Quality Transport Planning

Belfast to Pegasus and Woodend Bypass

Modelling Addendum Report

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1 Executive Summary

1.1 QTP were engaged by the New Zealand Transport Agency Waka Kotahi (**NZTA**) in June 2024 to undertake traffic modelling for the Belfast to Pegasus Motorway and Woodend Bypass (**B2P**).

1.2 The scope was to provide design flows from the model for the Scheme Design Review contract that was to be awarded in July 2024. Owing to the short amount of time available to undertake the work, the scope was to use the latest version of the readily available traffic models, with review and update of the generic model focussed on the SH1 corridor.

1.3 More recently, some of the modelled flows on the more local routes parallel to SH1 that logically may form an alternative route under the assessed B2P tolling strategy (with tolls both north and south of the proposed Williams Street 'Pineacres' interchange) have been queried.

1.4 Accordingly, this report is concerned only with the review of the modelled flows on such alternative routes (to using the tolled sections of SH1) and the adopted link types / speeds that potentially influence such routing.

1.5 The B2 project models have been revised to better reflect the observed speed on the rural back roads parallel to, and northwest of, the proposed scheme, including on the on the Tuahiwi Road / Greens Road / Revells Road corridor.

1.6 The revised (2018) base model daily flows better reflect available daily count data for these roads, being lower than within the original Woodend Bypass 2018 project model.

1.7 In the future year mid-term horizon 2038 model with the proposed B2P project, including the $1.25/$2.50 light/heavy vehicle tolls north and south of the proposed Pineacres interchange, the effects of the revised link speeds have a smaller effect than in the base year model.

1.8 Modelling of the proposed B2P project (including tolls) in the original project model indicated high traffic volumes on some rural back roads parallel to and northwest of the proposed scheme, for example 8,000 vpd on Revells Road and up to 10,000 vpd on Greens Road. Modelled daily traffic volumes on such roads remain high for the revised model (compared to recent counts), at 7,000 and 8,000 vpd respectively.

1.9 Revised modelling has been undertaken of a previously modelled scenario that additionally includes a left-in, left-out intersection of Revells Road with Lineside Road. This indicates that this potential traffic management measure does serve to reduce modelled daily traffic volumes at Revells Road (3,000 vpd) and on Greens Road (5,000 vpd), with some modest increases (up to 1,000 vpd) on Williams Street and on the Woodend Bypass. The measure does however result in an increase in flows on parallel Bramleys Road to the northwest (of around 1,500 vpd) and on through Tuahiwi (an increase of around 1,000 vpd).

2 Introduction

2.1 QTP were engaged by the New Zealand Transport Agency Waka Kotahi (**NZTA**) in June 2024 to undertake traffic modelling for the Belfast to Pegasus Motorway and Woodend Bypass (herein referred to as **B2P,** but previously referred to in QTP reporting as the Woodend Bypass).

2.2 The scope was to provide design flows from the model for the Scheme Design Review contract that was to be awarded in July 2024. Owing to the short amount of time available to undertake the work, the scope was to use the latest version of the readily available traffic models.

2.3 Specifically, the agreed scope of the work was to use the latest version of the Christchurch Assignment and Simulation Traffic model (**CAST**) to estimate design flows for the Woodend Bypass. The work included:

- Review and update of the 2018 'base' and 2021 'present-year' models to better reflect the road network on the existing SH1 corridor
- Changes to the generic future year models assumed 'interim corridor improvements' at the direction of the NZTA given the Woodend Bypass was to be implemented sooner than assumed within the models (introduced in the furthest horizon year of 2048 only)
- Review of External Zone growth assumptions
- Review of assumed demographic growth in Pegasus and Ravenswood
- 2018 and 2021 model vs count checks and relatively minor refinements to modelled demands
- 2018 and 2021 model vs observed travel time comparisons
- The use of elastic assignments such that input modelled travel demands in future years are adjusted to some degree in relation to changes in travel 'costs' (principally travel times) relative to the base year (i.e. supressed demand due to increased congestion or conversely induced traffic due to lower travel times for specific trips)
- Cordoning of the model at the Waimakariri River in order to retain practical model run times under elastic assignment, including under further changes to the model demand segmentation required for subsequent toll modelling.

