MEMO TO: Neil Trotter, KCDC (cc Don Wignall, Transport Futures)

FROM: David Wanty, Wanty Transportation Consultancy

SUBJECT: SIDRA Airport Traffic Model review

ORIGINAL DATE: 7 & 11 Nov. 2016 REVISED: 28 November

This memorandum has been quickly prepared relating to a review of the SATURN/SIDRA traffic modelling methodology for the Paraparaumu Airport Zone and proposed District Plan and Plan Change activities

1. MODELLING METHODOLOGY

1.1. SATURN elements

The essence of the methodology followed was to take the KTM SATURN model output PCU flows (1.0 * light vehicles plus a factor greater than one, typically 2 * heavy vehicles) and use the turning flows as the input flows for a SIDRA network model, which was to be used for planning purposes rather than for design purposes. This is standard practice for simulation modelling as well.

In terms of the SATURN modelling, the Beca KTM SATURN model was revised to provide better calibration within the specific area of interest. This is good practice since the KTM model is itself dependent on the Greater Wellington Strategic Transport Model(s).

It is understood that the VISSIM simulation model was unsuitable for use (refer to section 3.19 of the modelling method report) at the critical time and hence the expedient creation of the SIDRA model. Importantly sections 3.7 and 3.13 of the modelling method report indicate that the approach was common with VISSIM.

Furthermore section 3.12 indicates that the same airport development (net) generated trip rates were applied as per Plan Change 73 which apparently have been independently agreed upon. The trip rates, which include the existing Mega Mite 10 and approximately 8,000 sqm supermarket, appear low as they apparently exclude passby and diverted trips.

The SIDRA model thus has lower than expected turning flows into and out of the three modelled airport accesses use (refer to section 4.8 of the modelling method report), in particular the existing Friendship Place access. The SIDRA modelled flows do precisely match the spreadsheet airport activities generated trips, but apparently the Beca VISSIM model had lower flows which is difficult to understand. Both have flows along Kapiti Road less than expected (refer to section 4.7 of the modelling method report).

This is undesirable as a model is supposed to be a mathematical representation of reality and clearly the flows for the existing situation (2015/2016) are lower than they should be. This means that the results need to be carefully interpreted and used in a suitable manner for comparative and not absolute, purposes.

1.2. SIDRA model area

The model study area extended from the Toru Rd/Teito St/airport access in the southwest, to the Ocean Rd roundabout on Kapiti road in the northwest and to the new signalised intersection of Arawhata Road with Kapiti Road in the southeast. This then comprised five sets of signalised intersections but excluded the remaining nearby three sets of signals along Kapiti Road that are nearby to the southeast.

The SIDRA network details are given in the table below, noting that the 3 crossroads signals and 3 priority controlled Tee intersections along Kapiti Road (east) highlighted in cyan are not part of the airport model, and likewise the 3 roundabouts and the link road Tee intersection that are highlighted in blue.
Thus the airport model comprises 15 intersections (the allowable SIDRA limit is presently 20 sites).

Table 1: Modelled intersection summary details

Site	Location name	Appr Form, Phasing, R+Y	Lane arrangement (S,E,N,W)	Approach distance	Coordn; Crit gap	Notes
	KAPITI ROAD EAST					
0	Friendship Pl/'Ford' Airport 1 roundabout	4 leg rotary, 5+5 m; 2 circ	LTR; LT,R; LTR; LT,R	E: 365m		Oct'16 single circ. 50m R bays
1	Te Roto Dr	3 leg signals A,B,B- 2,0+3	-; T,T,R; L,R; LT?	E: 40m	E44, Wp	R 99m. W exit 60 m W should be LT,T,T
2	Milne Dr	3 leg signals A,B,B- 2,0+3	L,R; L,T,T; -; T,T,R	E: 170m	E44,W44	R 97m, L 30m bays
3	Expressway W ramps	3 leg signals A,B2,B3 *+2	LT,R; T,T,R; 2; LT,T,T (4th leg exit)	E: 60m	E55,W45	Dec'16 25m R, 100m T bays
4	Expressway E ramps	3 leg signals A,B,C *+2	1;LT,T,T; LT,R; T,T,R (4th leg exit)	E: 180m	E44,W55	Dec'16. LT 100m, T 50m, R 25m bays
5	Arawhata Rd	3 leg signals A,B,C *+2	-; T,R; L,R; LT,T	E: 170m	E33, W44	Nov'16. K Rd R 30m, R 60m bay. E exit 50
6	Larch Grove / Brett Ambler Way Aquatic	4 leg signals A,B,C *+2	LTR; LT,R; LTR, LT, R	E: 100m	Epp, Wpp	R 25m bays.
7	Warrimoo St	Tee GW	-; T,R; L,R; LT	E: 50m	TWSC calib	R 15m bays
8	Ngahina St	Tee GW ?	L,R; LT; -; T,R	E: 110m	TWSC calib	R 15m bays Should be Stop.
9	Rimu Rd/Waimarie Ave	4 leg signals A,B,E,C *+2,4	L,TR,R; L,T,R; LTR; LT,R,R	E: 30m (S: 90m)	S444 ? E444, Wppp	L 75; R 15; R 50,25 S exit 60m
10	Kapiti Lights	Tee GW	L,R; LT,T; -; T,T,R	E:130	TWSC calib	R 15m bays
11	Amohia Street SH1	4 leg signals A,B,E,C *+2,4	L,T,T,R; LT,T,R; LT,T,R; LT,T,R	(E: 1000)	Eppp,W444	S 10,25; E 50,25; N 100,50; W 25m bays
	KAPITI ROAD WEST					
a	Lodestar Place (NW) Airport 2 Tee junction	Tee GW (opp Lake View Ct)	L,R; LT; -; T,R	E: 260m	TWSC calib	S R 50; W R 15m bays
b	Langdale Ave	Tee GW	-; T,R; L,R; LT	E: 100m	TWSC calib	R 15m bays
c	Cedar Dr	Tee GW	-; T,R; LR; LT	E: 315m	TWSC calib	R 10m bay
d	Hurley Rd	Xroad GW	LTR; LT,R; LTR; LTR	E: 345m	TWSC calib	R 20m bay
e	Ocean Rd/Bluegum Rd roundabout	4 leg rotary, 4+5 m; 1 circ	LTR; LT,R; LTR; LT,R	E: 295m W:100m		Oct'16 single circ. 50m R bays
	OCEAN/BLUEGUM/TORU					
f	Ocean / Bluegum 1	Tee GW	LT; -; TR; LR	N: 205m	TWSC calib	
g	Ocean / Bluegum 2	Tee GW	TR; LR; LT; -	N: 10m	TWSC calib	
h	Bluegum Rd / Toru Rd	Xroad GW	LTR; LTR; LTR; LTR	N: 100m	TWSC calib	
i	Toru/Teoti St/airport	Tee GW	LR; LT; -; TR	(E: 175)	TWSC calib	
	RIMU ROAD					
13	Iver Trask Place/ Rimu Rd	3 leg rotary, 6+6 m; 1 circ	LT; -;TR; LR	N: 120m		
14	Main PC72A / Rimu Rd/ Coastlands	4 leg rotary, 10+6m;1 circ	LTR; LTR; LTR; LTR	N: 250m		New layout
15	Ihakara St / Rimu Rd	4 leg rotary, 10+6m;1 circ	LTR; LTR; LTR; LTR	N: 350m W: 600		
16	Ihakara St /Link road	Tee GW	-; TR; LR; LT	N: 900m E: 600m		New connection

Note: All the above sites were included in the SIDRA files provided as well as some "testing" variants.

