household (HH)

Sector	Zone	2017 Dwelling Units	2038 Dwelling Units	New Dwelling Units	People / HH	Cars / HH
Mosgiel	120	463	524	70	1.92	0.97
Mosgiel	121	95	107	104	2.40	1.58
Mosgiel	122	68	77	104	2.24	1.59
Mosgiel	125	115	130	70	2.12	1.31
Mosgiel	455	95	124	874	1.63	1.00
East Taieri	460	39	53	19	2.62	1.95
Mosgiel	461	56	69	77	2.66	2.45
East Taieri	462	123	152	36	2.73	2.01

Mosgiel	463	132	167	30	2.60	1.98
Mosgiel	464	95	120	743	2.74	2.11
Mosgiel	467	44	57	781	2.85	2.14
Mosgiel	470	145	190	140	2.74	2.04
TOTAL		1,614	1,924	3,048		

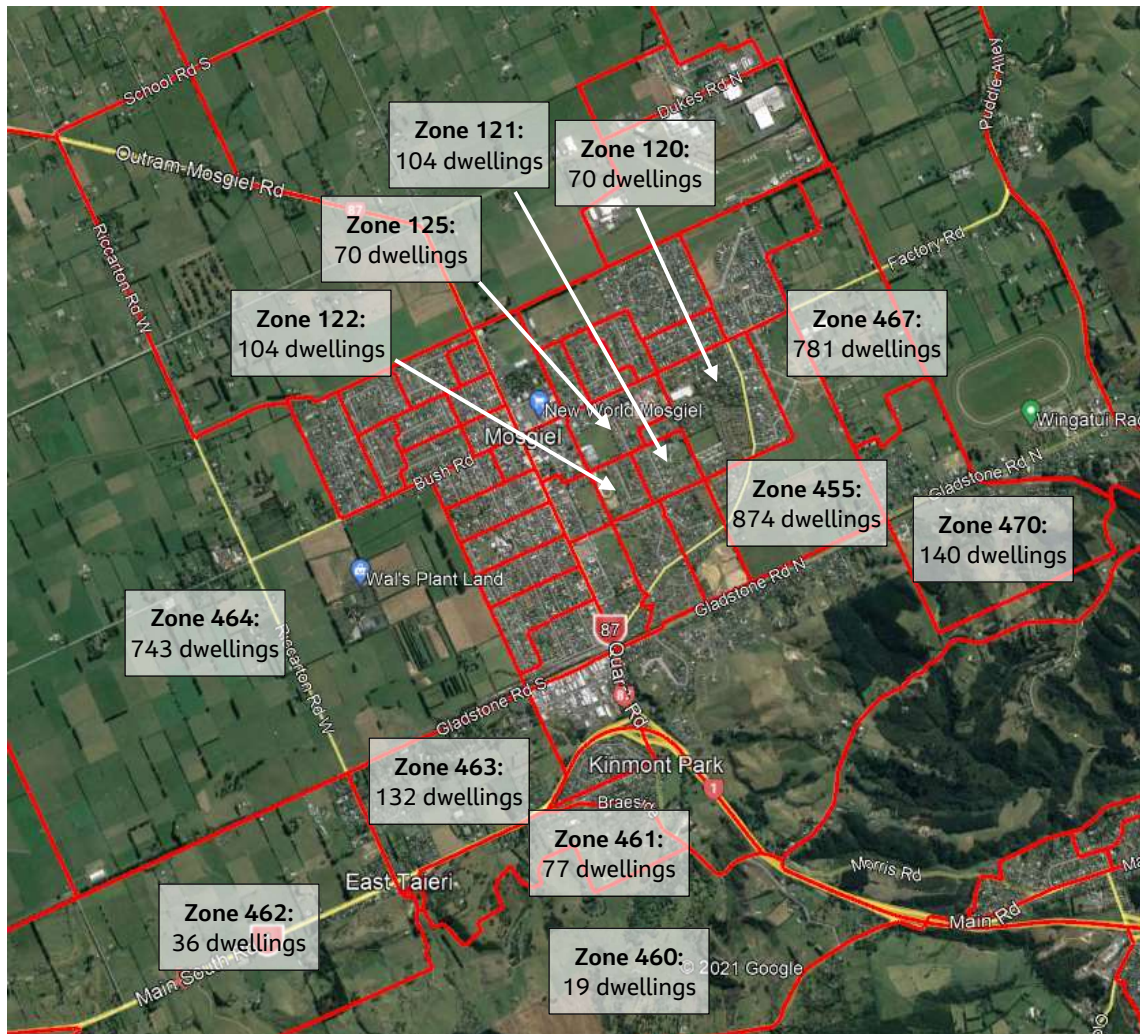


Figure 1: Mosgiel with model zone boundaries (in red) and number of new dwellings

To update the land use input into the model, these dwelling units were added to the number of households in the corresponding zones in the revised 2038 population forecast, based on the assumption that dwelling units and households are equivalent.

The values for people per household and number of cars per household were assumed to stay constant with 2038 revised forecasts for each zone where dwellings were added. The resulting average number of people and cars per household for the added dwellings were however checked against the overall average for Mosgiel for sense-checking. The population and number of vehicles in the zones were then calculated using those rates and the updated household totals.

The 2038 model was run with the resulting land use to assess the impact of the additional housing on the transport network.

3. Results

The following section presents the forecast results for 2038 with the additional dwellings. Additional plots showing modelled traffic volumes, volume/capacity ratios, and intersection level of service are shown in Appendix A.

3.1 Trip Production

This section presents total daily trip production and trip production by mode aggregated into the 12-sector system shown in **Figure 2**.

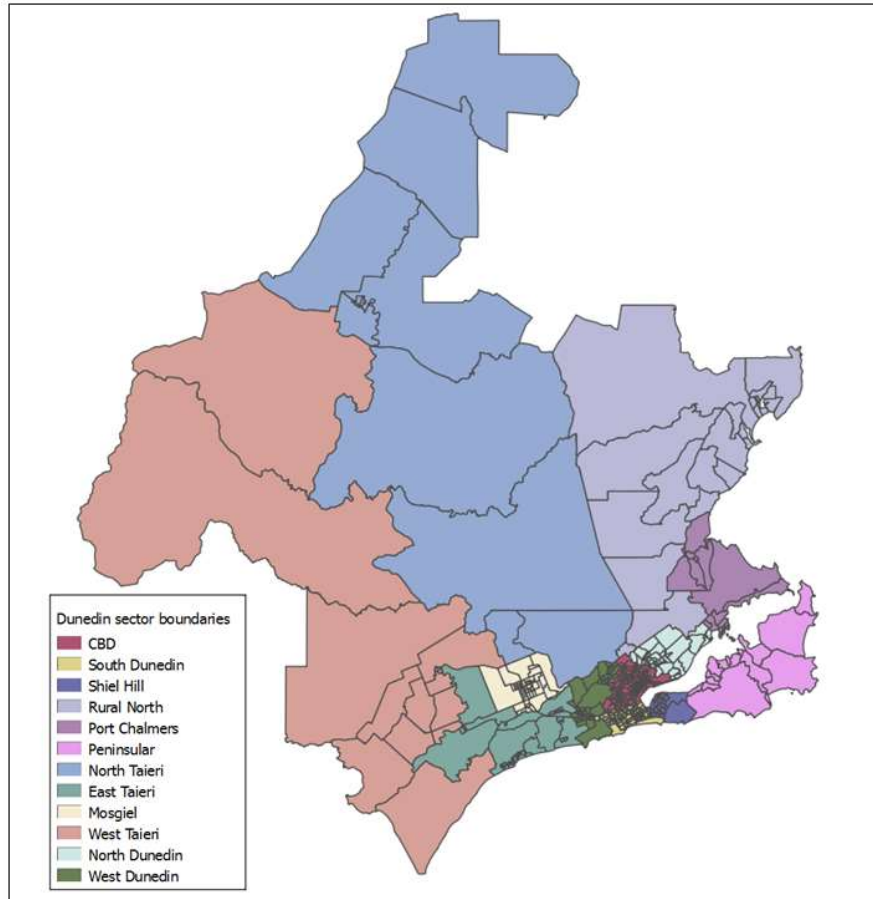


Figure 2: Dunedin Citywide Model Sectors

Table 2 shows daily trip production across all modes.