2.4 The above changes to the generic latest version of CAST and data comparisons are described within the Woodend Bypass Traffic Modelling Technical Report[1].

2.5 Further modifications to the resulting CAST Woodend project model for the purpose of toll modelling is described within the Woodend Bypass Toll Modelling Technical Report[2]. The key change for toll modelling is the identification of trips by purpose and the further segmentation of trips by low, middle and high 'willingness to pay' (a toll) segments. This results in the assignment of some 12 user classes (9 for light vehicles and 3 for heavies) each with differing values of time assumed and hence willingness to pay a given toll. Compared to the simple 2 vehicle classes assigned in the generic CAST model (all light and heavy vehicles), this technique, in-line with NZTA's tolling assessment guidance, provides a much more realistic estimate of the proportion

[1] Version 00a initially dated 23 July 2024 with the most recent update dated 16 September 2024.

[2] Version 01b dated 5 September 2024, including economic assessment

of vehicles willing to pay a given toll.

2.6 As noted above, the short amount of time initially available to develop a project model and to provide design flow estimates meant that review and update of the generic model focussed on the SH1 corridor.

2.7 More recently, some of the modelled flows on the more local routes parallel to SH1 that logically may form an alternative route under the assessed tolling strategy (with tolls both north and south of the proposed Williams Street 'Pineacres' interchange) have been queried. Specifically, modelled traffic volumes on Revells Road in the base and with-scheme (tolled) future models have been queried.

2.8 Accordingly, this report is concerned only with the review of the modelled flows on such alternative routes (to using the tolled sections of SH1) and the adopted link types / speeds that potentially influence such routing.

3 2018 Base Model Review

3.1 Overview

3.1.1 The traffic modelling progressed in 2024 used the then-current version of the CAST traffic model, being the v23 model, this update being prepared in 2023, and retaining 2018 as the base-year model. This is the year in which the Statistics New Zealand (**SNZ**) 2018 census data forms the demographic inputs to the Christchurch Transportation Models and the year to which the CAST model is calibrated and validated to traffic counts and journey times. At the time of writing, the v23 model remains the latest official generic model adopted by the Christchurch Model Management Group (**MMG**).[3]

3.1.2 All future year models (2028, 2038 and 2048) provide traffic volume and network operation forecasts with demographic growth and network changes relative to the 2018 base model.

3.1.3 The review of the 2018 model flows vs counts presented within the Woodend Bypass Modelling Report included all available link counts provided by Waimakariri District Council (**WDC**) and processed for the original 2018 base model validation and calibration[4]. The comparison showed generally excellent correlation with the model surpassing NZTA's Transport Model Development Guidelines (**TMDG**) criteria.

3.1.4 The Woodend Bypass toll modelling report presented only the results of initial tolling scenarios that included only a single toll on the Woodend Bypass section of the project. This indicated a mid-horizon year (2038) daily flow on Revells Road of around 1,500 vpd.

3.1.5 Subsequent to completing the initial round of toll modelling and reporting, NZTA requested a number of additional toll scenarios, including a strategy of tolls on SH1 both north and south of the proposed Pineacres interchange. It is understood that the preferred toll strategy is for $1.25 light vehicles and $2.50 at each of these locations.

3.1.6 NZTA have queried the realism of the modelled flow 'diversion' to alternative local road routes under this toll strategy (in particular Revells Road) given forecast daily flows on Revells Road are some 8,000 vpd at 2038[5].

