DEMP Stage 2

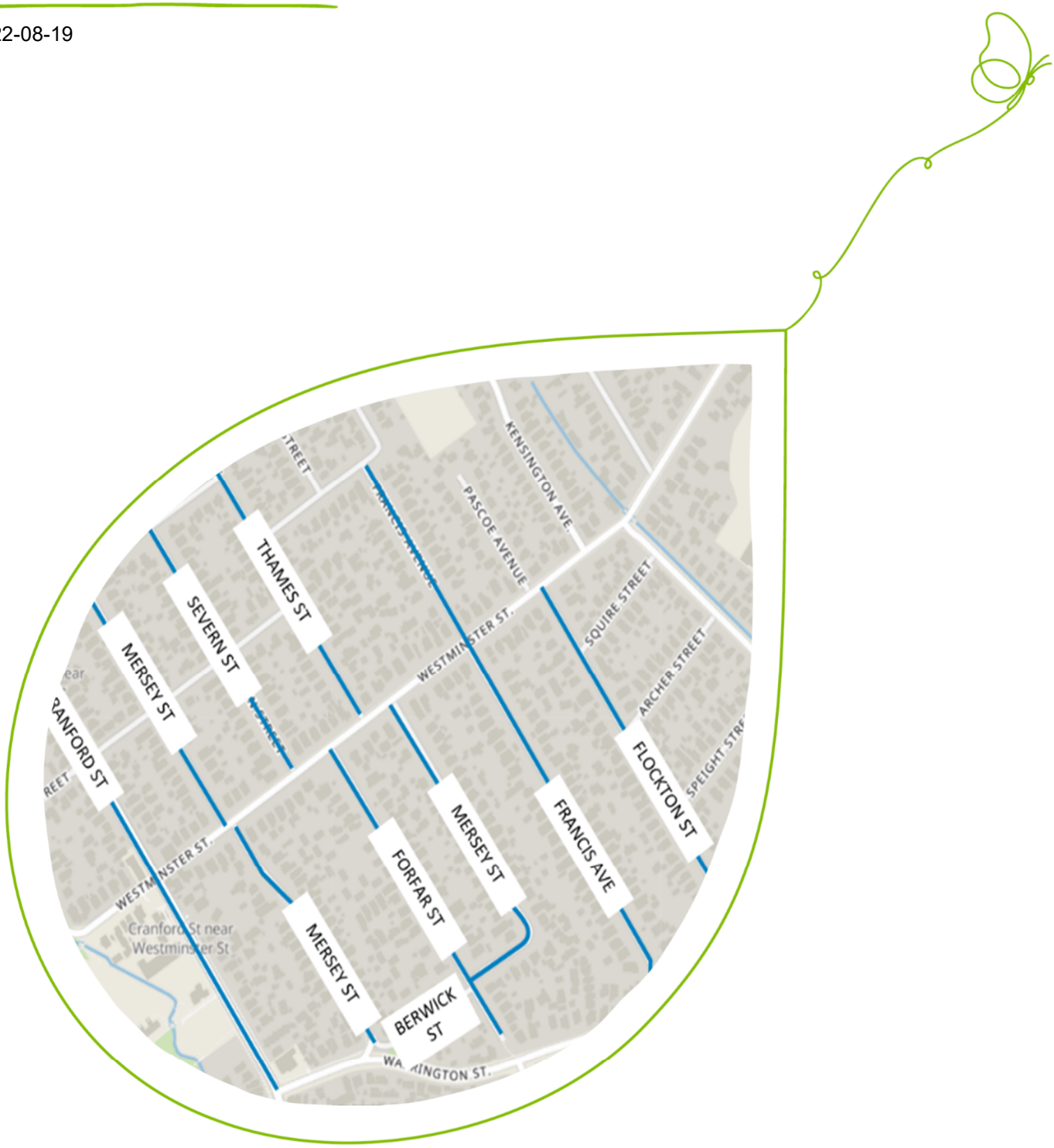
DEMP Stage 2 Modelling Summary Interpretative Report

Christchurch City Council

Reference: P512336

Revision: 2

2022-08-19



Executive Summary

Since the opening of the Christchurch Northern Corridor (CNC), Christchurch City Council (CCC) has monitored the impact of the works as part of the Downstream Effects Management Plan (DEMP) Stage 2. Through this monitoring and engagement with residents of Francis Avenue and Flockton Street, an increase in traffic vehicle volumes has been noted along Francis Avenue and Flockton Street.

As part of the DEMP Stage 2 works, CCC has investigated several design options to understand which, if any, could help to reduce vehicle volumes along Francis Avenue and Flockton Street, while minimising adverse effects elsewhere. To inform this work, traffic modelling has been undertaken by Quality Transport Planning (QTP), who have provided an independent technical traffic modelling report. Traffic modelling was undertaken using the latest (v21a) version of the Christchurch Assignment and Simulation Traffic (CAST) model. The CAST model was checked, and updated where required, to make sure it reflected the local road network and traffic volumes.