Table 2: Total Demand per Production Sector - All Modes

Sector	2038	2038 Mosgiel New housing	% Growth
CBD	288,130	298,040	3%
South Dunedin	115,643	118,926	3%
Shiel Hill	37,436	37,929	1%
Rural North	12,307	12,509	2%
Port Chalmers	21,249	21,877	3%
Peninsula	14,477	14,774	2%
North Taieri	5,400	5,511	2%

East Taieri	28,642	29,411	3%
Mosgiel	64,031	83,091	30%
West Taieri	13,119	13,400	2%
North Dunedin	45,356	45,936	1%
West Dunedin	38,468	38,962	1%
Total	684,257	720,364	5%

The results show that trip production increases by 30% from Mosgiel, and by 5% in the model overall. All sectors have at least a slight increase in trip production as a result of new non-home-based trips made by the additional population. East Taieri, where about 50 of the new dwelling units would be located, has a 3% increase in trips.

The following tables show daily trip production by mode, aggregated to the 12 sectors. Note that 'light vehicles' represents person trips by light vehicle (i.e. driver and passengers) and not vehicle trips.

Table 3: Total Demand per Production Sector - Light Vehicles

Sector	2038	2038 Mosgiel New housing	% Growth
CBD	230,388	237,905	3%
South Dunedin	92,442	94,809	3%
Shiel Hill	31,650	32,037	1%
Rural North	11,180	11,336	1%
Port Chalmers	17,965	18,455	3%
Peninsula	13,197	13,460	2%
North Taieri	4,982	5,076	2%
East Taieri	26,508	27,230	3%
Mosgiel	54,968	72,616	32%
West Taieri	12,321	12,576	2%
North Dunedin	38,187	38,641	1%
West Dunedin	33,078	33,454	1%
Total	566,865	597,595	5%

Table 4: Total Demand per Production Sector - Public Transport

Sector	2038	2038 Mosgiel New housing	% Growth
CBD	4,731	4,915	4%
South Dunedin	2,280	2,364	4%

Shiel Hill	748	758	1%
Rural North	19	19	2%
Port Chalmers	41	41	0%
Peninsula	118	119	1%
North Taieri	0	0	—
East Taieri	118	124	5%
Mosgiel	456	488	7%
West Taieri	0	0	—
North Dunedin	976	987	1%
West Dunedin	555	575	4%
Total	10,042	10,390	4%

Table 5: Total Demand per Production Sector - Active Modes

Sector	2038	2038 Mosgiel New housing	% Growth
CBD	53,011	55,220	4%
South Dunedin	20,921	21,754	4%
Shiel Hill	5,037	5,134	2%
Rural North	1,109	1,154	4%
Port Chalmers	3,243	3,381	4%
Peninsula	1,162	1,195	3%
North Taieri	418	435	4%
East Taieri	2,017	2,057	2%
Mosgiel	8,606	9,986	16%
West Taieri	797	824	3%
North Dunedin	6,194	6,307	2%
West Dunedin	4,835	4,933	2%
Total	107,350	112,380	5%

Light vehicle trips have increased by 5% overall and 32% from Mosgiel, which is higher than the total increase in trips from Mosgiel. The newly generated trips have a higher light vehicle mode share than the Mosgiel trips in the original 2038 model (93% for the new trips, compared to the previous 86% share in Mosgiel). The main reason for this is that while new population has been added in Mosgiel, the distribution of where employment and education are located has not changed. Therefore, most of the new trips generated by the new households are between Mosgiel and Dunedin, where most jobs and schools are located. Because of this assumption, results are on the upper end of what could be expected in terms of impact on volumes and travel times to Dunedin. If jobs and education in Mosgiel were to increase as well, there would be more trips within Mosgiel, including by active modes, and fewer long-distance trips to Dunedin.

Public transport trips increase by 7% from Mosgiel and 4% over the entire model. Active mode trips increase by 16% from Mosgiel and 5% overall.

3.2 Travel Distance and Time

3.2.1 Light Vehicles

The light vehicle-hours and vehicle-kilometres, as well as average trip time and length are shown in **Table 6**.

The model indicates that the increased housing in Mosgiel would increase light vehicle hours by about 5-7% in all periods in 2038, and vehicle kilometres by a similar amount. Average trip time and average trip length increase slightly (less than 2%) in all periods except interpeak. As noted in the previous section, these results are on the upper end of the impact we would expect because the distribution of destinations (e.g. jobs and schools) did not change with the added population.

Table 6: Light vehicle travel time and distance

Indicators	Time Period	2038	2038 Mosgiel New housing	% Growth
Light vehicle hours	AM	12,363	13,247	7.2%
	IP	28,689	30,072	4.8%
	PM	20,522	21,839	6.4%
	ON	14,273	15,089	5.7%
Light vehicle kilometres	AM	513,975	547,290	6.5%
	IP	1,163,638	1,217,665	4.6%
	PM	830,944	878,345	5.7%
	ON	595,701	630,171	5.8%
Average trip time (mins)	AM	9.6	9.8	1.7%
	IP	8.5	8.5	-0.3%
	PM	9.2	9.3	1.1%
	ON	9.7	9.7	0.4%
Average trip length (km)	AM	6.7	6.8	1.1%
	IP	5.8	5.7	-0.5%
	PM	6.2	6.2	0.4%
	ON	6.7	6.8	0.5%

3.2.2 Public Transport

Table 7 shows changes in public transport use, including the number of boardings, total passenger-kilometres and passenger-hours (both relating to the vehicle trip and excluding access/egress legs), and average trip lengths and duration.

Table 7: Public Transport Usage

Time Period	Time Period	2038	2038 Mosgiel New housing	% Growth
AM Peak	Boardings	2,410	2,495	3.6%
	Passenger-kilometres	9,770	10,077	3.2%
	Passenger-hours	374	392	4.9%
	Average trip length (km)	4.1	4.0	-0.4%
	Average trip time (mins)	9.3	9.4	1.3%
Inter Peak	Boardings	4,066	4,227	4.0%
	Passenger-kilometres	15,533	16,045	3.3%
	Passenger-hours	576	598	3.9%
	Average trip length (km)	3.8	3.8	-0.6%
	Average trip time (mins)	8.5	8.5	0.0%
PM Peak	Boardings	3,794	3,900	2.8%
	Passenger-kilometres	15,524	15,923	2.6%
	Passenger-hours	605	631	4.3%
	Average trip length (km)	4.1	4.1	-0.2%
	Average trip time (mins)	9.6	9.7	1.4%

3.3 Levels of Service

The following table presents intersection levels of service (LoS) for 2038 both with and without the new housing in Mosgiel.