3.1.7 To this end, NZTA have provided some additional count data sourced from WDC on local roads that was not available during the generic base model update to 2018 census. In addition, the coded link types reflecting the assumed free-flow speeds on the local roads within the vicinity of B2P have been reviewed. This has not been undertaken since the Waimakariri District was coded within the generic CAST models in 2018 and did not form part of the scope of the initial Woodend Bypass modelling in 2024 due to tight time constraints and focus on other model checks and refinements described above.

3.2 Existing Woodend Bypass Project Model vs Count Comparison

3.2.1 The following table provides a comparison of the supplied daily counts and modelled flows on the

[3] The MMG appointed QTP on 7/7/2025 to update the model to the 2023 census, which is likely to be completed towards the end of 2025.

[4] CAST was first updated to 2018 census data in 2021, being v21 of the model

[5] For the model scenario without further traffic management to mitigate such potential increased use of Revells Road. A subsequent scenario was also run with Revells Road left-in, left-out only at Lineside Road.

local roads that could form alternative routes to the tolled motorway.

Road Name	Count Site	Direction	Location Notes	Count Date	ADT	CAST 2018	Diff
Church Bush Rd	0135A	Both lanes	350m north of Tuahiwi/Revells Rd	15/06/2021	400	2,300	+1,900
Revells Rd	0558A	Both lanes	1500m north of Lineside Rd	24/06/2021	1,200	2,500	+1,300
Tuahiwi Rd	0661A	Both lanes	300m north of Cox Rd	15/06/2021	1,000	500	-500
Tuahiwi Rd	0661B	Both lanes	670m south of Greens Rd	24/11/2021	1,100	1,100	+0
Tuahiwi Rd	0661C	Both lanes	700m south of Rangiora Woodend Rd	15/06/2021	1,500	4,900	+3,400
Williams St	0708J	Both lanes	140m north of Dale St	22/09/2023	7,800	6,700	-1,100
Williams St	0708L	Both lanes	120m south of Main North Rd SH1	7/08/2023	4,100	5,100	+1,000

Figure 3.1: Comparison of Counts vs 2018 Modelled Flows, Original Woodend Project Model

3.2.2 The CAST model was originally developed with the intention of reflecting observed counts within a around 100 vph, equating to a tolerance of around 1,000 vpd[6]. For this broad comparison of daily volumes, the 2018 modelled flows are significantly higher than the counts at Revells Rd and Church Bush Rd, whilst the modelled flow at Tuahiwi Rd at its northern end is much higher in the model than the counts suggest.

3.3 Speed Limit Review

3.3.1 As noted above, the free-flow speed limits on the local road network in Waimakariri District were coded in the model in 2018. Since that time, there have been changes (reductions) to the posted speed limits. Revells Road was coded with a free flow speed of around 90kph[7] whilst the Tuahiwi Road / Greens Road / Pa Road corridor was coded 80kph.

3.3.2 The National Speed Limit Register indicates these roads are now subject to a posted speed limit of 80kph. Google Maps indicates a total travel time of 7 minutes on this 8.2km corridor of narrow roads (sometimes just 6m wide), indicating an appropriate free-flow speed of around 70kph. The links on these roads have accordingly been recoded with 70kph link types, including on connecting roads in the area, being Bramleys Road, Turiwhaia Road and Te Pouapatuki Road. In addition, a modelled single link representing a section of Williams Street with both 50kph and 80kph has been revised from an 80kph link type to 70kph.

3.3.3 The speed limits on Smith Street between SH1 and Williams Street have also been reviewed in the context of the urbanisation and associated speed limit changes that have occurred in recent years. These Smith Streets changes have only been made to the future year models, as the speed limit changes have only occurred sometime after 2018.

3.4 Effect of 2018 Model Speed Limit Review and Update

3.4.1 The following table illustrates the updated model vs count comparison.

[6] Typically, in broad-terms, rule of thumb is that daily flows are around 10 x peak hour flows

[7] In urban areas, generally roads are coded to reflect the posted speed limit, but with two-lane roads coded with a free-flow speed of 2kph below the speed limit and multi-lane roads 2kph above. This differentiation improves both travel time validation in the model and the relative attractiveness of such roads. On narrow rural roads, the modelled free-speed is generally lower than the posted speed limit, particularly where at the time of coding, the speed limit was 100kph.