This Summary Interpretative Report summarises the modelling outputs of the QTP technical report. This report focuses on Francis Avenue, Flockton Street and the surrounding local study area as shown in the adjacent figure.

Figure 1 - Study Area as referred to throughout this report

Model Outputs

A summary of the options considered and the resulting outputs and impacts are provided below. The modelling report focuses on changes to traffic volumes, but this summary also considers impacts on residents' accessibity and constructability. The level of complexity in terms of construction considers a range of factors. These include the extent and complexity of design required to provide a safe design across all modes, the removal and/or relocation of existing infrastructure, the time and cost required to implement, and the disruption to residents during construction.

Options A (Traffic signals at Hills Rd / Akaroa St intersection), Option B (Traffic signals at the Aylesford St / Hills Rd intersection) and Option C (Traffic signals at the Flockton St / Warrington St intersection):

The modelling indicates that Options A, B and C will likely retain daily vehicle volumes along streets in the study area very close to the existing situation. This includes Francis Avenue and Flockton Street which are unlikely to see a reduction in traffic (refer to Section 6.2, 0, and 0 for more detail).

Option D (Opening Forfar St) and Option D2 (Opening Forfar St with traffic calming):

The modelling indicates that Option D and D2 will draw a significant volume of traffic away from Cranford Street. Option D will increase vehicle volumes along Mersey Street (south of Westminster) and Forfar Street above the threshold of a local road. Option D2 pushes Forfar Street above this threshold. These options are also indicated to increase the vehicle volumes along several other streets in the study area. Flockton Street is indicated to see little benefit from either option, with only Francis Avenue seeing a significant reduction in vehicle volumes. Overall, Options D and D2 are indicated to provide relief to Francis Avenue but will likely negatively impact several other streets in the study area (refer to Section 6.5 and 0 for more detail).

These options would improve residents' access to the wider network through an additional connection onto Warrington Street but modifications to the intersection would be difficult to construct.

Option D3 (Opening Forfar St with a left turn out only):

The modelling indicates that Option D3 will draw some traffic away from Cranford Street but will likely retain vehicle volumes along most streets in the study area very close to the existing situation. This excludes Francis Avenue which is indicated to see some reduction in vehicle volumes. Traffic volumes on Flockton Street are indicated to remain close to existing (refer to Section 6.7 for more detail).

This option improves residents' access to the wider network through an additional left turn out connection onto Warrington Street but integrating a left turn only at this existing signalised intersection will be difficult to construct.

Option D4 (left turn added to Berwick Street):

The modelling indicates that Option D4 will draw some traffic away from Cranford Street but will likely retain the daily vehicle volumes along most streets in the study area very close to the existing situation. This excludes Francis Avenue and Mersey Street. Francis Avenue is indicated to see some reduction in vehicle volumes while Mersey Street (both north and south of Westminster Street) is indicated to accommodate increased traffic volumes. Mersey Street south of Westminster in particular, is indicated to accommodate a volume of vehicles above that recommended for a local road (above 2000vpd). Refer to Section 0 for more detail.

This option improves residents' access to the wider network through an additional left turn out connection onto Warrington Street, and it is considered relatively easy to construct.

Option D5 (left turn added to Berwick with calming on Mersey Street):

The modelling indicates that Option D5 will draw some traffic away from Cranford Street but will likely retain the daily vehicle volumes along most streets in the study area very close to the existing situation. The modelling indicates that this option will reduce vehicle volumes along Francis Avenue, with Flockton Street also seeing a minor reduction. Similar to Option D4, Mersey Street (south of Westminster) is indicated to accommodate an increased volume of vehicles when compared to existing, however it will remain below the 2000 vpd threshold recommended for a local road (refer to Section 0 for more detail).

This option improves residents' access to the wider network through an additional left turn out connection onto Warrington Street, and it is considered relatively easy to construct.

Option E (Cul de sac Flockton St and Francis Ave (midblock)):

The modelling indicates that Option E will significantly reduce vehicle volumes along Francis Avenue and Flockton Street, with little change to the vehicle volumes along other roads in the study area. However, this option effectively transfers the volumes of Francis Avenue and Flockton Street onto Aylesford Street, significantly increasing its estimated daily vehicle volumes (refer to Section 6.10 for more detail).

This option will reduce residents' accessibility to their streets and the wider network but it is relatively easy to construct.