Table 8: Number of intersections per level of service

Time Period	LOS	2038	2038 Mosgiel New housing	% Change
AM Peak	A	1,688	1,674	-1%
	B	429	416	-3%
	C	169	180	7%
	D	42	50	19%

	E	19	20	5%
	F	6	13	117%
Inter Peak	A	1,803	1,781	-1%
	B	410	418	2%
	C	112	120	7%
	D	19	20	5%
	E	6	11	83%
	F	3	3	0%
PM Peak	A	1,615	1,588	-2%
	B	437	429	-2%
	C	201	216	7%
	D	53	58	9%
	E	26	37	42%
	F	21	25	19%

Results show an increase in intersection congestion, with generally more intersections experiencing LoS E and F in all time periods. Many of the intersections that move to a lower LoS are along the main routes between Mosgiel and Dunedin. The Taieri Road / Helensburgh Road intersection becomes LoS F in the AM peak, and the Taieri Road / Kaikorai Valley Road intersection becomes LoS F in both peaks. There are also a number of intersections in the city centre that have a lower LoS by one category because of the slight increase in traffic in Dunedin. For example, Smith Street / Rattray Street becomes LoS F in the AM peak and Castle Street / Anzac Avenue becomes LoS F in the PM peak. Changes in LoS occur mainly at priority intersections. No signalised intersection is at LoS F in either scenario and the additional traffic does not significantly change the LoS of these intersections.

See Appendix A for plots of intersection LoS. Plots of link volume/capacity (V/C) ratio are also provided in Appendix A. These plots show that V/C mainly increases in the peak direction on SH1 and Three Mile Hill Rd. However, even with the additional housing only a few sections have a V/C greater than 0.7, and most of those were already above 0.7 before the additional housing.

3.4 Travel Times on Key Routes

Table 9 presents the 2038 travel times on the key routes shown in **Figure 3** with and without the additional housing.

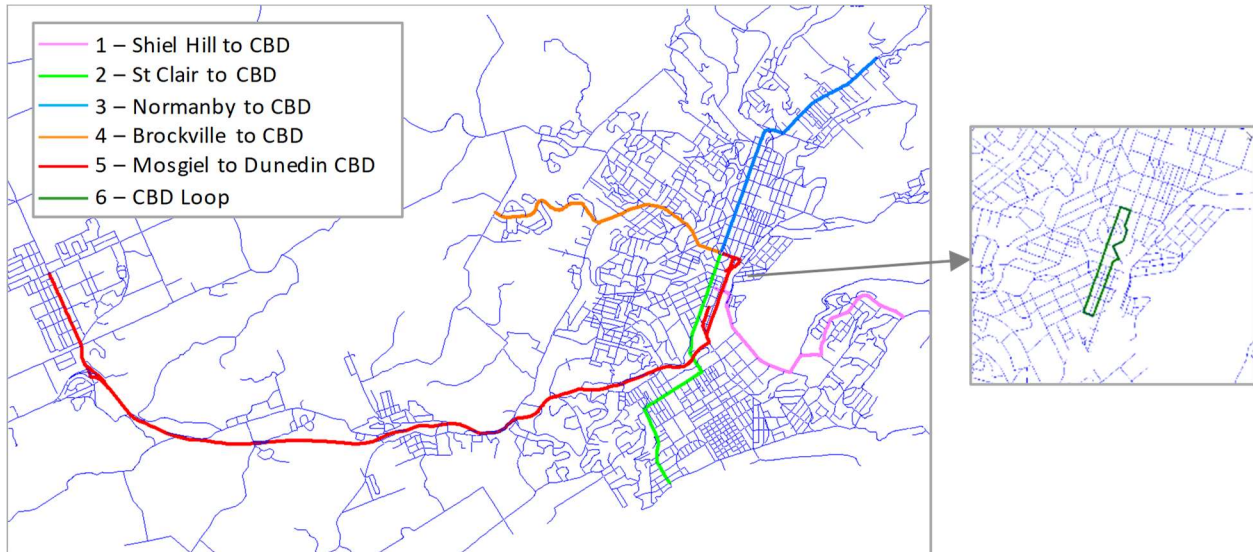


Figure 3: Key Travel Time Routes

Table 9: 2038 Travel Time on Key Routes (in minutes)

ROUTE AND DIRECTION		2038	2038 Mosgiel New housing	% Difference
AM Peak				
1	Inbound	12	12	1%
	Outbound	11	11	0%
2	Inbound	10	10	1%
	Outbound	9	9	0%
3	Inbound	13	13	0%
	Outbound	13	13	0%
4	Inbound	9	9	2%
	Outbound	7	7	0%
5	Inbound	19	21	8%
	Outbound	17	17	0%
6	Anti-Clockwise	11	11	0%
Inter Peak				
1	Inbound	10	10	1%
	Outbound	10	10	1%
2	Inbound	9	9	0%
	Outbound	9	9	0%

3	Inbound	13	13	0%
	Outbound	13	13	0%
4	Inbound	8	8	1%
	Outbound	7	7	1%
5	Inbound	17	17	1%
	Outbound	17	17	1%
6	Anti-Clockwise	11	11	1%
PM Peak				
1	Inbound	11	11	1%
	Outbound	12	12	0%
2	Inbound	10	10	0%
	Outbound	10	10	1%
3	Inbound	13	13	1%
	Outbound	13	14	1%
4	Inbound	9	9	3%
	Outbound	8	8	3%
5	Inbound	18	18	1%
	Outbound	22	24	10%
6	Anti-Clockwise	11	11	0%

Results show that most routes have only a slight increase in travel time, if any. Travel time on Route 5 between Mosgiel and the CBD, however, increases in the peak direction, by 8% in the inbound direction in the AM peak and 10% in the outbound direction in the PM peak, or about 1.5 to 2 minutes.

Travel times along the Three Mile Hill Road between Mosgiel and Dunedin was not included in the DTM validation and therefore no survey data is available. Given that a sizable share of the new traffic generated by the additional dwellings uses this road instead of the State Highway, modelled travel times between Mosgiel and Dunedin (Octagon) were however compared for both roads (in the 2017, 2038 base and 2038 + new dwelling scenarios), as well as against travel times (extracted from the Google Maps API for Three Mile Hill Road, while these are not exactly the same as 2017 surveyed times, they are still useful for sense checking model results). Results are shown in the following table.

			Distance (km)	Observed	2017 Modelled	2038	2038+Mosgiel New housing	% diff vs 2038
E/b	SH1	AM	16.0	18.2	17.9	19.2	20.7	8%
		IP		17.1	16.4	17.0	17.3	1%
		PM		18.6	16.9	17.7	18.0	1%
	Three Mile Hill Road*	AM	16.4	19.0	17.7	18.0	18.9	5%
		IP		18.0	17.1	17.3	17.4	1%
		PM		18.0	17.4	16.8	17.7	6%
W/b	SH1	AM	16.0	17.6	16.3	16.9	16.9	0%
		IP		17.6	16.4	17.2	17.4	1%
		PM		20.2	19.3	22.0	24.1	10%
	Three Mile Hill Road*	AM	16.4	18.0	17.0	17.1	17.2	0%
		IP		18.0	16.9	17.1	17.2	0%
		PM		20.0	18.6	19.1	20.2	6%

* Based on Google Maps API

Table 10: Travel times comparison – SH1 & Three Mile Hill Road (in min)

Results show that 2017 modelled travel times are generally a good match with observed, with peak direction times on Three Miles Hill Road slightly faster compared with Google Maps API times but within acceptable range. Observed times are similar on both SH1 and Three Mile Hill Road, with the latter being less than 1 min slower in most cases.