The network did not include the left in only access (from Kapiti Road southeast approach) to Mega Mitre 10 but this is considered acceptable. Unfortunately every site had the default site ID of 1, suggesting that the creation of the models was done in a very tight timeframe.

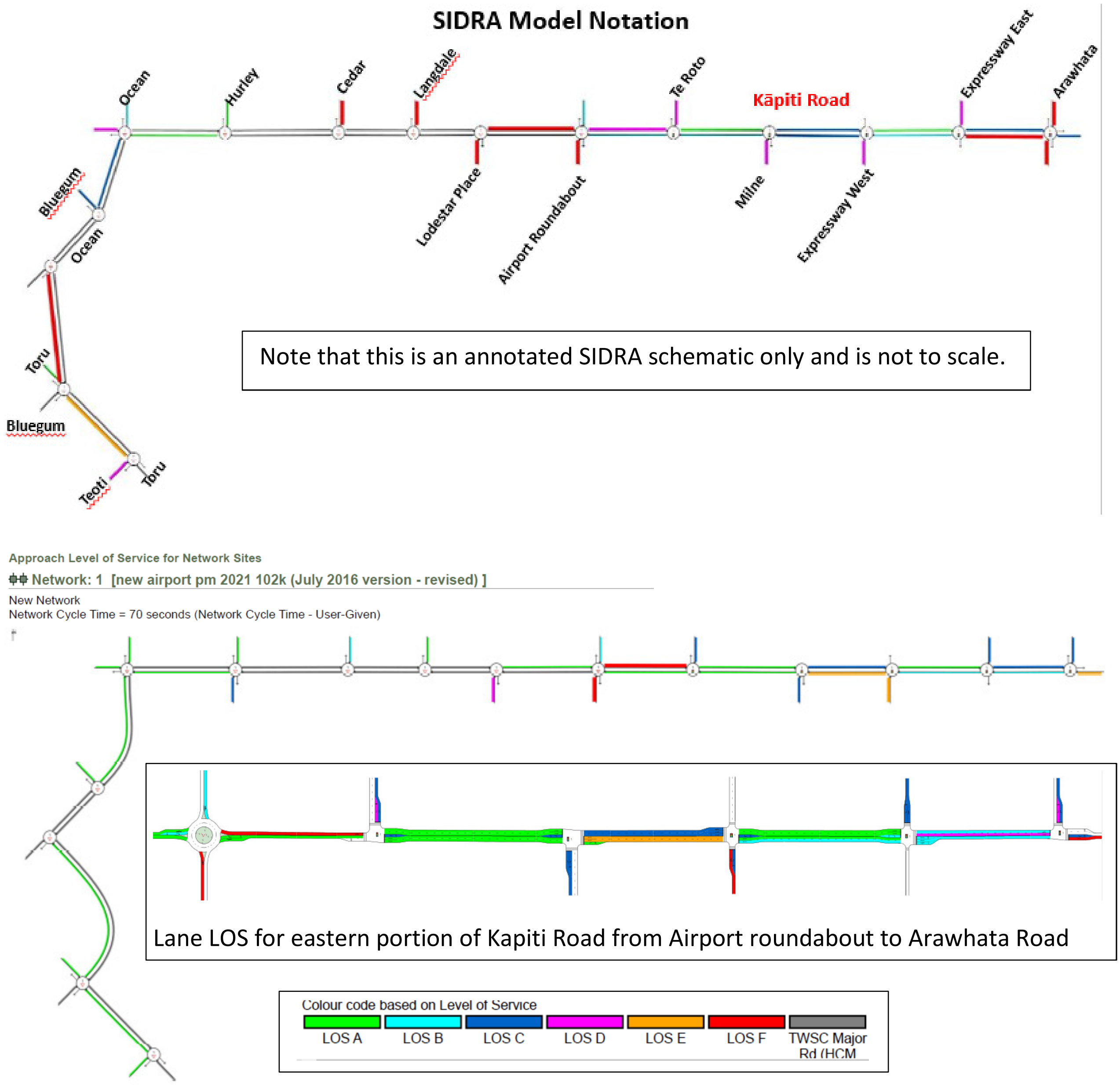


Figure 1: SIDRA Airport Model notation and example Level of Service output

1.3. SIDRA general elements

Whereas the SIDRA default values were used in nearly all cases, the saturation flow rates were modified to match Austroads (refer section 4.6 of the modelled method report). This is acceptable, as is changing the desired network speed from 50 (60 in Australia) to 55 k/h. Typically the speed limit would be used (i.e. 50 km/h) but this only affects the calculated network level of service (LOS) based on the speed efficiency (ratio of the network speed to this input value). Actuated signal control was also applied whereas it would be usual to specify fixed timing consistent with SCATS for the PM peak. The yellow default was reduced from 4 to 3 seconds for Te Roto and Milne Drives as is commonly done for NZ (changed for one phase to 0 sec) and reduced to only 2 seconds for the new signals but for which the red was varied (12 seconds for side road Phase A and 0,2 seconds for the next two Kapiti Road phases).

SIDRA version 6.1 was used to develop the Airport (and City Centre) model. Whereas the current SIDRA version 7.0 (latest is 7.0.5) can automatically determine suitable common cycle times and offsets for signal coordination along Kapiti Road, this was not possible for version 6, instead relying on manual optimisation (refer to section 4.11 of the modelling method report). Unfortunately re-running version 6.1 with 7.0 best requires modification of the site input files as use of manual arrival progression factors overrides program calculation so the progression factors need to be reset to program. In addition SIDRA 7.0 allows for common control grouping whereby two closely spaced intersections are controlled by the same (single) controller, which is the case for the Te Roto Drive and Milne Drive intersections.

The SIDRA 6.1 PM peak models used a user defined 70 second cycle time for the 2021 with 102,900 sqm GFA. Presumably this was established by manually trying different cycle times but there is no evidence provided to support this.

Necessitating manual inputs makes it problematic for predicting the future so it is strongly recommended that the SIDRA 6.1 models be converted to utilise the SIDRA 7 automatic signal optimisation capabilities.

SIDRA 6.1 did not allow routes to be created to allow signal timing and coordination to be easily seen. Examination of the results for 2021 102.9k GFA revealed poor westbound coordination as modelled but which could potentially be significantly improved.