Road Name	Count Site	Direction	Location Notes	Count Date	ADT	CAST 2018	Diff
Church Bush Rd	0135A	Both lanes	350m north of Tuahiwi/Revells Rd	15/06/2021	400	200	-200
Revells Rd	0558A	Both lanes	1500m north of Lineside Rd	24/06/2021	1,200	500	-700
Tuahiwi Rd	0661A	Both lanes	300m north of Cox Rd	15/06/2021	1,000	500	-500
Tuahiwi Rd	0661B	Both lanes	670m south of Greens Rd	24/11/2021	1,100	1,000	-100
Tuahiwi Rd	0661C	Both lanes	700m south of Rangiora Woodend Rd	15/06/2021	1,500	1,400	-100
Williams St	0708J	Both lanes	140m north of Dale St	22/09/2023	7,800	6,600	-1,200
Williams St	0708L	Both lanes	120m south of Main North Rd SH1	7/08/2023	4,100	5,000	+900

Figure 3.2: Comparison of Counts vs 2018 Modelled Flows, Revised Woodend Project Model

3.4.2 The above table indicates how the revised speed limits have resulted in modelled daily traffic flows that are a better reflection of the count data. Whilst the overall trend is for the model flows to be a little lower than observed, we note that the modelled flows are for 2018 whilst the supplied counts are for 2021 and 2023. Accordingly, some traffic growth is likely to have occurred during this period.

3.4.3 The following model plot illustrates the modelled daily flows in the revised 2018 base model in the vicinity of the B2P project. In common with previous modelled daily volumes presented, these are rounded to the nearest 500 vpd to avoid implying high levels of precision.