With increased demand in 2038, and even more so with additional housing in Mosgiel, travel times increase in the peak direction, with the increase being more marked on the State Highway route.

4. Conclusions

The proposed developments add a significant number of new dwelling units to the Mosgiel area. This leads to a 30% increase in the number of trips from Mosgiel, with 93% of these trips being light vehicle trips. Because this scenario assumed that the residential population of Mosgiel would increase without any change in the location of employment and education, there are likely more trips between Mosgiel and Dunedin than would occur in reality. Therefore, the modelled impact on the network is on the upper end of the likely impact.

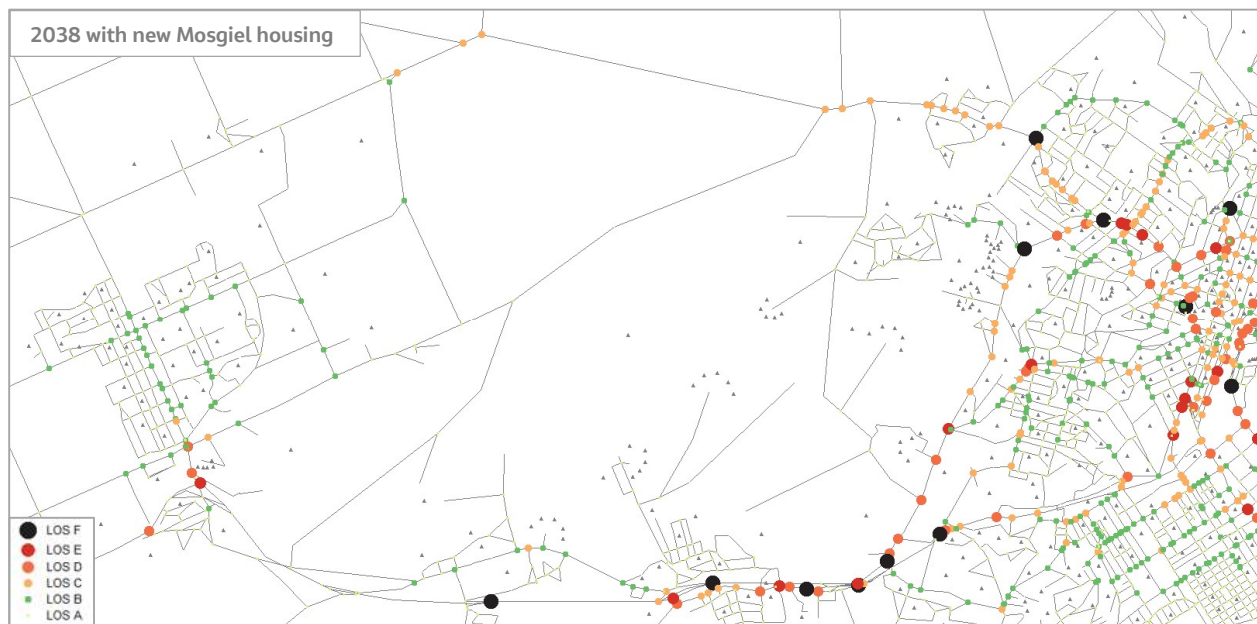
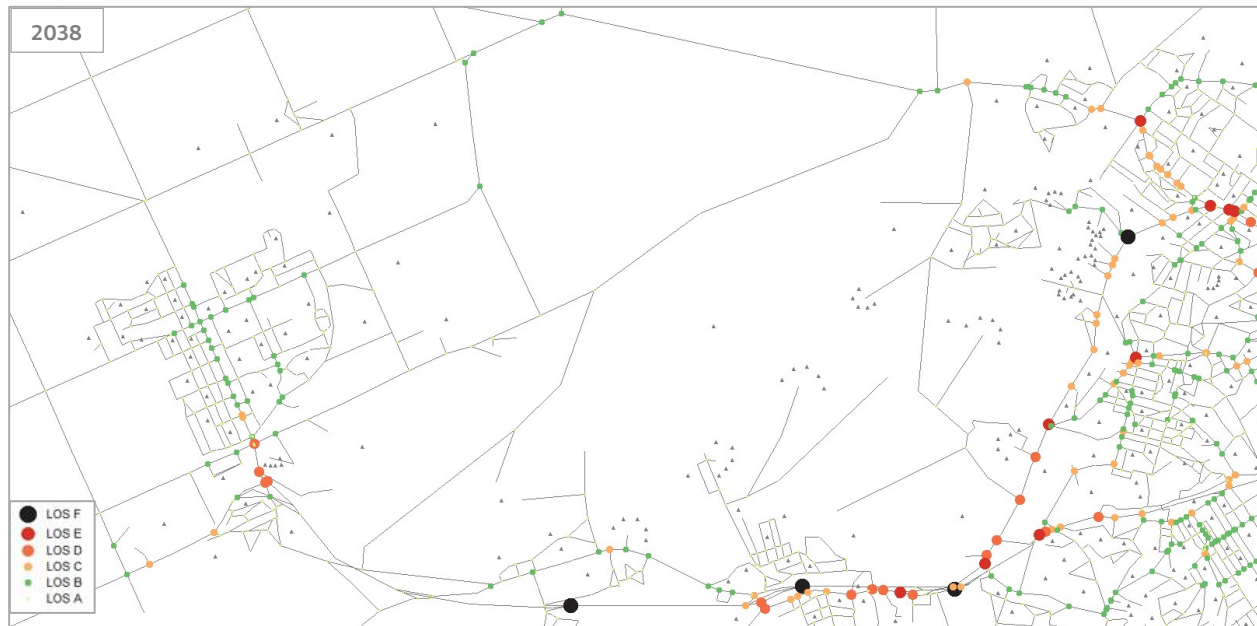
The model indicates that the additional trips lead to some worsening of LoS at intersections both along the routes between Mosgiel and Dunedin (SH1 and Taieri Road) and to a lesser extent in Dunedin due to a general increase in traffic. There is also an increase in travel time in the peak direction along the Mosgiel-Dunedin key travel time route of 8-10%, or approximately 2 minutes.