Option F (Removing Bus Lanes Along Cranford Street):

We also investigated the potential impacts of removing the temporary bus lanes along Cranford Street between Innes Road and Berwick Street in order to install a peak hour traffic lane or T2 lane to understand if this option would attract traffic to Cranford Street and (as a consequence) reduce vehicle volumes along Francis Avenue and Flockton Street. The modelling indicated that the addition of traffic lanes along Cranford Street would have negligible impact on the traffic volumes along Francis Avenue or Flockton Street compared to the existing situation (refer to Section 6.11 for more detail).

Summary

Overall, of the options considered, most have either no or minor impact on reducing vehicle volumes on Francis Avenue and Flockton Street, or the reduction may occur at the cost of further impacts elsewhere in the study area. None of the options tested to date are indicated to appease all streets in the study area.

Out of the options modelled, Option D5 (left turn from Berwick Street onto Warrington Street with traffic calming on Mersey Street), results in the closest option which balances outcomes across the study area. However, this is at a cost to Mersey Street, which would see an increase in traffic volumes compared to existing (+900 vpd). The increase indicated along Mersey Street will still be less than what Mersey Street accommodated pre-CNC, and vehicle volumes are indicated to remain below the 2000vpd threshold.

Option D5 is indicated to reduce traffic flows on Francis Avenue and Flockton Street, overall reduces throughput in the study area south of Westminster Street, while balancing the impact as much as possible across the study area. The modelling indicates that an appropriate level of traffic calming would most likely need to be applied to ensure significant volumes of traffic are not attracted to Mersey Street. This option also retains vehicle access for residents of Francis Avenue and Flockton Street while maintaining volumes along other streets in the study area (with the exception of Mersey Street) close to existing.

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1 Introduction

Since the opening of the Christchurch Northern Corridor (CNC), Christchurch City Council (CCC) have engaged with the residents of St Albans. Through this engagement, residents of Francis Avenue and Flockton Street have noted an increase in vehicle volumes along their streets. As part of the DEMP Stage 2 works, CCC has investigated several design options to understand which, if any, could help to reduce vehicle volumes along Francis Avenue and Flockton Street without causing adverse effects elsewhere. To inform this work, traffic modelling has been undertaken by QTP, who have provided an independent technical traffic modelling report. The full technical traffic modelling report has been independently reviewed by Abley Ltd.

This Summary Interpretative Report aims to summarise the QTP technical report, with a focus on the modelling process and the clear results (that can be drawn despite any limitations and uncertainty associated with the model) rather than the technical details of the model.

This Interpretive Report summarises the following:

Section 2 - Model Calibration: Calibration of the traffic model to check that it appropriately represents current traffic conditions (with consideration given to the impacts of Covid-19)

Section 3 - Comparison of Pre and Post CNC traffic volumes

Section 4 - Where is the additional traffic coming from?: Select Link Analysis (SLA) along Francis Avenue and Flockton Street to inform where traffic is coming from and going to

Section 5 - Design options considered

Section 6 - Modelling Results: Modelled outputs of design options tested

Section 7 - Comparison of options

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What is DEMP Stage 2?

The downstream effects management plan (DEMP) is a condition of the CNC designation.

There are three stages of works to mitigate the downstream effects of the CNC, which are outlined below:

Stage 1: High priority works that were implemented prior to the opening of CNC

Stage 2 *(current stage)*: Projects built either before the CNC opened or in the three years after it opened. These measures primarily consider how to mitigate the effects of the additional traffic on other road users (pedestrian and cyclists) and the community.

Stage 3: Options which may be implemented between the opening of the CNC and up to ten years after opening, with the majority expected to occur from year 3 onwards. The implementation of these treatments will depend on the outcome of monitoring and also target the interventions where they are needed.

Study Area

This report focuses on Francis Avenue, Flockton Street and the surrounding local study area, considering the impacts of a range of design options on the roads highlighted in Figure 2 below.

Figure 2: Study Area

Design Options

The following design options have been tested in the model:

Option A - Install traffic signals at the Hills Road / Akaroa Street intersection

Option B - Install traffic signals at the Aylesford Street / Hills Road intersection

Option C - Install traffic signals at the Flockton Street / Warrington Street intersection

Option D - Re-open Forfar Street with four-way traffic signals at Warrington Street and Madras Street

Option D2 - Re-open Forfar Street with four-way traffic signals and traffic calming along Forfar Street

Option D3 - Re-open Forfar Street partially (allowing left turn out only – without traffic calming)

Option D4 - Install a left turn out of Berwick Street onto Warrington Street

Option D5 - Install a left turn out of Berwick Street onto Warrington Street with traffic calming along Mersey Street

Option E - Cul de sac both Francis Avenue and Flockton Street (midblock)

Option F - Remove bus lanes along Cranford Street between Innes Street and Berwick Street and install a peak hour traffic lane (or T2 lane).

These design options are described in further detail in Section 5 of this report.

