Memorandum

To	Hamish Crawford
Copy	Cheryl Cleary and Robert Swears
From	Emma Cui and Allan Liu
Office	Auckland Westhaven
Date	8 November 2021
File/Ref	2-37400.00
Subject	**Nukuhau Plan Change: Additional Modelling**

1 Introduction

Following on from previous memos (22 September and 12 October 2021) in which we described the results of modelling for a range of scenarios for the Nukuhau Private Plan Change 37, the purpose of this memo is to describe the results of additional modelling that has been carried out subsequent to statements of evidence being submitted. This memorandum concludes that if residential development on the northern side of the River proceeds in the manner identified by Mr Heath (Property Economics), the effects of Plan Change traffic on the transport network are likely to be significantly less than described in the previous memos and in my 20 October statement of evidence.

2 Extent of Residential Development

In the 12 October 2021 memorandum we described a range of development scenarios. These were based on the indicative residential supply breakdown from the Taupo Residential Dwelling Demand Addendum Report (July 2021). The left-hand column of Figure 1 below (which is replicated from the 12 October memo) is a screenshot from the Report that lists the indicative available residential land that could be developed north of the Waikato River. The two struck through locations are not to the north of the Waikato River.

Northern End of the Lake		Southern End of the Lake	
~~EUL~~	~~1,000~~	Kuratau/Omori	180
~~WEL~~	~~496~~	Mohi	50
Brentwood	120	Turang	400
Lakeside Brentwood	350	Whareroa	160
Vineyard on Huka falls	36	Undeveloped half charges	275
Acacia Bay	150	**Total Southern End**	**1,065**
Kinloch	334	**Unzoned**	
7 Oaks	162	Five Mile Bay site A and C	440
Undeveloped half charges	742	Nukuhau Private Plan Change	780
Total Northern End	**4,290**	**Total Unzoned**	**1,220**

Figure 1: Permitted Land Development North of Bridge, Taupo Residential Dwelling Demand Addendum Report (July 2021)

The various proportions of development described in Table 1 of the 12 October memorandum (which is replicated below), included development of proportions of various combinations of the following areas:

Table 1: Assessed Scenarios described in 12 October memorandum

Scenario Name	Name in SIDRA	New	Growth from 2021	All permitted land	Undeveloped half charges	Nukuhau	Houses	Trips*
2021 Scenario #0	2021 no dev	N	0%	0%	0%	0%	0	0
2025 Scenario #1	2025 no Nukuhau	N	1% p.a.	50%	30%	0%	781	645
2025 Scenario #2	2025 with Nukuhau	N	1% p.a.	50%	30%	40%	1093	930
2030 Scenario #0	2030 S1	Y	1% p.a.	0%	0%	0%	0	0
2030 Scenario #1	2030 no Nukuhau	N	1% p.a.	100%	60%	0%	1561	1290
2030 Scenario #2	2030 S3	Y	1% p.a.	100%	60%	30%	1801	1490
2030 Scenario #3	2030 with Nukuhau	N	1% p.a.	100%	60%	80%	2185	1860
2030 Scenario #4	2030 S2	Y	1% p.a.	50%	30%	30%	1018	852

*Trips: Additional trips generated from the development and 1% growth in base traffic volumes go to and from Taupo town centre via the Control Gates Bridge

Based on the findings of Mr Heath, we understand that the extent of residential development north of the Waikato River is likely to be less than the proportions we modelled. Therefore, our previous modelling is likely to present conservative results. Based on Mr Heath's analysis, we understand that the extent of development north of the Waikato River (prior to establishment of a second river crossing) is likely to be:

1 997 additional dwellings north of the CGB (without Nukuhau) by 2030.
2 140 more dwellings by 2030 if Nukuhau was 100% zoned from today.

We have adopted a weighted approach and distributed the 997 dewellings across the zoned land and undeveloped half charges as shown in Table 2 below.

Table 2: Predicted Number Dwelling

Development	No. Dwellings_Economics Memo	No. Dwellings capacity
Seven Oaks and Kinloch	266	496
Acacia Bay	80	150
Brentwood and Lakeside Brentwood	252	470
Undeveloped half charges	398	742
Total	**997**	**1858**

3 Modelling Based on Property Economics Estimates

Similarly to the approach we used for previous modelling, we have compared travel times associated with development of "all permitted land" and the "undeveloped half charges" against the travel times associated with those two areas of development plus additional development associated with Nukuhau.