Appendix A. Model Output Plots

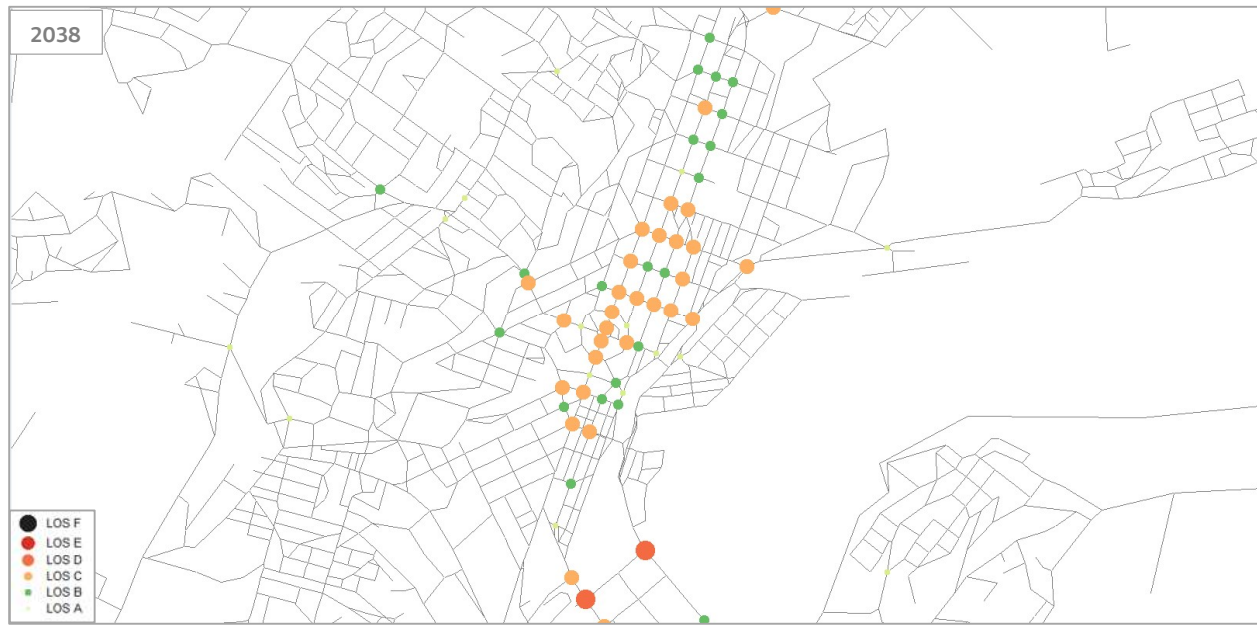
Intersection LoS – All intersections, 2038 AM



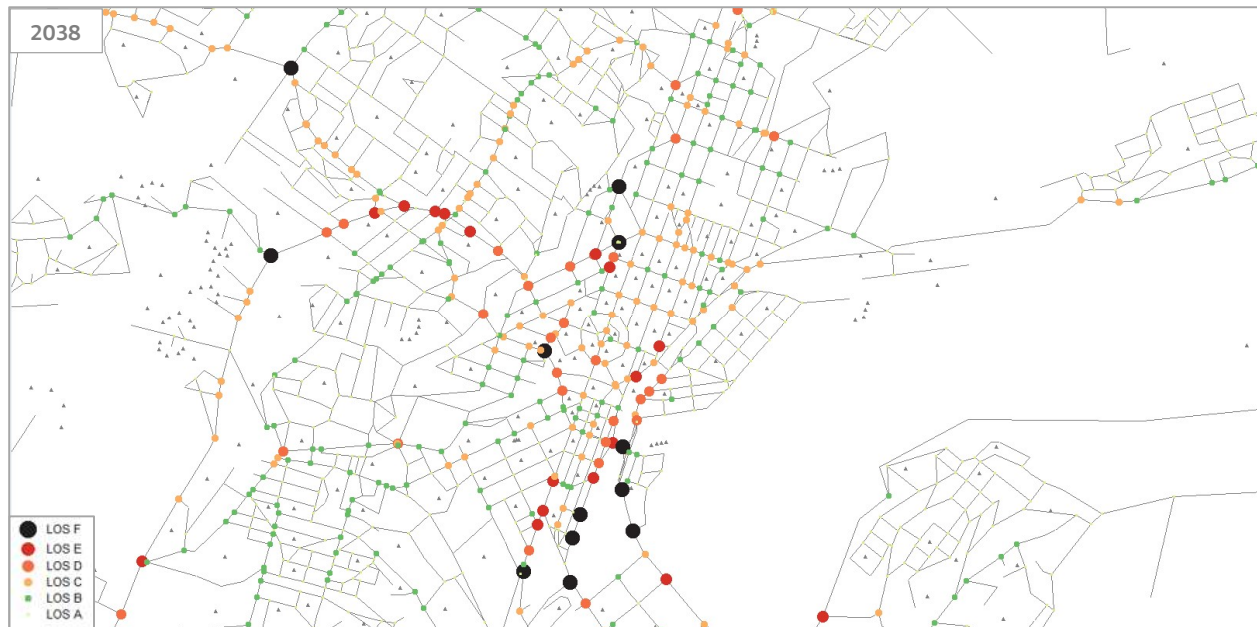
Intersection LoS – All intersections (Mosgiel view), 2038 AM



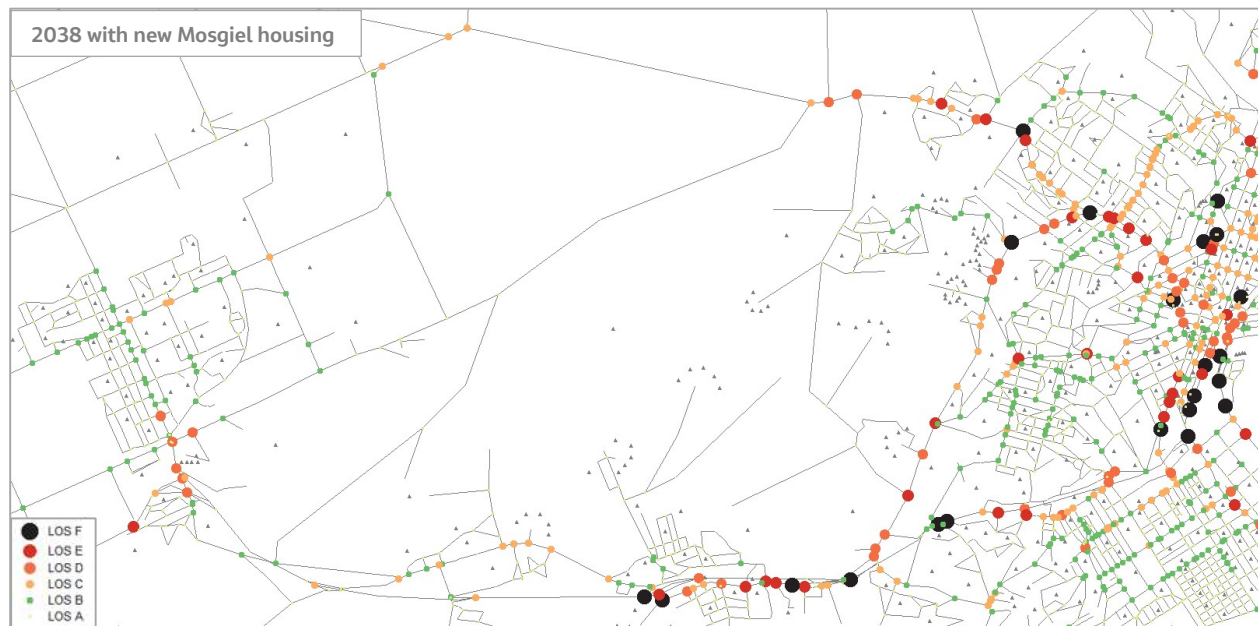
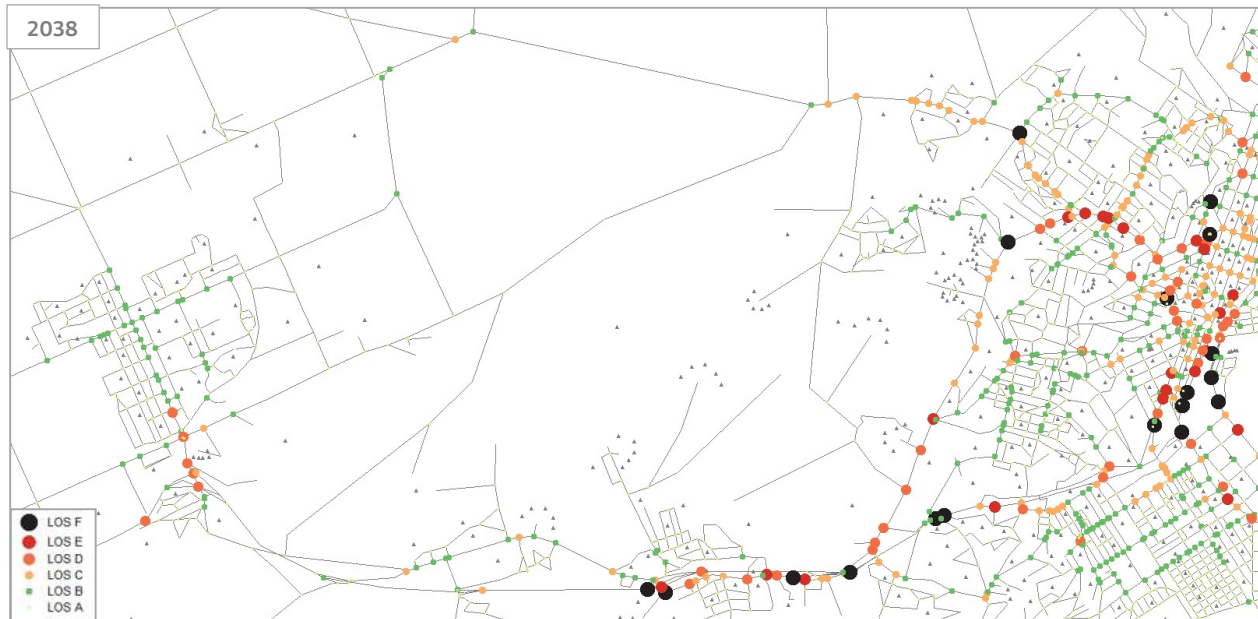
Intersection LoS – Signalised intersections, 2038 AM