2 Model Calibration

Traffic modelling was undertaken using the latest (v21a) version of the Christchurch Assignment and Simulation Traffic (CAST) model. The CAST model is extremely powerful as it simulates local scheme benefits / impacts whilst also capturing the effects on the wider road network.

The following checks and amendments were made to the default CAST model to add sufficient detail to allow for testing of design options in the study area:

The default CAST model assumed that the Flockton Street and Francis Avenue northern approaches to Warrington Street and the Jameson Avenue approach to Innes Road, included separate lanes for left and right turn movements. However, currently, there is only a single approach lane constructed at these locations. The model was therefore updated to reflect single approach lanes at these locations.

Checks were undertaken to ensure the CAST model reflected the on-street traffic signal timings and the operation on Cranford Street (at its intersections with Innes Road, Westminster Street, Berwick Street) and on Warrington Street (at its intersections with Madras Street and Barbadoes Street). The default CAST model matched the observed signal timings and operation reasonably well, except for the Cranford Street movements at its intersection with Westminster Street. Currently, signage bans right turns from Cranford Street onto Westminster Street at this intersection, to allow for two through lanes in the peak direction during peak periods. However, on site observations confirmed that this signage was ignored (or unable to be adequately read) because it was common for right turns to be made and only a single through lane properly utilised. The Cranford/Westminster intersection was therefore adjusted in CAST to reflect this observed behaviour.

The bus lanes on Cranford Street were not specifically coded in CASTv21 (noting it is a temporary trial). The bus lanes were therefore added to the model based on the currently constructed implementation.

Traffic Counts

The 2021 base model was also validated against recently collected traffic counts in the study area (October 2021). Overall, traffic counts obtained in 2021 were generally lower than indicated by the model and historic values. These differences are likely due to Covid restrictions in place at the time of the traffic counts, and subsequent changes in travel behaviour (such as more frequent working from home). Rather than adjusting the model to better match the 2021 travel counts, the raw model values have been maintained. This is considered more representative of 'normal' traffic conditions outside of Covid-19 impacts.

Travel Time Checks

As a check on the model's ability to replicate on-street travel time, modelled and observed (based on collected actual travel time data) travel times of two parallel routes were compared. These two routes were selected to better understand the relative travel times of the Cranford Street based route and an alternative parallel route through the study area. The routes, and associated travel times, are shown in Figure 3.