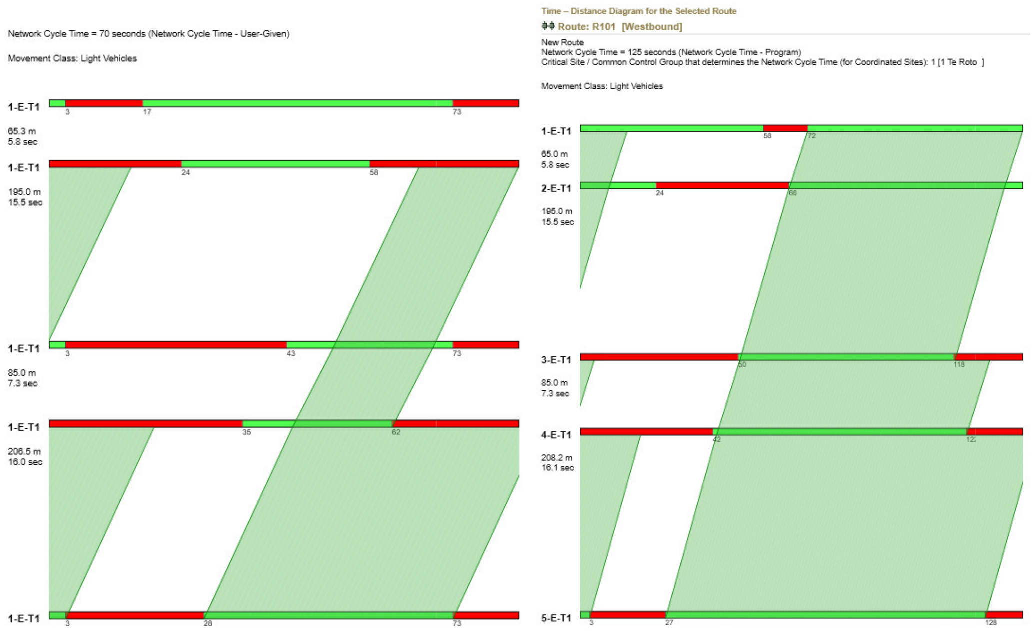


Figure 2: Westbound coordination for provided file (70s cycle) and example modified file (125s cycle)

Examination of the results, where able (I was unable to run SIDRA 6.1), also indicated convergence issues.

Table 2: Modelled network summary details

My Ref	GFA	Largest change DoS, cycle time	Network Speed, LoS, arrival flow	Worst delay, Lane changes	Notes
A3d	new airport pm 2021 102k (July 2016 version - revised)	5.2%, 70 sec 10 iterations	15.3 km/h, F, 23,511 / 24,891	493/494 sec, 561 Te Roto	15.5 km/h for Ver 7.0.5
B3f	new airport pm 2031 340k (July 2016 version)	11.3%, 70 sec 10 iterations	8.6 km/h, F, 30,463 / 34,503	1233/1234 s, 518 Te Roto	Wrongly named 2021
C2a	new airport pm 2017 Base v8 23k (Nov 2015)	0.9%, 70 sec 9 iterations	30.1 km/h, D, 21,167 / 21,167	40/40 seconds 452 Te Roto	Converted to .sip7 (7.0.5)

The above table reveals that the default target 1.0% largest change in the Degree of Saturation (DoS) was not reached for the future runs before the maximum of iterations, set at the default 10, was reached (approximately one minute run time per iteration on my i7 laptop). The largest changes were large and there were some large lane changes for the Te Roto Drive southeastern approach emanating from the downstream merge and also the need for right turning vehicles to change into the right turn lane into Te Roto Drive.

The only vehicle class used was Light vehicles, since the SATURN output flows were PCUs. While this is acceptable for strategic purposes, assuming that the KTM had more than one user class the LV and HV should have been entered separately. Or else some assumption about the %HV could have been made, especially if SIDRA was run from the freely available application spreadsheet which would make sense.

It would have been clearer too if a special user class(es) was used to note which trips were generated and which were not (that is passby or diverted). In this manner the model turn flows into the airport site could have been corrected to match what is expected in reality and not to exclude the passby and diverted trips. Presumably this could have been readily handled if running SIDRA from the APL spreadsheet.

It was noticed also that the 2021 Peak Flow Factors (PFF) for the two expressway and Arawhata Rd signals were specified as 100%, which is okay for strategic purposes but differs from the rest of the site; they should all be the same. From Table 2 there is no evidence of capacity reduction for 2017 (arrival flows match the demand flows), while for 2021 (103k GFA) there is some capacity reduction such that the demand flows are not quite reached.

1.4. SIDRA specific elements

The Te Roto Drive intersection was modelled with only a single shared left/through (LT) lane whereas there is also a through short lane and a right turn short lane and three exit lanes to Milne Drive. The pedestrian crossing distances are set by default to program using the lane and median widths (there is also a median) and so this might affect the Te Roto phase time (it is preferable to input the pedestrian crossing distances). The Milne Drive intersection was also modelled with a short left, through and through lane whereas it is a full shared left/through, though and short through lane with three exit lanes to Te Roto Drive. These appear to be the critical intersections the study area and so they should be correctly modelled in the first instance.

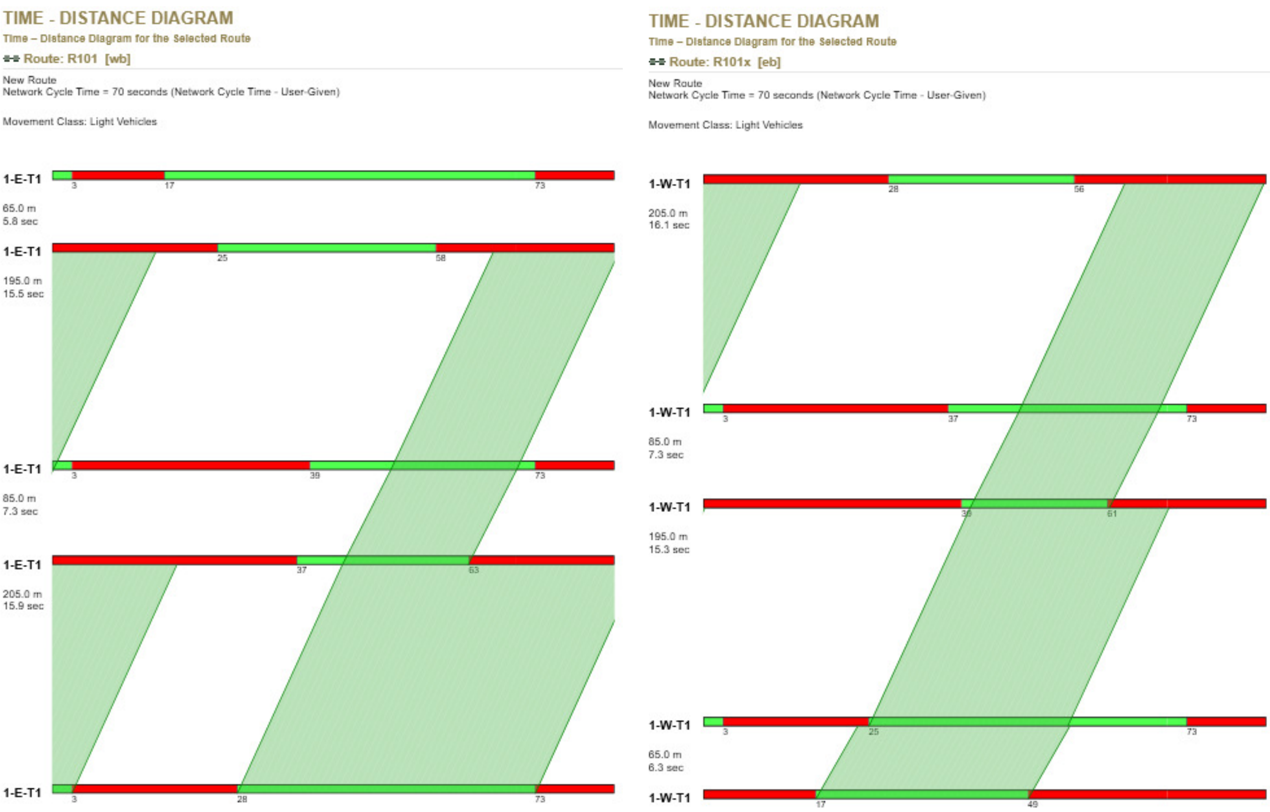


Figure 3: Westbound (left diagram) and eastbound (right diagram) coordination for 2017 with 23k GFA