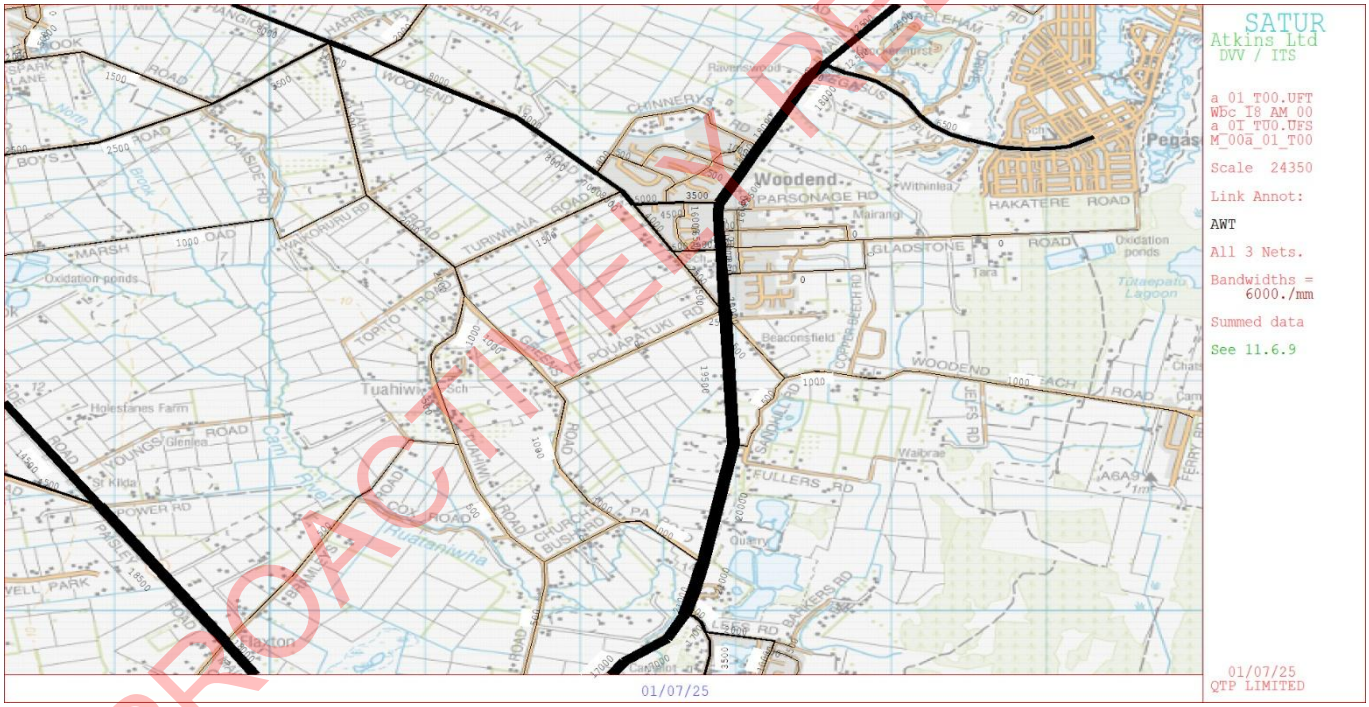

Figure 3.3: Modelled Weekday Flows, Revised 2018 Base Model

3.4.4 The following model plot illustrates the changes to the modelled daily flows at 2018 due to the revised link free-speeds assumed within the model over the wider modelled area (rounded to the nearest 100 vpd). The widths of the bands are proportional to the change, with increases shown in red and reductions in green.