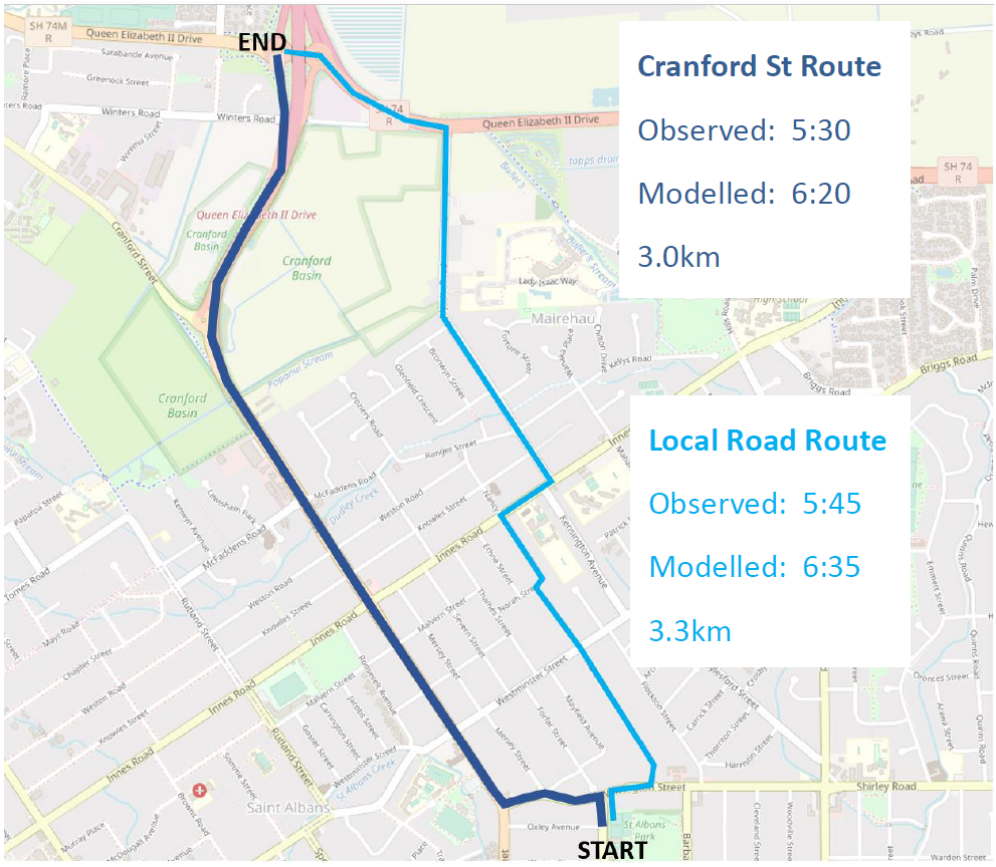


Figure 3: Travel Time Comparison

As shown in Figure 3, the modelled travel times are higher than the observed travel times. This is most likely due to Covid-19 impacts which has decreased congestion and therefore decreased travel time. No adjustment was made to the model (to ensure the modelling represented ‘normal’ unrestricted conditions). With consideration of Covid-19 impacts, relativity between the model and observed travel times were considered to be very good.

Overall, the validated base model (updated as described) has thereafter been used to understand current network operations which helps to understand the likely effectiveness of potential design options.

3 Comparison of Pre-CNC to Existing Conditions

This section of the report will compare current traffic volumes in the study area to pre-CNC conditions.

3.1 Local Road Threshold

Generally, the recommended threshold for a 'local road' is 2000 vehicles per day (vpd).[1] Figure 4 below visually demonstrates which roads in the study area meet or exceed this threshold.

Figure 4: Roads which meet or exceed the 2000vpd threshold for a local road (left: pre-CNC; right: existing situation)

Traffic counts indicate that prior to the opening of CNC, Mersey Street (south of Westminster Street), Forfar Street and Flockton Street were all accommodating daily traffic volumes greater than recommended for a local road. Since the opening of CNC (and other associated road changes), only Flockton Street continues to accommodate vehicle volumes greater than 2000 vpd.

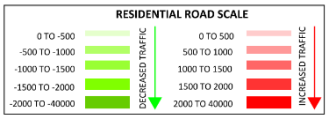
The traffic modelling and assessment included morning and evening peak periods. This resulted in a large number of outputs, but also confirmed that impacts during peak periods can be reliably correlated with daily flows. Therefore, this report focuses on the daily flows to simplify the comparisons.

Figure 5 depicts the *difference* **(referred to as 'change')** in daily vehicle volumes between pre-CNC and the existing situation in the study area.

Note the following when interpreting Figure 5:

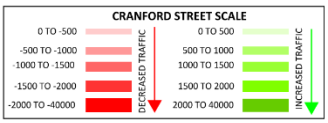
Two scales have been shown; one for **'Residential Streets'** and one for **'Cranford Street'**.

For Residential Streets our aim is to reduce daily traffic volumes. A **green scale** (positive impact) is therefore used to show a **decrease** in daily vehicle volumes. Darker shades of green and thicker lines depict a greater decrease in traffic. In essence, a dark green thick line indicates a significant decrease in traffic, whereas a faint green thin line indicates a minor decrease.



Similarly, a **red scale** (negative impact) is used to indicate a **increase** in daily vehicle volumes

As Cranford Street is an arterial road, we aim to push as much traffic as possible from residential roads onto Cranford Street.



A **decrease** in daily vehicle volumes along Cranford Street is therefore a negative outcome, and is shown in **red**, while an **increase** in volumes (a positive outcome) is shown in **green**.

[1] Based on the Christchurch Infrastructure Design Standard Part 8: Roading (2022), the One Network Road Classification (ONRC) and a study by Chesterman, R and Koorey, G (2010,) on Christchurch 'local roads'

Change in traffic in the area:

The numbers depicted in circles in Figure 5 indicate the combined change in traffic on residential streets both north and south of Westminster Street.

For example, the modelling indicates that there are currently 500 less daily vehicle movements north of Westminster Street[2] when compared to pre-CNC conditions.

The modelling also indicates that there are currently 4200 less daily vehicle movements south of Westminster Street[3] when compared to pre-CNC.

This indicates that the opening of CNC and the associated road changes have reduced daily vehicle volumes both north and south of Westminster Street in the study area.