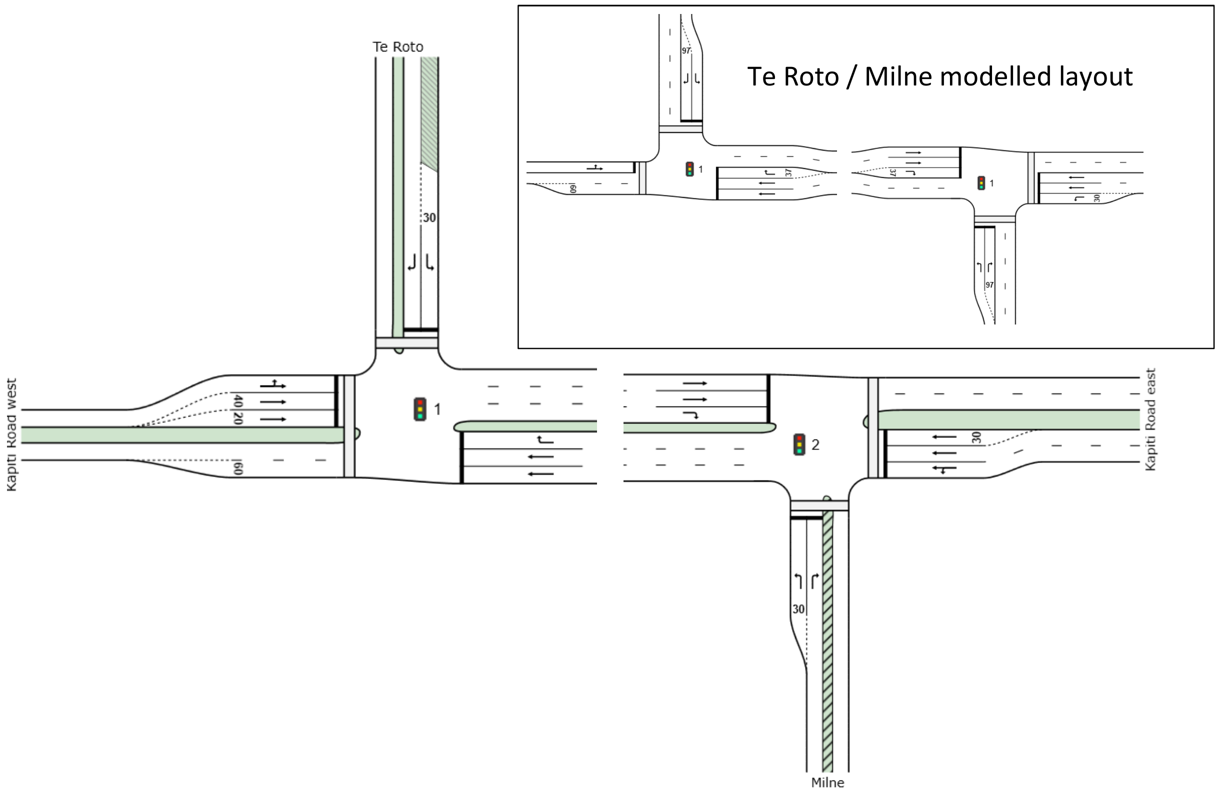


Figure 4: Revised layouts tested for Te Roto Drive and Milne Drive (40 m gap in between)

It is noted though that the intersection layout has been changing in recently; the KCDC aerials show the old layout with only one through lane in each direction between the Drives whereas at least the model had 3.

The modelled intergreen (yellow + red) and number of phases for the sites are given in the Figure below.

Sequence **Opposed Turns**

Phase Data

Phase:	A	B	B -
Variable Phase	☐	☐	☐
Reference Phase	◉	○	○
Phase Time (optional)	0 sec	0 sec	0 sec
Phase Frequency	Program	Program	Program
Yellow Time	3 sec	3 sec	3 sec
All-Red Time	2 sec	2 sec	0 sec
Dummy Movement Data:			
Dummy Movement Exists	☐	☐	☐
Minimum Green Time			
Maximum Green Time			

There must always be a phase (and only one phase) checked as the Reference
The first phase will be used as the default Reference Phase.

Detection Data

	Major Movement	Minor Movement
Effective Detection Zone Length	4.5 m	4.5 m

Actuated Signal Data

	Major Movement	Minor Movement
Maximum Green Time	90.0 sec	20.0 sec
Gap Setting	2.5 sec	2.0 sec

Sequence **Opposed Turns**

Phase Data

Phase:	A	B2	B3
Variable Phase	☐	☐	☐
Reference Phase	◉	○	○
Phase Time (optional)	6 sec	60 sec	6 sec
Phase Frequency	Program	Program	Program
Yellow Time	2 sec	2 sec	2 sec
All-Red Time	12 sec	0 sec	2 sec
Dummy Movement Data:			
Dummy Movement Exists	☐	☐	☐
Minimum Green Time			
Maximum Green Time			

There must always be a phase (and only one phase) checked as the Reference
The first phase will be used as the default Reference Phase.

Detection Data

	Major Movement	Minor Movement
Effective Detection Zone Length	4.5 m	4.5 m

Actuated Signal Data

	Major Movement	Minor Movement
Maximum Green Time	90.0 sec	20.0 sec
Gap Setting	2.5 sec	2.0 sec

Figure 5: Phase sequence details Sites 1 and 2 (left) and Sites 3 and 4, 5 and 6 Expressways (right)

The pedestrian crossing distances were input for the new signals as 10 m for Kapiti Road and 12 m for the side roads. The latter should be 18m for Arawhata Rd at which the Kapiti Road crossing distance is 15.5 m. For consistency all the pedestrian crossing distances at signals should be input (20-22 m for Te Roto/Milne).

1.5. Friendship Place roundabout

The Friendship Place roundabout was modelled with two through lanes along Kapiti Road which was the arrangement until very recently. Following a safety audit undertaken by David Wanty at the request of Council, there is now one through lane operating in each direction.