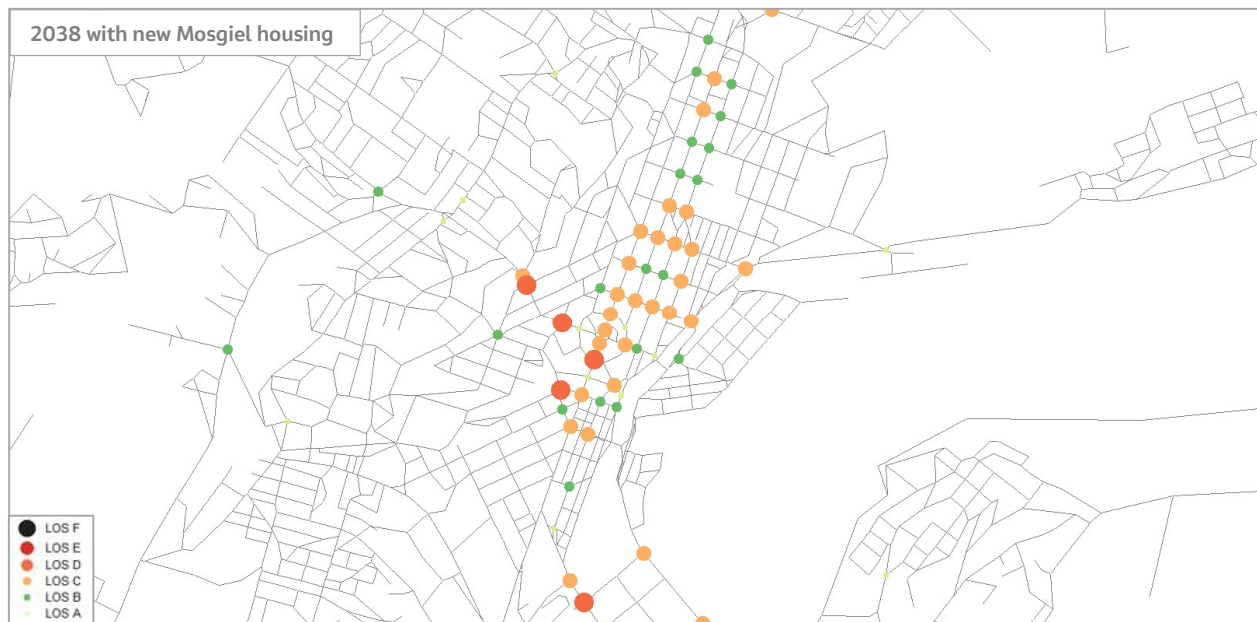
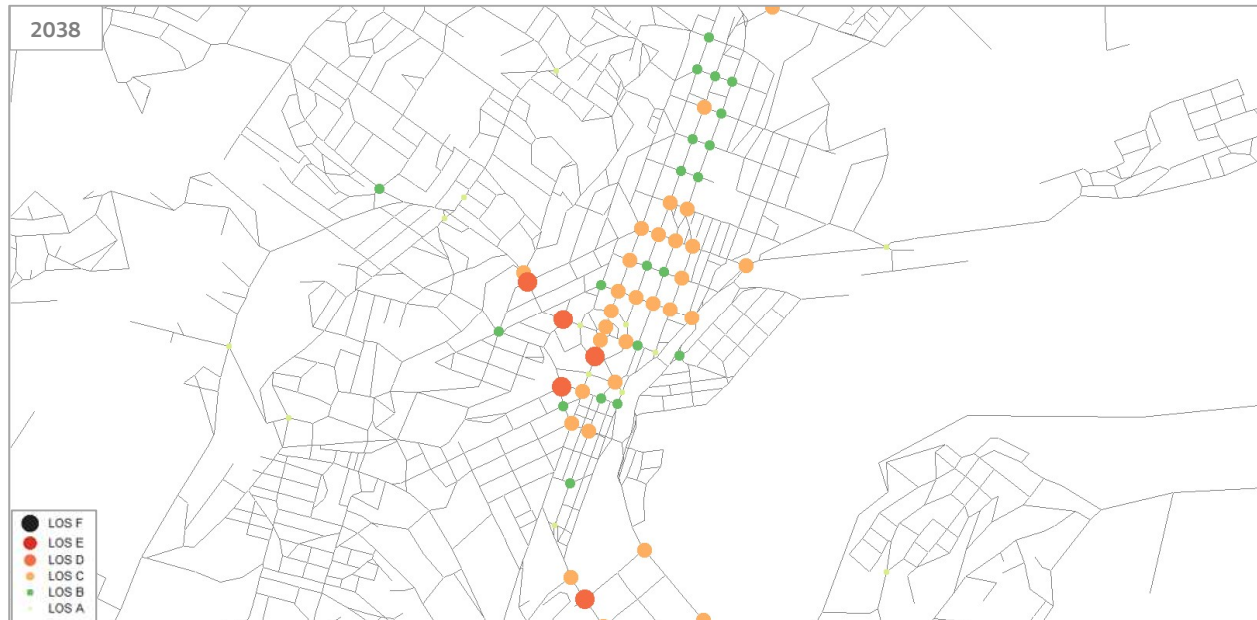
Intersection LoS – All intersections, 2038 PM