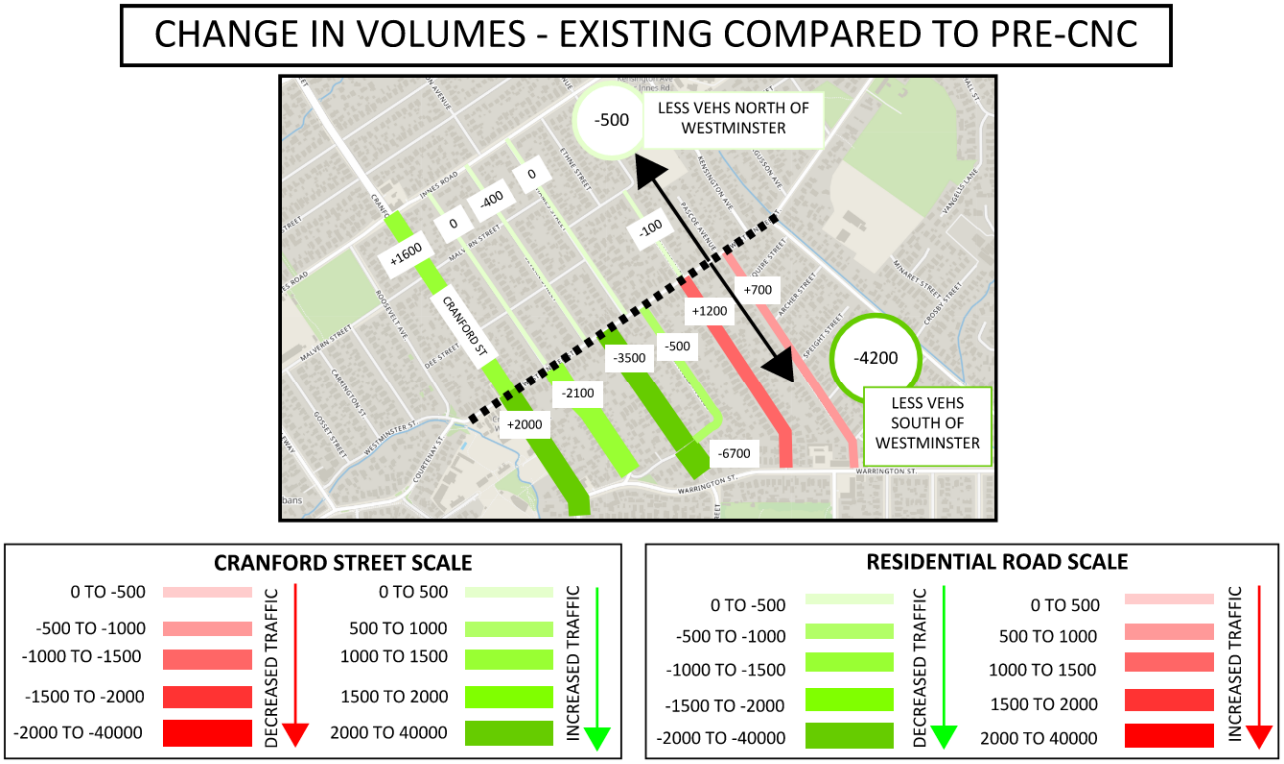


Figure 5: Change in Daily Vehicle Volumes (Pre-CNC to Existing)

Figure 5 indicates that since the opening of CNC and its associated road changes, all streets in the study area have experienced a reduction in daily vehicle volumes or have remained close to pre-CNC volumes, with the exception of Francis Avenue (south of Westminster) and Flockton Street.

[2] Along the combined volumes of Mersey Street (north of Westminster Street), Severn Street, Thames Street and Francis Avenue (north of Westminster Street)
[3] Along the combined volumes of Mersey Street (south of Westminster), Forfar Street, Mayfield Street, Francis Avenue (south of Westminster) and Flockton Street

4 Where is the additional traffic coming from?

Select Link Analysis (SLA) was undertaken to better understand the potential source of trips along Francis Avenue and Flockton Street. SLA allows you to select a particular 'link', that represents a street and direction (e.g., Flockton Street or Francis Avenue and northbound or southbound), and it will indicate, via the width of green bands, where traffic is coming from and going to, in association with the particular link selected. This analysis provides an indication as to where drivers on these roads are coming from and going to, along with the most efficient routes used.

With respect to the SLA, the model indicates the following:

Both Francis Avenue and Flockton Street are primarily being used to access to/from the local neighbourhood, indicated by the blue circled areas in the following figures.

Very few trips have an origin or destination north of QEII Drive, with a small proportion of trips noted from the Mairehau Road/Prestons area, where a route via Francis Avenue or Flockton Street is very attractive to connect to the Central City eastern one-way system (Madras Street and Barbadoes Street).

A negligible number of trips are indicated to be using these local roads (Francis and Flockton) as an alternative to the Cranford Street/Berwick Street route.

Figure 6 and Figure 7 indicates the source of AM and PM trips respectively along Francis Avenue.