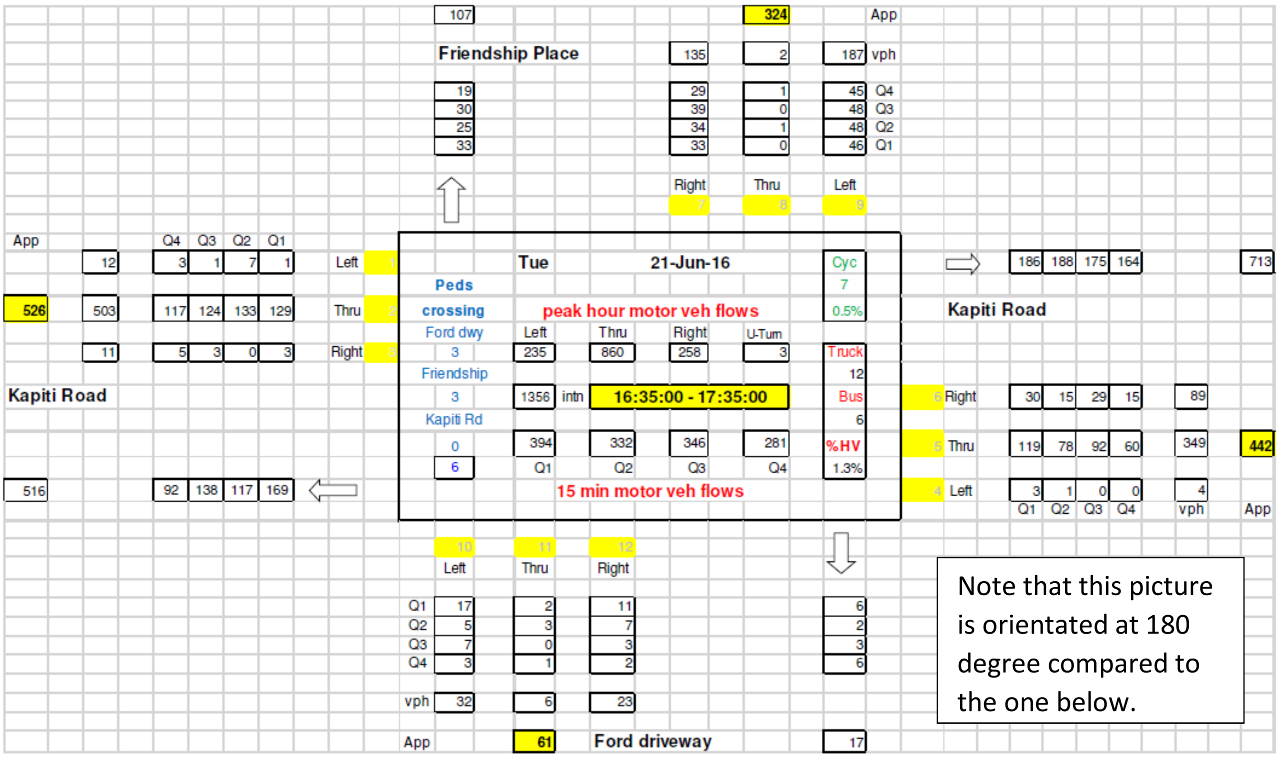


Figure 6: Observed turning flows from 4:35 – 5:35 pm (excludes the upstream left in only from the east)

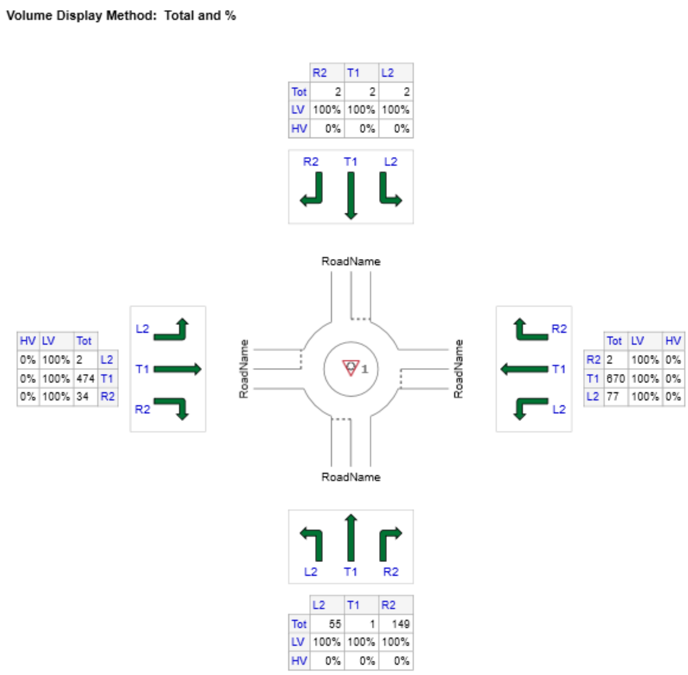


Figure 7: Modelled 2017 (5-6) PM model (23k GFA) input flows

Comparison reveals that the modelled 2017 Kapiti Road flows are substantially higher, possibly suggesting that the existing development GFA is much less than 23,000 sqm (includes consented).

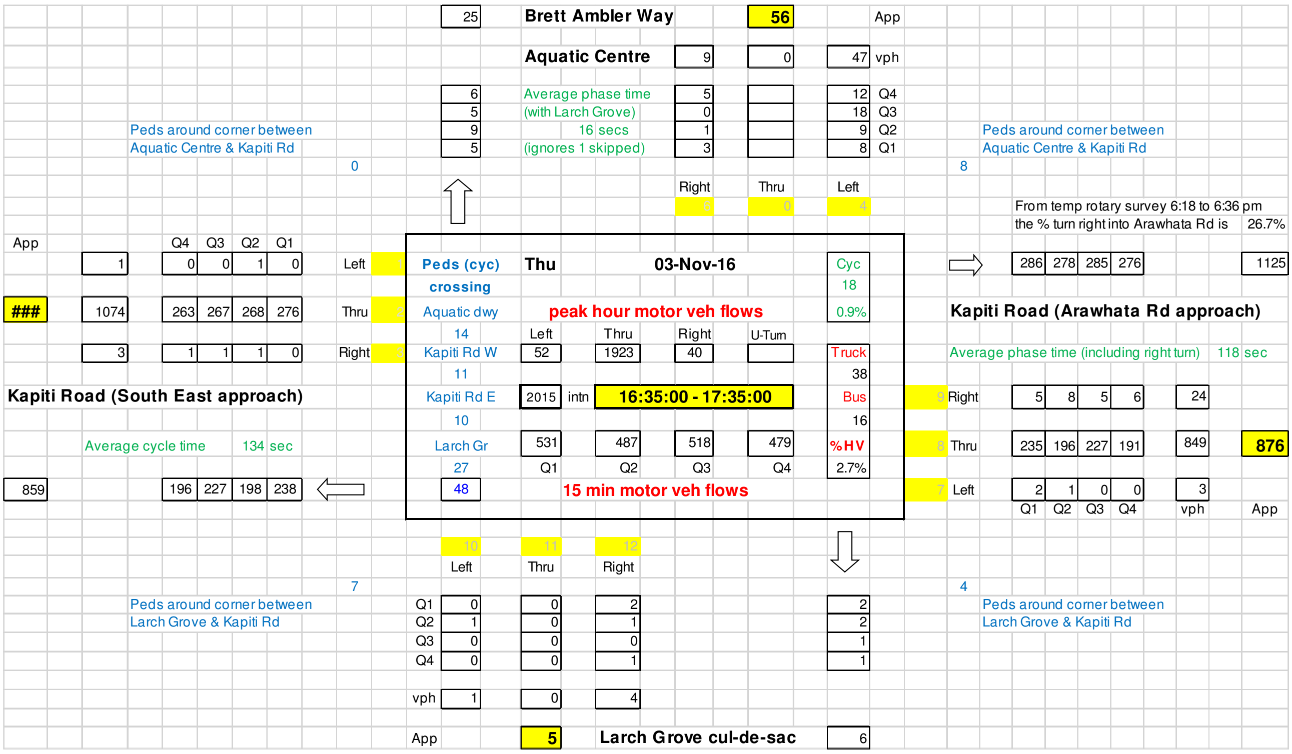
The model has far more traffic turning right out of Friendship Place than left, but the observed flows has more turning left. This however might be consistent with a high passby component not included in the modelled turns out.