Noting that the routes to which reference is made are the same as the routes described in the 12 October memorandum, the results of the previous modelling and the additional modelling are described in Table 3 to Table 6 below. The notation used to describe the proportions of the various areas is the same as the notation used in the 12 October memo; that is, (XX /YY / ZZ) represents:

- XX% development for all areas north of the River, with the exception of Nukuhau and the Undeveloped half charges.
- YY% development for the Undeveloped half charges area north of the River.
- ZZ% development for the Nukuhau Plan Change area.

In relation to Mr Heath's analysis we have identified the proportions as follows:

- Scenario #5 (PE/PE/0): development of dwellings to the north of the River based on the All permitted and Undeveloped half charges quantities described in Section 2 of this memo.
- Scenario #6 (PE/PE/PE): development of all dwellings to the north of the River based on all of the development described in Section 2 of this memo.

Comparison between the previous modelling and the modelling based on Mr Heath's analysis is a little difficult because the previous modelling described incremental delays in units of minutes. By contrast, the extent of incremental travel time for the most recent modelling is best described in units of seconds because none of the incremental times exceed one minute. The modelling results are as follows.

Table 3: AM Peak Travel Times

Scenarios	AM En-route Travel Time (seconds)			
	Route 1	Route 2	Route 3	Route 4
2030 Scenario #0 (0/0/0)	166	164	168	166
2030 Scenario #1 (100/60/0)	405	364	407	365
2030 Scenario #2 (100/60/30)	375	472	377	474
2030 Scenario #3 (100/60/80)	448	544	449	546
2030 Scenario #4 (50/30/30)	324	281	326	283
2030 Scenario #5 (PE/PE/0)	308	275	310	276
2030 Scenario #6 (PE/PE/PE)	311	319	313	321

Table 4: Comparison of AM Peak Travel Times between Scenarios

Scenarios	AM En-route Travel Time (seconds)			
	Route 1	Route 2	Route 3	Route 4
2030 Scenario #1 (100/60/0) - 2030 Scenario #0 (0/0/0)	239	200	239	199
2030 Scenario #3 (100/60/80) - 2030 Scenario #0 (0/0/0)	282	380	281	380
2030 Scenario #3 (100/60/80) - 2030 Scenario #1 (100/60/0)	43	180	42	181
2030 Scenario #4 (50/30/30) - 2030 Scenario #0 (0/0/0)	158	117	158	117
2030 Scenario #2 (100/60/30) - 2030 Scenario #1 (100/60/0)	-30	108	-30	109
2030 Scenario #6 (PE/PE/PE) - 2030 Scenario #5 (PE/PE/0)	3	44	3	45
*Negative numbers likely to be due to change in cycle time at signals, this has been discussed and confirmed with Dave Smith				