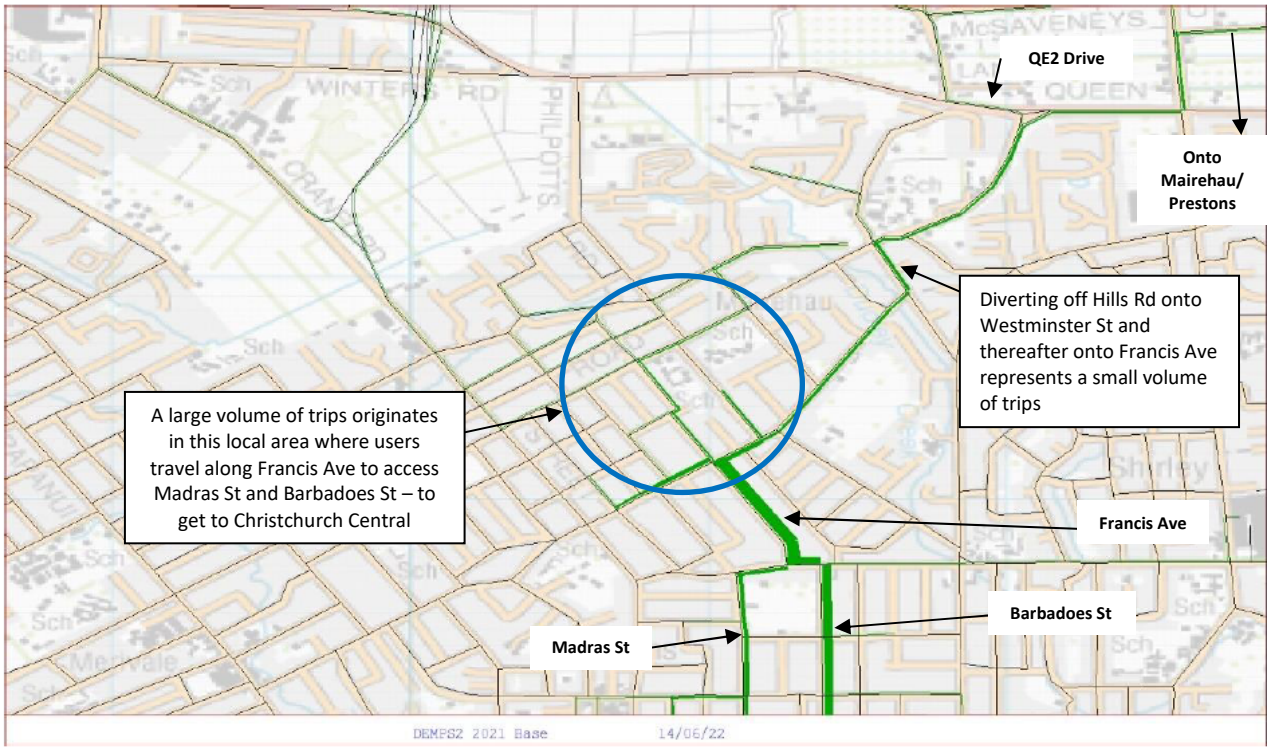


Figure 6: Francis Ave AM Peak Southbound

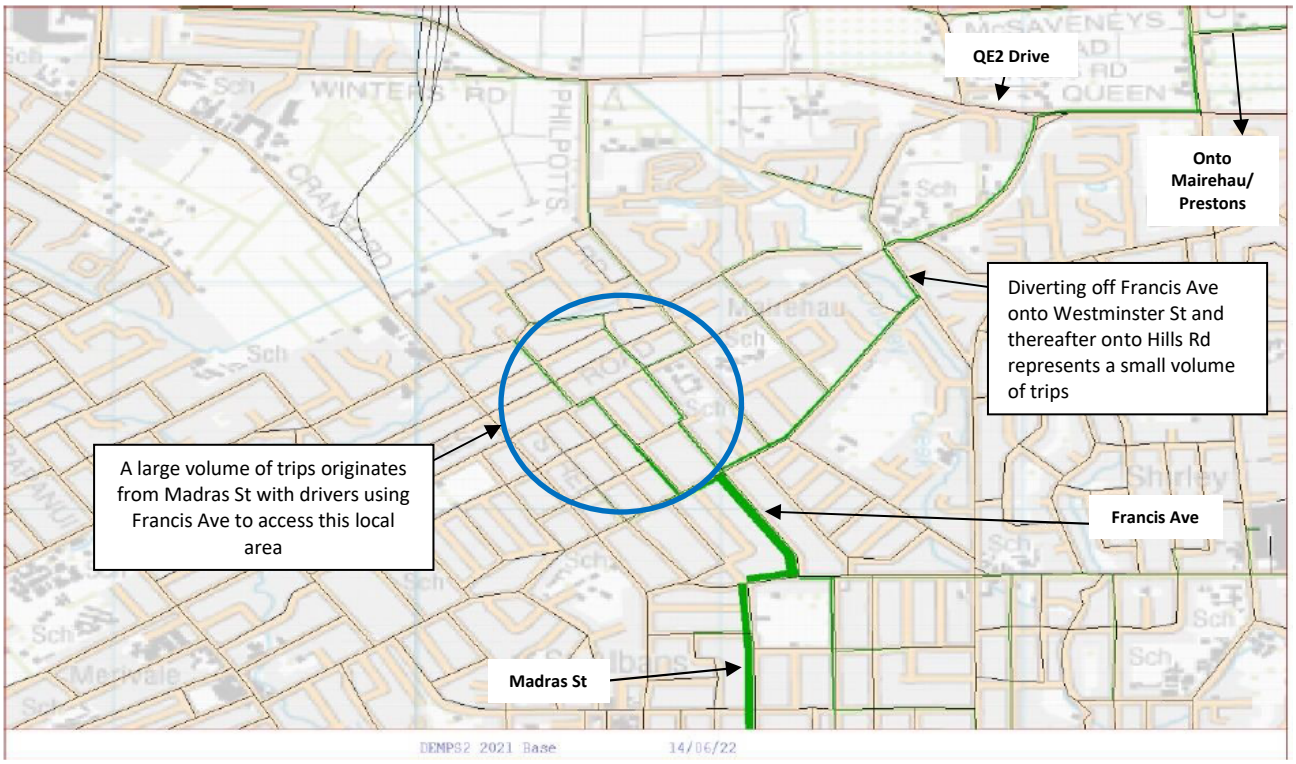


Figure 7: Francis Ave PM Peak Northbound