From discussion with the modeller it is estimated that the Airport 23k GFA model had an additional consented 6k? sqm of GFA accessed from Friendship Pl.

1.6. Aquatic Centre signals and Arawhata Road Tee intersection

The signals at Brett Ambler Way were surveyed and revealed the following peak hour flows, and average main phase times (the Kapiti Road phase includes any (e/b) lead right phase that occasionally occurs).

In addition that turning movements at Arawhata Road Tee intersection were derived from the surveyed factored flows from 6:18 to 6:36 pm in proportion to the 1125 vph westbound and 876 vph eastbound values in the figure below.



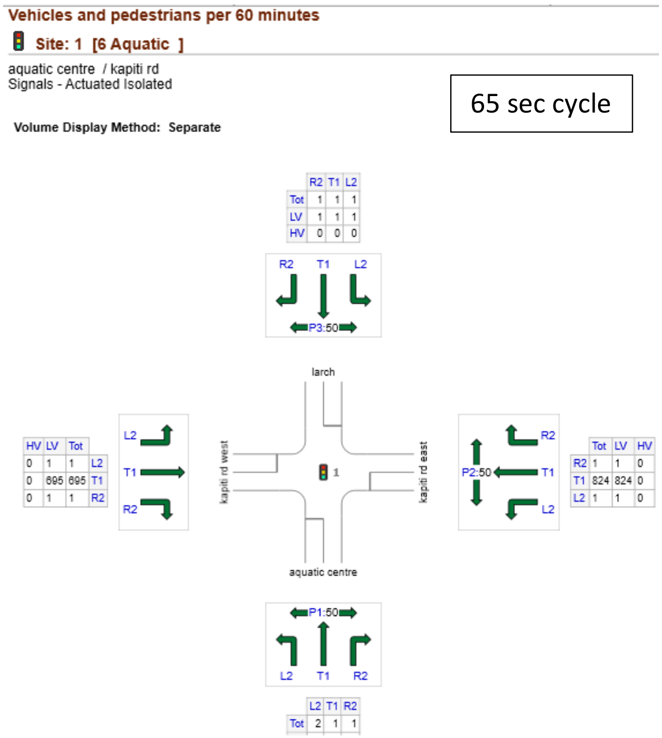
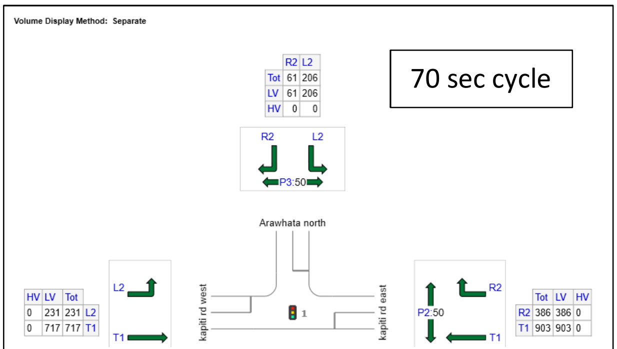


Figure 8: Aquatic Centre and Arawhata Road turn flows



The modelled 2017 PM peak (23k GFA) had 903 westbound and 386 (30%) turning right compared to observed/estimate of 825 w/b and 300 (27%) turning right into Arawhata Road.

The model had 717 eastbound and 231 (24%) turning left compared to observed/estimate 597 through and 112 (16%) turning left.

For the left and right out of Arawhata Road the model had 206 and 61 (29%) and compared to observed/estimate 279 and 74 (21%) resp.

2. SIDRA MODEL REVISIONS AND RERUNS

2.1. Convergence issue for future years

Revisions were made to the model in line with the above to establish if these will help the identified convergence issue for future years with larger scale airport development, for example 2021 with 103k GFA. Fixed timing signal coordination for the westbound direction from Arawhata Road to Te Roto Drive was selected allowing the model to choose the common cycle time and phase times and offsets. Maximum 150 second cycle time and 5 second increments was selected with the number of iterations set at the maximum 20 (keeping the default 1.0% DoS change).

Initial attempts had proved unsuccessful at improving convergence thus requiring closer examination of the model as inferred from the above details. However the convergence outcome was again poor with the maximum number of iterations reached after 26 minutes; the chosen selected a 150 second maximum cycle time which indicates difficulties and results as below.

Table 3: Revised modelled network summary details (using SIDRA version 7.0.5)

My Ref	GFA	Largest change DoS, cycle time	Network Speed, LoS, arrival flow	WB route speed, LOS, arr/demand	Notes
A2d	new airport pm 2021 102k (July 2016 version - revised)	5.2%, 70 sec 10 iterations	15.3 km/h, F, 23,511 / 24,891	493/494 sec, 561 Te Roto	
A2d (i)	DKW airport pm 2021 102k (July 2016 version - revised)	7.1%, 150 sec 20 iterations	10.1 km/h, F, 23,289 / 24,891	WB 8.2, EB 16.6 WB 6475 / 6765 EB 5263 / 5833	
A2d (ii)	DKW airport pm 2021 102k (July 2016 version - revised)	11.2%, 90 sec 20 iterations	14.6 km/h, F, 23,626 / 24,891	WB 18.0, EB 24.3 WB 6190 / 6765 EB 5204 / 5833	With CCG?
A2d (iii)	DKW airport pm 2021 102k (July 2016 version - revised)	1.7%, 70 sec 10 iterations	19.1 km/h, E 24,081 / 24,891	WB 21.1, EB 20.4 WB 6585 / 6765 EB 5489 / 5833	Rev Te Roto & Milne Drives
A2d (iv)	DKW airport pm 2021 102k (July 2016 version - revised)	1.5%, 70 sec 10 iterations	16.1 km/h, F 24,061 / 24,891	WB 20.8, EB 23.4 WB 6565 / 6765 EB 5491 / 5833	Rev Exp'ways & Arawhata

The above table reveals that the default target 1.0% largest change in the Degree of Saturation (DoS) was not reached with unsettled results. It also indicates that the program selected cycle time (150 seconds, initial runs indicated 125 seconds) is sub-optimal which is of concern. It is unknown why the unsettled results arise or why the program cycle time selection is struggling but further investigation is warranted, especially of the phasing arrangement for the Te Roto Drive/Milne Drive staggered Tee intersection operating under a single controller. Clearly this is a matter of "less haste, more speed" required.