Intersection LoS – All intersections (Mosgiel view), 2038 PM

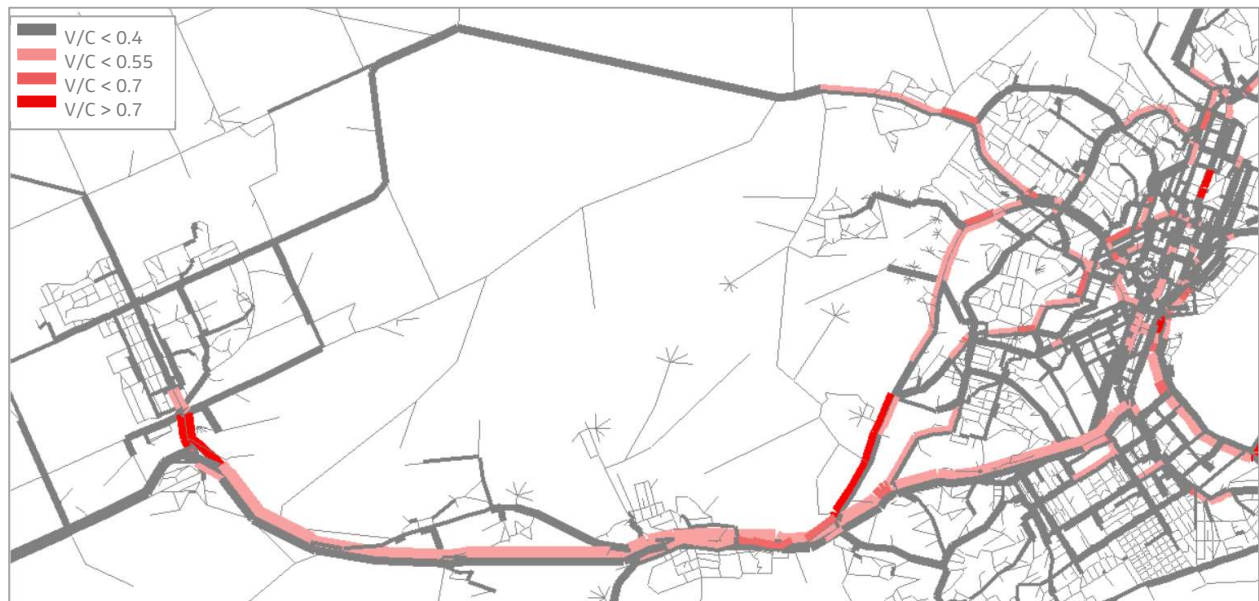


Intersection LoS – Signalised intersections, 2038 PM

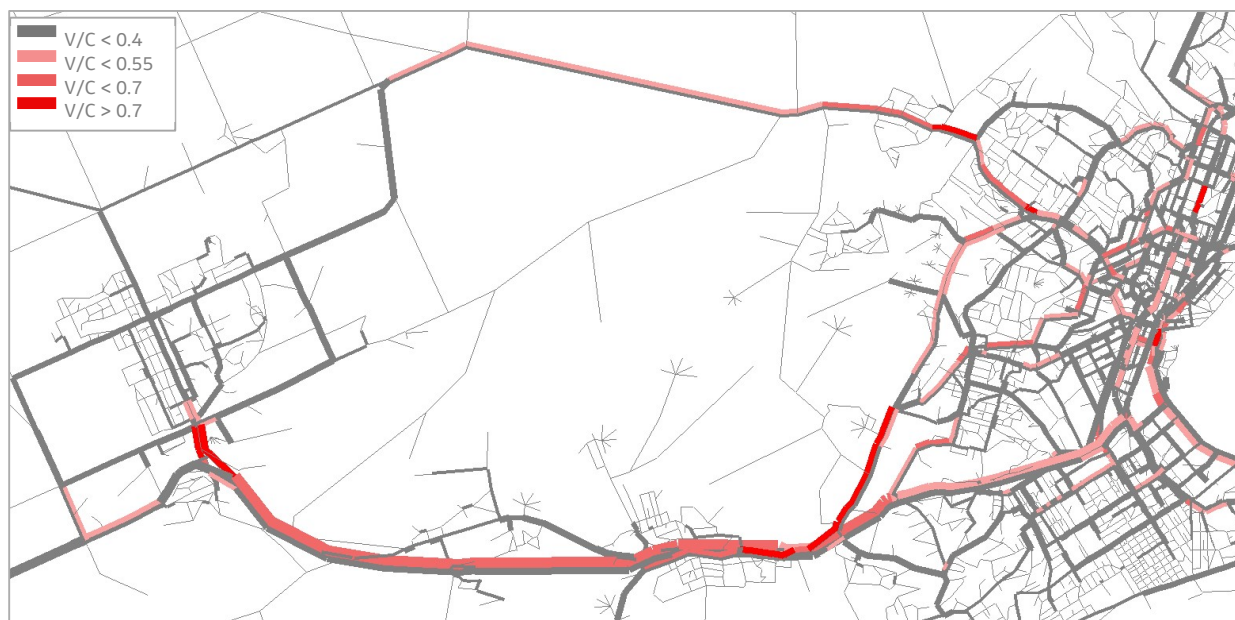


Link V/C Plots

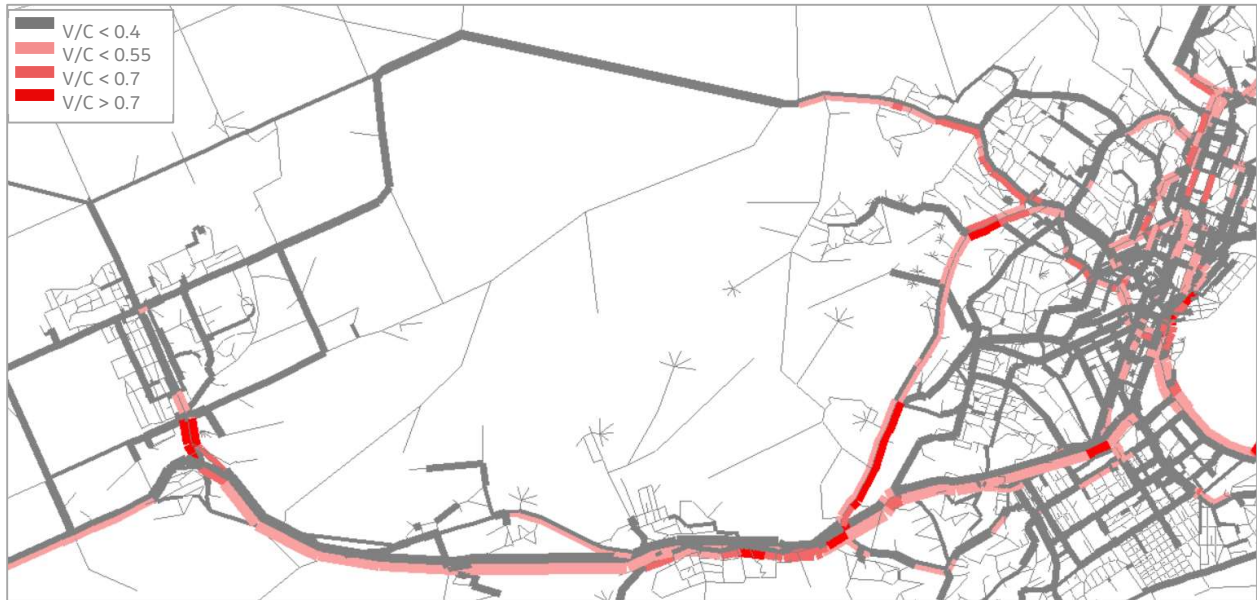
2038 AM