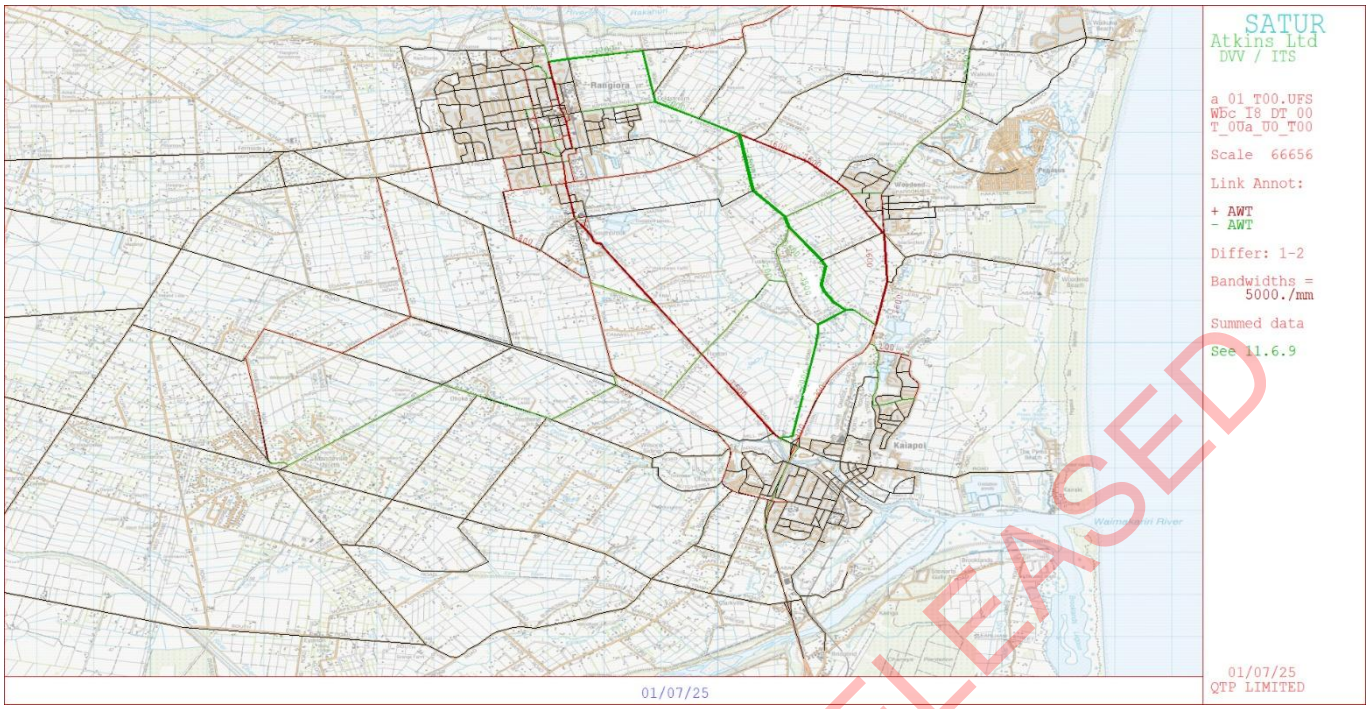

Figure 3.4: Changes in Modelled Weekday Flows Due to Revised Link Speeds, 2018 Base Model

3.4.5 The above plot illustrates the reductions in modelled flows (in green) on the Tuahiwi Road / Greens Road / Revells Road corridor due to the lower link speeds implemented (reductions of between 2,000 and 3,500 vpd) and the corresponding increases on the Woodend-Rangiora Road and Lineside Road corridors (typically increases on each of around 1,500 vpd).

3.4.6 The following chapter indicates the significance of the revised link speeds carried forward to the future year modelling of the tolled B2P project.

4 Effect of Revised Model on Assessed Tolled B2P Scheme Flows

4.1 The following model plot illustrates the effect of the revised model link speed changes on the advised proposed B2P scheme, including the $1.25/$2.50 light/heavy vehicle tolls north and south of the proposed Pineacres interchange, for the mid-term horizon year of 2038.