Table 5: AM Peak Travel Times

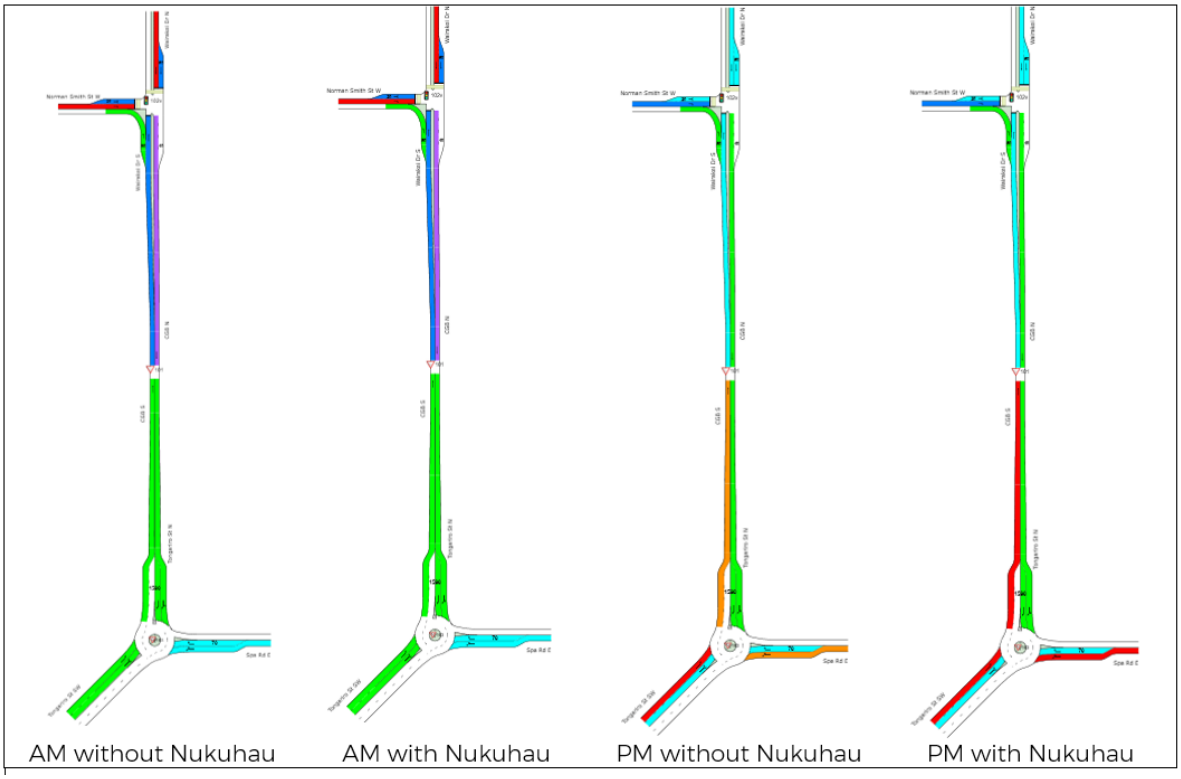
Scenarios	PM En-route Travel Time (seconds)			
	Route 5	Route 6	Route 7	Route 8
2030 Scenario #0 (0/0/0)	208	195	168	155
2030 Scenario #1 (100/60/0)	891	879	302	290
2030 Scenario #2 (100/60/30)	959	947	372	360
2030 Scenario #3 (100/60/80)	1086	1078	428	420
2030 Scenario #4 (50/30/30)	690	679	235	224
2030 Scenario #5 (PE/PE/0)	682	671	234	224
2030 Scenario #6 (PE/PE/PE)	737	725	260	248

Table 6 Comparison of PM Peak Travel Times between Scenarios

Scenarios	PM En-route Travel Time (seconds)			
	Route 5	Route 6	Route 7	Route 8
2030 Scenario #1 (100/60/0) - 2030 Scenario #0 (0/0/0)	683	684	134	135
2030 Scenario #3 (100/60/80) - 2030 Scenario #0 (0/0/0)	878	883	260	265
2030 Scenario #3 (100/60/80) - 2030 Scenario #1 (100/60/0)	195	199	126	130
2030 Scenario #4 (50/30/30) - 2030 Scenario #0 (0/0/0)	482	484	67	69
2030 Scenario #2 (100/60/30) - 2030 Scenario #1 (100/60/0)	68	68	70	70
2030 Scenario #6 (PE/PE/PE) - 2030 Scenario #5 (PE/PE/0)	55	54	26	24

The PM peak incremental delays are greater than the AM peak incremental delays for the Property Economics development extent analysis. However, those PM peak increments are all less than the increments for any of the other PM peak land use development combinations considered previously.