A two site network of just the Te Roto and Milne Drives Tee intersections was created. Initially similar problems arose with cycle times of 45 and 150 seconds for the no CCG and CCG variants respectively.
Changes were then made to the phasing where it was noticed that the pedestrian movement across Kapiti Road clashed with the Kapiti Road B- phase, and filter right turn was allowed at Te Roto Drive.
Rerunning the no CCG option resulted in a 70 sec cycle time being selected and 1.6% change in DoS after 10 iterations, or 1.8% after 20 iterations. Amending the 1% restriction to 2% (the maximum allowed is 10%) resulted in 1.8% after 3 iterations.
Rerunning the CCG option resulted in a 150 sec cycle time being selected and 1.7% change in DoS after 6 iterations, suggesting that the CCG option for the staggered Tee should be ignored even though it appears to operate with a single controller (and the Aquatic Centre traffic signals currently operate with an average cycle time of 134 seconds).
Running the whole network at 70 second cycle resulted in a 1.7% change in DoS after 10 iterations with less capacity reduction – refer Ref A2d (iii) in the table above.

A network model of the expressway signals and the Arawhata Road signals was then created and the phasing timings were changed to standard values, plus some of the phasing (pedestrian conflict and removal of filter

right at Arawhata Road as have two opposed through lanes). Running with westbound coordination as before the program cycle time selected by SIDRA was 60 seconds with 1.9% DoS after 6 iterations.
These changes were automatically applied to the whole network model which was then run again, the final results being those for A3d (iv) in the table above.
The last two runs show that acceptable convergence can be achieved from changes.

2.2. Convergence issue reruns

Following correspondence with the modeller, additional information was provided as follows, which included 2017. For the 62k and above GFA and above the convergence criteria for the re-runs were relaxed to a maximum of 20 iterations and 2.0% change in DoS, the latter relaxed to 3% or 4% for other GFA.

Table 4: Modelled network convergence summary details (assumed all runs were at 70 second cycle)

My Ref	GFA	Original (6.1) Largest change DoS, cycle time	Network Speed, LoS, arrival flow /demand flow	Re-test (6.1/7.0) Largest change DoS, cycle time	Network Speed, LoS, arrival / demand flow
C1a	new airport pm 2017 23k (July 2015 ver 8 - revised)	1.0%, 70 sec 9 iterations	30.2 km/h, D, 21,167 / 21,167	1.0%, 70 sec 9 iterations	30.3 km/h, D,
C1b	new airport pm 2017 42k (July 2015 ver 8 - revised)	1.1%, 70 sec 10 iterations	27.0 km/h, E, 22,792 / 22,938	1.0%, 70 sec 10 iterations	27.3 km/h, E,
C1c	new airport pm 2017 62k (July 2015 ver 8 - revised)	10.0%, 70 sec 10 iterations	18.0 km/h, E, 23,764 / 24,963	1.7%, 70 sec 8 iterations	18.0 km/h, E,
C2a	new airport pm 2017 23k (Nov 2015 version - revised)	1.0%, 70 sec 9 iterations	30.2 km/h, D, 21,167 / 21,167	1.0%, 70 sec 9 iterations	30.3 km/h, D, 21,167 / 21,167
C2b	new airport pm 2017 42k (Nov 2015 version - revised)	1.4%, 70 sec 10 iterations	20.2 km/h, E, 23,469 / 24,428	1.4%, 70 sec 10 iterations	20.2 km/h, E,
C2c	new airport pm 2017 62k (Nov 2015 version - revised)	10.0%, 70 sec 10 iterations	12.7 km/h, E, 24,558 / 26,851	1.4%, 70 sec 11 iterations	12.6 km/h, E,
A2d	new airport pm 2021 102k (July 2016 version)	5.2%, 70 sec 10 iterations	15.3 km/h, F, 23,581 / 24,891	3.1%, 70 sec 6 iterations	15.9 km/h, F,
A3f	new airport pm 2031 340k (July 2016 version)	11.3%, 70 sec 10 iterations	8.6 km/h, F, 30,463 / 34,503	2.6%, 70 sec 16 iterations	10.5 km/h, F,
B3a	new airport pm 2031 23k (July 2016 version)	3.9%, 70 sec 10 iterations	25.3 km/h, E, 23,106 / 23,545	1.8%, 70 sec 14 iterations	25.8 km/h, E,
B3b	new airport pm 2031 42k (July 2016 version)	6.7%, 70 sec 10 iterations	23.5 km/h, E, 24,579 / 25,270	2.8%, 70 sec 14 iterations	23.7 km/h, E,
B3c	new airport pm 2031 62k (July 2016 version)	17.7%, 70 sec 10 iterations	21.1 km/h, E, 26,442 / 27,446	2.0%, 70 sec 20 iterations	22.1 km/h, E,
B3d	new airport pm 2031 102k (July 2016 version)	11.5%, 70 sec 10 iterations	19.3 km/h, E, 28,754 / 30,148	3.4%, 70 sec 13 iterations	19.3 km/h, E,
B3e	new airport pm 2031 203k (July 2016 version)	21.5%, 70 sec 10 iterations	12.4 km/h, F, 31,668 / 34,386	3.3%, 70 sec 16 iterations	13.0 km/h, F,
B3f	new airport pm 2031 340k (July 2016 version)	16.3%, 70 sec 10 iterations	9.0 km/h, F, 33,799 / 38,284	3.6%, 70 sec 18 iterations	8.7 km/h, F,

My Ref cXg naming: c: C=2015 runs for 2017, A=additional runs, B=July 2016 runs; X: 1=2017, 2-2021, 3-2031; and
g: a=23k (existing plus consented), b=42k, c=62k, d=103k, e=203k, f=340k (re-test using 7.0.5)

The above table reveals that it is necessary to increase the allowable number of iterations to the current maximum of 20 and to relax the maximum change in Degree of Saturation criterion to generally 2.0% for the lower levels of development (62k GFA and below) and to 3.5% for higher development levels.

It is considered that relaxing the later criterion is acceptable, but the results are also contingent on the site modelling (refer the difference between Table 3 A3d (iii) and (iv) network speed results) and importantly the user selected cycle time which was left unchanged at a short 70 second cycle (the existing average cycle time for the Aquatic Centre traffic signals exceeds 130 seconds).

2.3. Summary reporting

SIDRA version 6.1 was only able to display results by approaches but version 7.0 allows displaying results by lane which is more meaningful and helpful. Showing the results for the probability of blocking back and capacity reduction is also useful, although version 7 only shows four colour display with >30% between the worst range (red colour) shown (I have personally requested showing 6 bands with >50% the upper limit). It is considered that the capacity reductions made by SIDRA are indicative of a need to make network improvements as one might expect from the airport generating substantial additional demands on the network.

For my run A2d (iv), minor (0-10%) capacity reduction applied to the Te Roto Drive short (30 m) left turn bay (could easily lengthen the bay by restricting on-street parking) and to the northwestern approach of Te Roto Drive (heavily utilisation of the single through lane). Unsurprisingly the short (30 m) median through lane at Milne Drive leading directly to the right turn into Te Roto Drive introduces capacity reduction (> 30%) but it should be able to be lengthened by making better use of the existing wide flush median. Surprisingly the median eastbound through lane at the eastern expressway signals also suffered capacity reduction exceeding 30%, which I surmise further modelling revision might resolve.

The impact of the network changes would also be more readily discernible with reporting of route summaries, something that was not possible in SIDRA 6.1. Giving only the overall network result masks the impact in critical areas or even individual sites which could be performing at unacceptable levels but which might be amenable to straightforward mitigation measures but at significant cost.