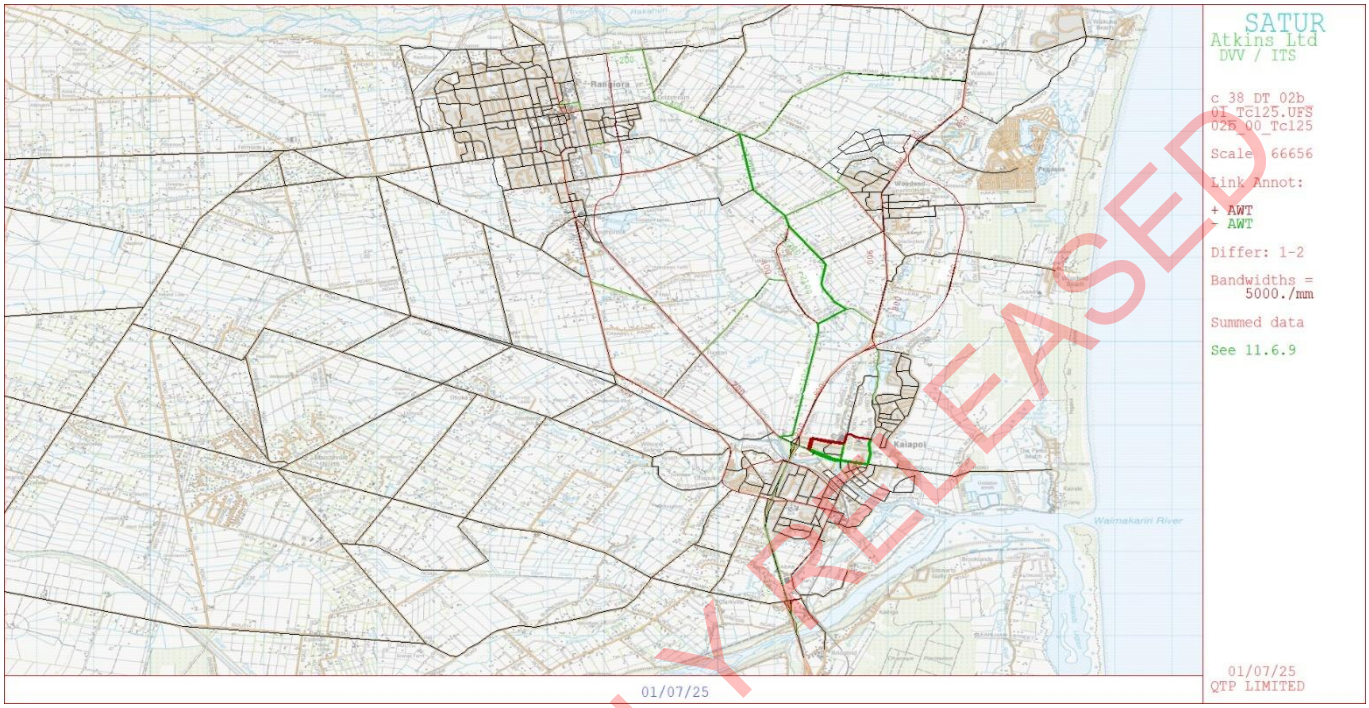

Figure 4.1: Changes in Modelled Weekday Flows Due to Revised Link Speeds, 2038 With-B2P Model

4.2 The effects of the revised link speeds assumed in the future year B2P model are similar to those presented within the previous chapter for the 2018 base model, but the changes are generally smaller (i.e. modelled flow reductions on the Tuahiwi Road / Greens Road / Revells Road corridor are reductions between 1,100 and 2,100 vpd compared to between 2,000 and 3,500 vpd in the base year model).

4.3 The following model plot illustrates the resulting modelled daily flows at 2038.

Figure 4.2: Modelled Weekday Flows, Revised 2038 With-B2P Model

4.3.1 It is noted that under this assumed tolling scenario (with tolls north and south of Pineacres) the modelled flows on the alternative route 'back roads' to the northwest of SH1 remain high (compared to recent counts) for the revised model. For example, daily flows on Revells Road are some 7,000 vpd and daily flows on Greens Road north of Church Bush Road are some 8,000 vpd.

4.3.2 Given such high flows on the alternative route 'back roads', per the original scheme modelling, a further scenario with Revells Road assumed to be left-in, left-out (LILO) at Lineside Road has also been run with the revised link speeds.