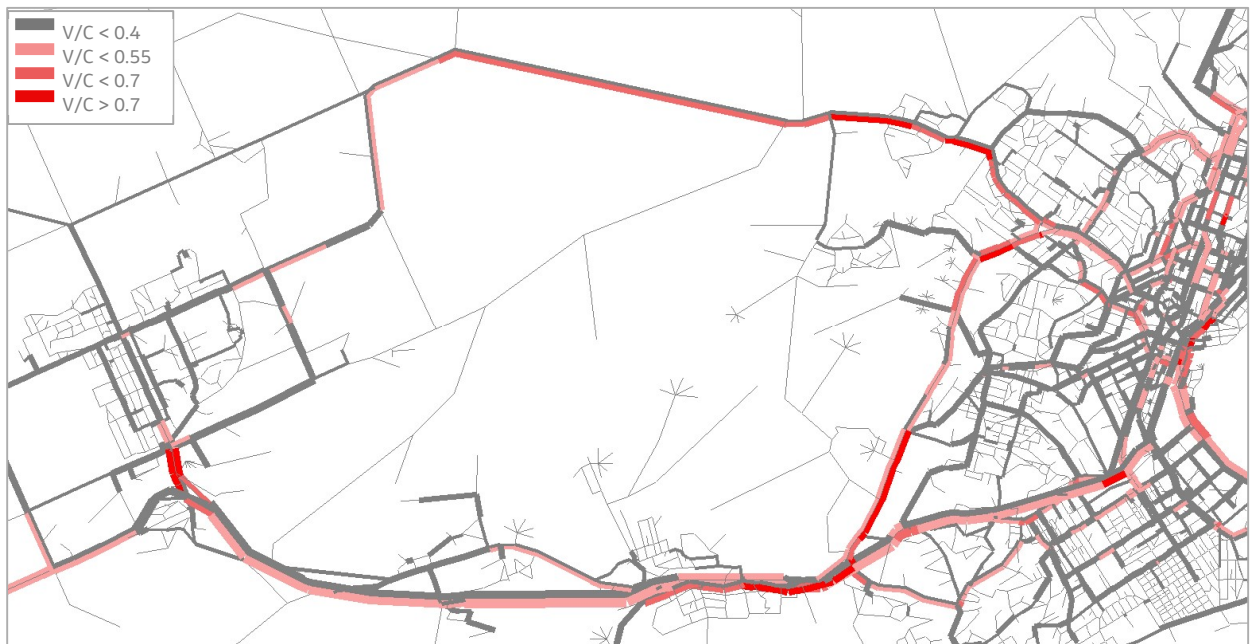
2038 with Mosgiel housing - AM



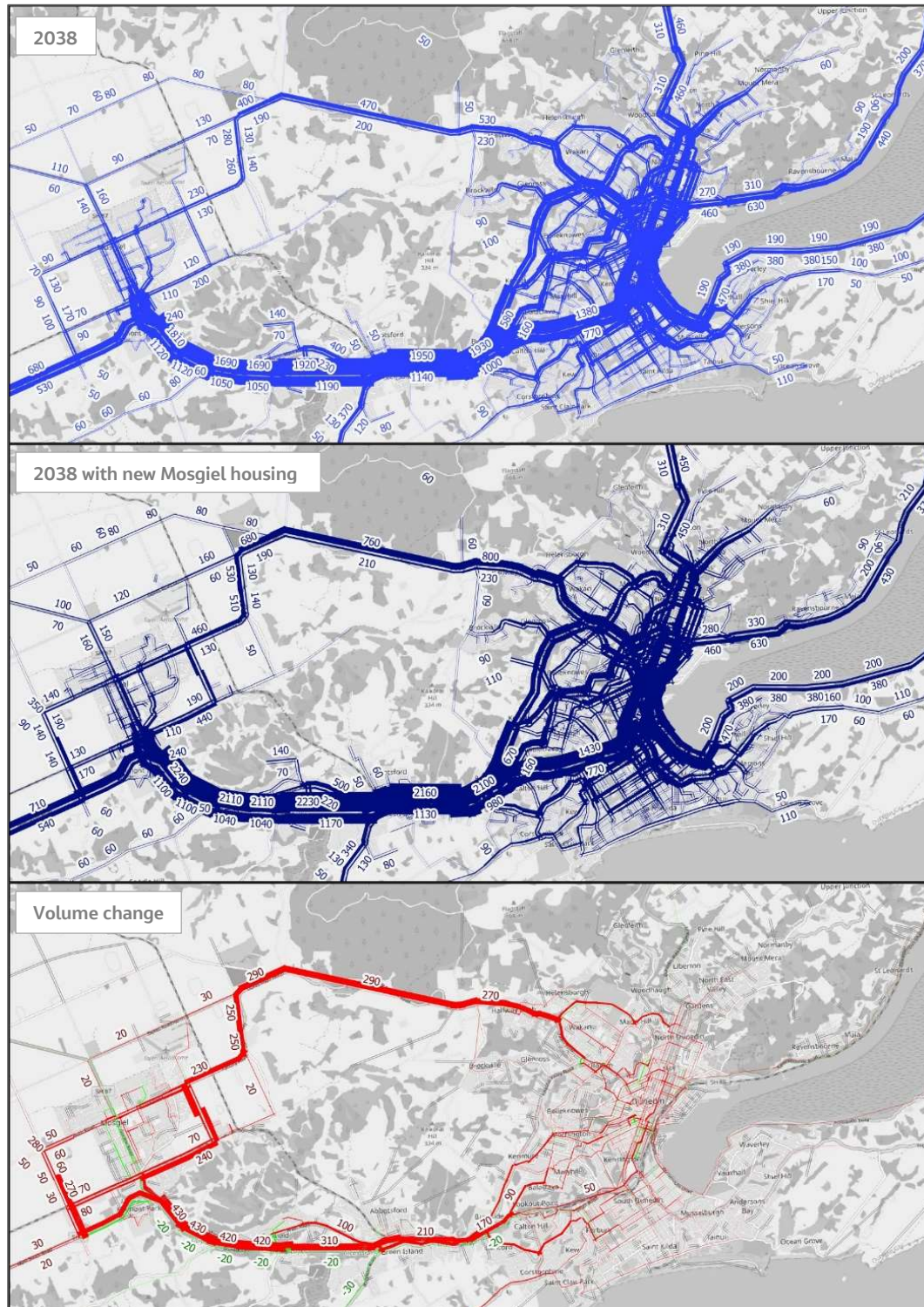
2038 PM



2038 with Mosgiel housing - PM



Light vehicles volumes (2hr) and volume changes - 2038 AM



Light vehicles volumes (2hr) and volume changes - 2038 PM