The diagram below (an enlarged version of which is included as the last page of this memorandum) illustrates the levels of service for the various approaches to the three elements of the network comprising the routes that have been considered. From the diagram it can be seen that the levels of service worsen for some of the approaches to the various elements, but remain unchanged for others:



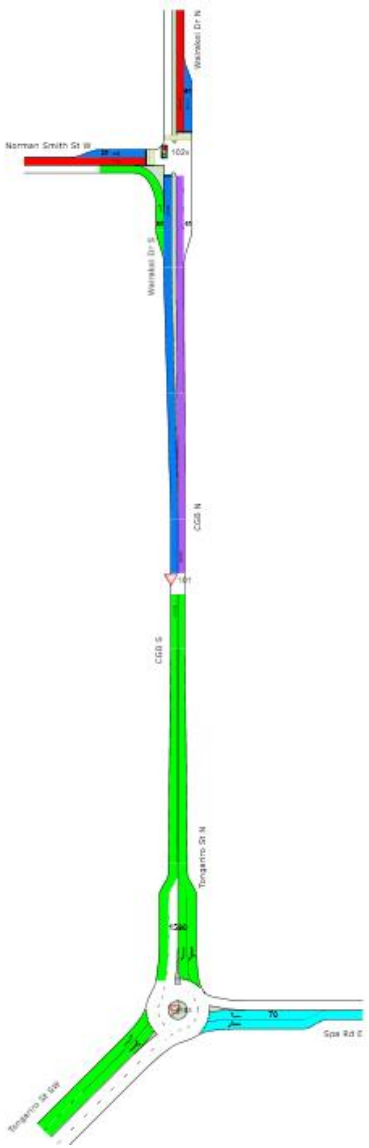
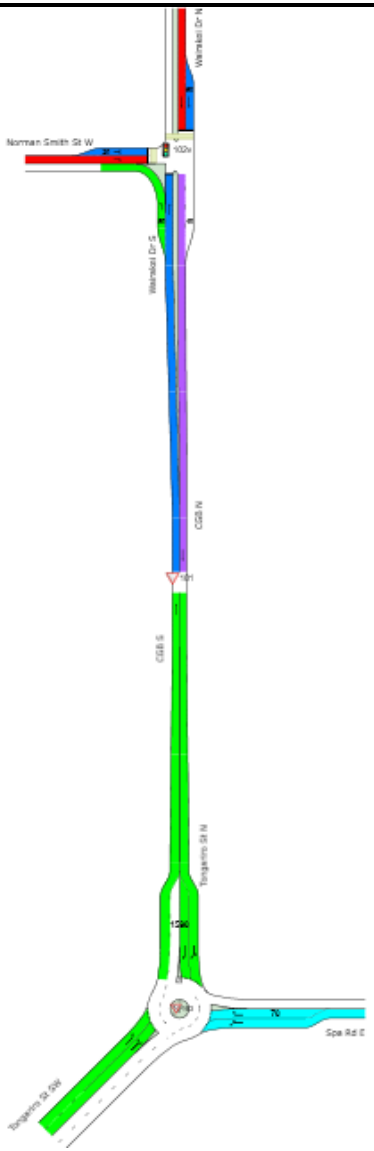
The level of service changes are as follows:

- PM peak northbound approach to Control Gates Bridge; changes from LoS E to LoS F. The change is represented by the travel time increases for all of the PM routes (Route 5 to Route 8) described in Table 6 above.
- PM peak westbound approach to the Spa Road roundabout; changes from LoS E to LoS F. The change is represented by the travel time increases for Route 7 and Route 8 described in Table 6 above.

While there is a delay increase of up to 45 seconds for two of the AM peak routes, these increases do not result in changes in level of service.

4 Conclusions

The modelling presented in the 22 September and 12 October memoranda indicated there would be relatively significant increases in travel time between (and including) the Norman Smith Street intersection and the Spa Road roundabout. However, that analysis was based on conservatively estimated extents of residential development to the north of the Waikato River. Based on subsequent analysis completed by Mr Heath (Property Economics), we have revisited the modelling and identified that the effects of adding development within the Nukuhau Plan Change area to the likely extent of development in other locations north of the River, it appears that the incremental travel time is likely to be less than one minute for any of the routes considered. Therefore, it appears our previous analysis, which described incremental delays of around three minutes, was very conservative

Scenario #5 PE/PE/0 AM AM without Nukuhau	Scenario #6 PE/PE/PE AM AM with Nukuhau	Scenario #5 PE/PE/0 PM PM without Nukuhau	Scenario #6 PE/PE/PE PM PM with Nukuhau
			

Colour code based on Level of Service

LOS A | LOS B | LOS C | LOS D | LOS E | LOS F

Delay Model: SIDRA Standard (Geometric Delay is included).