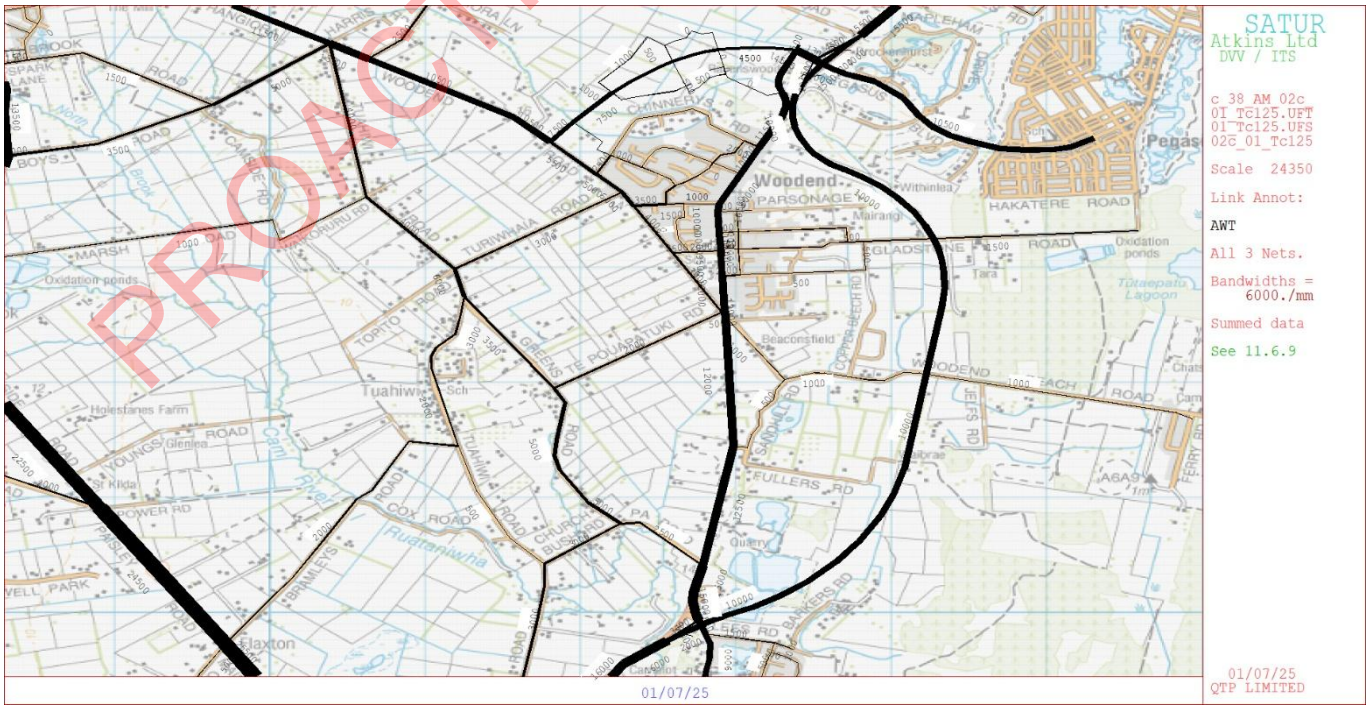

Figure 4.3: Modelled Weekday Flows, Revised 2038 With-B2P Model with Revells LILO at Lineside Rd

4.3.3 Comparing the above daily flow diagrams, the above traffic management intervention is successful in reducing modelled traffic flows on Revells Road, but results in an increase in flows on parallel Bramleys Road to the northwest (of around 1,500 vpd) and on through Tuahiwi (an increase of around 1,000 vpd). The Revells Road LILO intervention does however result in a net increase on Williams Road of around 1,000 vpd and on the Woodend Bypass of around 500 vpd which may be considered as more appropriate routes for through-traffic.

4.3.4 This report has illustrated example plots for the mid-term horizon year of 2038, though the modelling has been undertaken for both 2028 and 2048, with more comprehensive sets of model plots illustrating flows, delay and changes for all years. In addition, the flow data has been made available as KMZ files for viewing in GoogleEarth.

5 Revised Modelling Summary

5.1 The B2P and Woodend Bypass project models have been revised to better reflect the observed speed on the rural back roads parallel to, and northwest of, the proposed scheme, including on the on the Tuahiwi Road / Greens Road / Revells Road corridor.

5.2 The revised (2018) base model daily flows better reflect available daily count data for these roads, being lower than within the original Woodend Bypass 2018 project model.

5.3 In the future year mid-term horizon 2038 model with the proposed B2P project, including the $1.25/$2.50 light/heavy vehicle tolls north and south of the proposed Pineacres interchange, the effects of the revised link speeds have a smaller effect than in the base year model.

5.4 Modelling of the proposed B2P project (including tolls) in the original project model indicated high traffic volumes on some rural back roads parallel to and northwest of the proposed scheme, for example 8,000 vpd on Revells Road and up to 10,000 vpd on Greens Road. Modelled daily traffic volumes on such roads remain high for the revised model (compared to recent counts), at 7,000 and 8,000 vpd respectively.

5.5 Revised modelling has been undertaken of a previously modelled scenario that additionally includes a left-in, left-out intersection of Revells Road with Lineside Road. This indicates that this potential traffic management measure does serve to reduce modelled daily traffic volumes at Revells Road (3,000 vpd) and on Greens Road (5,000 vpd), with some modest increases (up to 1,000 vpd) on Williams Street and on the Woodend Bypass. The measure does however result in an increase in flows on parallel Bramleys Road to the northwest (of around 1,500 vpd) and on through Tuahiwi (an increase of around 1,000 vpd).