The LOS plots for the approaches along Ocean Road, Bluegum Road, Toru Road and Teoti Street are no worse than LOS D with full site development (2031 340k GFA) and so their results could be separated out from the results along Kapiti Road, which could also be split into the signalised portion (westbound and eastbound being treated separately to reflect different level of coordination) and the non-signalised portion.

By way of example the westbound and eastbound routes between and including Arawhata Road and Lodestar Place were created and route summary information added to the network results previously tabulated. These reveal substantive capacity reductions in the eastbound direction (so possibly it should have been modelled as being coordinated for the eastbound direction?). In addition northbound and southbound routes from the Toru Road airport access to the Ocean Rd/Kapiti Rd intersection were added.

Table 5: 2031 340k modelled network summary details

Ref	GFA	Largest change DoS, cycle time	Network Speed, LoS, arrival flow	Route speed, arrival/demand	Route speed, arrival/demand
A3f	new airport pm 2031 340k (July 2016 version - revised)	11.3%, 70 sec 10 iterations	8.6 km/h, F, 30,463 / 34,503	WB 13.1, EB 6.6 WB 6814 / 7763 EB 6287 / 8231	SB 36.2, NB 28.6 SB 788 / 824 vph NB 622 / 622 vph

It had been aforementioned that the other three signalised sites along Kapiti Road could or should be included in the network but since writing that statement the survey was undertaken of the Aquatic Centre signals which indicated a high cycle time. It is not known what the cycle time presently is at the Te Roto Drive / Milne Drive signals but the model indicates 70 seconds and so they may be in a different SCATS subsystem from the signals nearer SH1. However with the expressway completed the existing traffic patterns will change and demand decrease at the SH1 signals such that they (and Rimu Road) could possibly also satisfactorily operate at a substantially lower cycle time. Of course very large scale development of the Airport zone could impact on trips to/from Coastlands and vice-versa with substantial expansion of Coastlands. But such impacts would be captured in the external SATURN modelling.

2.4. Summary of issues

In summary then the SIDRA models can achieve better convergence if the number of iterations is increased to the current maximum of 20 iterations and if the maximum percent change in the Degree of Saturation is relaxed from 1% to 2% for lower levels of development and up to 3.5% for higher levels of development. It is considered that the 2% limit is acceptable and the 3.5% is tolerable but a lower level should be applied given that improvements to the network would likely have been made before such development levels were reached.

It would seem for this network that modelling a common cycle time for the two Te Roto Dr / Milne Dr sites is not working as well as leaving the program to coordinate their offsets but this would need further checking. It is considered that the optimum cycle time and offsets should be left for the program to decide since the results can differ a lot depending on the modelling of the cycle time, offsets and phasing.

2.5. Model revisions

It is recommended that the base SIDRA site models should be revised in the near future to reflect the recent and impending changes, and that other changes consistent with the manner that SIDRA 7 operate should be made with the networks re-run from an APL spreadsheet.

It is recommended that the passby and diverted trips be assigned to a SIDRA special user class(es) so that the actual number of trips to/from the airport zone(s) are included. This would significantly improve clarity and help in identifying potential mitigation measures as may be required.

3. District Plan thresholds

With respect to whether Integrated Transport Assessments (ITA) are needed at the specified thresholds given in the Proposed District Plan (PDP), while the specified thresholds are useful indicators, they cannot be relied upon to establish the impacts of continuing development of the Airport zone and the effect of potential mitigation measures. Furthermore, having an Airport development 1 sqm smaller than a threshold will clearly have a very similar effect to an Airport development 1 sqm greater than the same threshold so in principle the thresholds should not be treated as the "trigger point" for a certain type of ITA.

On this understanding, with suitable revisions the SATURN model could be used to establish the input flows for the SIDRA airport model from particular airport zone activities and the latter could then help identify where mitigation measures might be needed. By modifying the appropriate sites in the network model, SIDRA could then be used to examine mitigation measures and their impact compared to the planning baseline.

Notwithstanding the above, the results as presented indicate a clear deterioration in the network performance between the (existing plus consented) 23k GFA (Stage 1) development level and 42k and 62k development levels and to 102k (103k), 203 and 340k levels, the drop in the overall network speed between the thresholds appearing to be being about 3 km/h on the general results as presented (noting that the modelled flows are lower than the demands). The approximate 3 km/h overall network speed reduction would equate to a larger drop in the average speed along the eastern portion of Kapiti Road.

This supports the principle in the Proposed District Plan that assessments at or around these thresholds are needed.

However it is clear that should higher trip generating activities be proposed than anticipated in the trip generating levels assumed in the Proposed District Plan, comparing the C2 and C1 network speeds reveals that the 43,050 sqm GFA development might require additional (as yet unspecified) mitigation measures well in advance of the completion of Stage 2 (with Stage 1 being completion of 'current' consented development). The implication of the Proposed Plan Change which would allow higher generating activities would be the need to lower all five currently specified GFA development thresholds for the Airport, including new limitations on the Mixed Use Precinct and full Airport development.

Alternatively given that the trips generated is the explanatory viable and not the actual development gross floor area, an alternative would be that the generated trip levels also trigger off the requirement for an assessment and not just the Stage GFA levels (as were originally envisaged).

4. CONCLUSION AND RECOMMENDATIONS

4.1. SATURN/SIDRA Model

The SATURN/SIDRA modelling approach is in principle suitable for the intended purpose.

By supposition I conclude that the SIDRA model was probably undertaken in a very short timeframe and the "less haste, more speed" approach was compromised. SIDRA is a complex model and Kapiti Road is a complex situation, with the situation not helped by its continual recent (and impending) changes. I recommend that changes to the existing SIDRA model(s) be made prior to the model being "put to task".

The SIDRA model was developed for strategic purposes only; it is considered that relaxation of the two convergence criteria is required and would be acceptable for strategic purposes, noting that all models struggle converging with very high levels of additional traffic imposed on existing central city networks.

It is recommended that in due course the SIDRA model(s) be revised to reflect the actual existing and impending (November 2016) changes along Kapiti Road and upgraded to be compatible with the important new features available in version 7.0, with routes also added to improve reporting along with lane display plots. Importantly allowing the program to determine the signal cycle time and offsets should be introduced.

It is also recommended that the turning flows into and out of the airport zone should reflect the actual expected flows and not exclude the passby and diverted trips, and in this respect use should be made of the special user vehicle classes in SIDRA plus the ability to run SIDRA from an Excel spreadsheet. This would make the model more transparent, easier to understand, and easier to model the effects of different assumptions on trip generation (and travel patterns from the SATURN model).

4.2. PDP Provisions

It is concluded that Integrated Transport Assessments (ITA) are required for the Airport zone when the airport development areas reach (at or around) the thresholds in the PDP. In essence this also means whenever the expected level of trips (for the design hour, be it the PM peak or midday Saturday) reach the quintessential associated generated trip levels for the Gross Floor Area thresholds.

5. FINAL COMMENTS

This assessment has only been undertaken of the PM peak, noting that there is no SATURN Saturday peak model. It is likely that the above recommendations relating to the SATURN/SIDRA modelling would also apply to the SIDRA Coastlands Model which I understand also exists and is linked to the Airport model.