Figure 8 and Figure 9 below indicates the source of AM and PM trips respectively along Flockton Street.

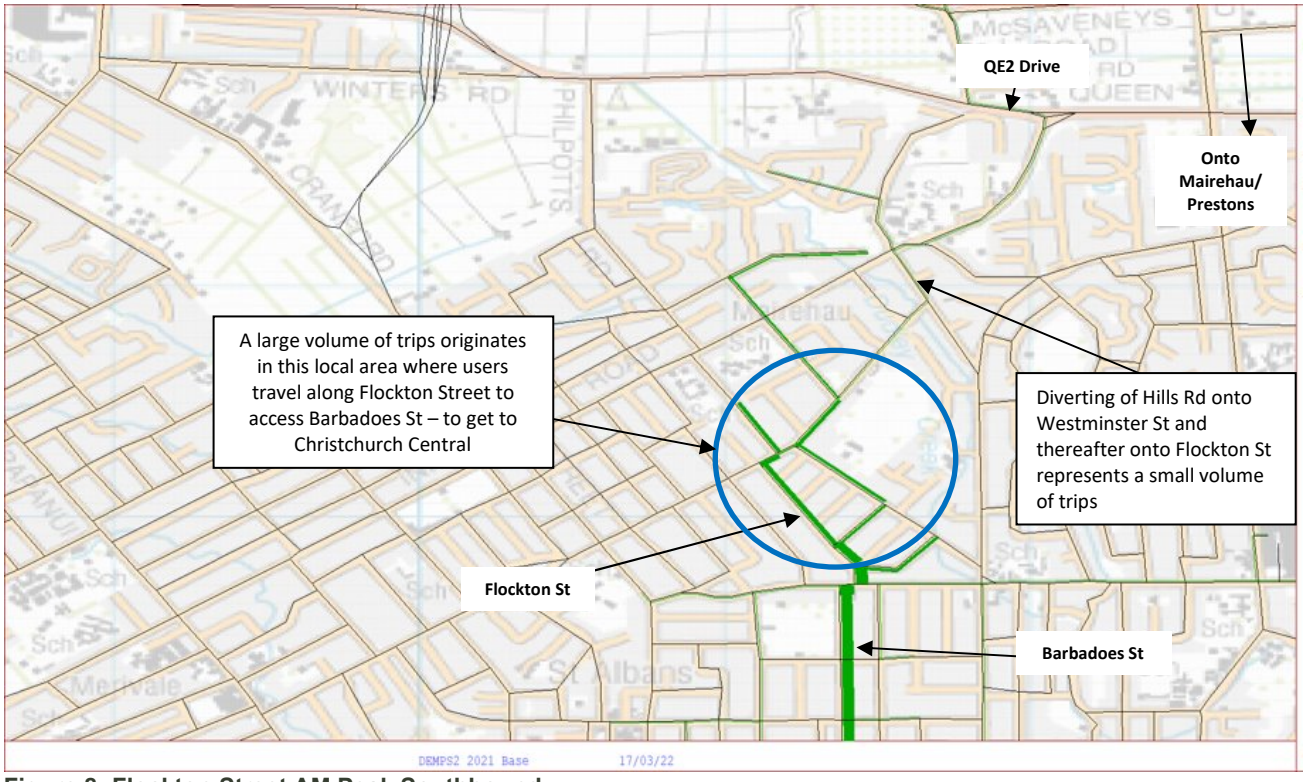


Figure 8: Flockton Street AM Peak Southbound

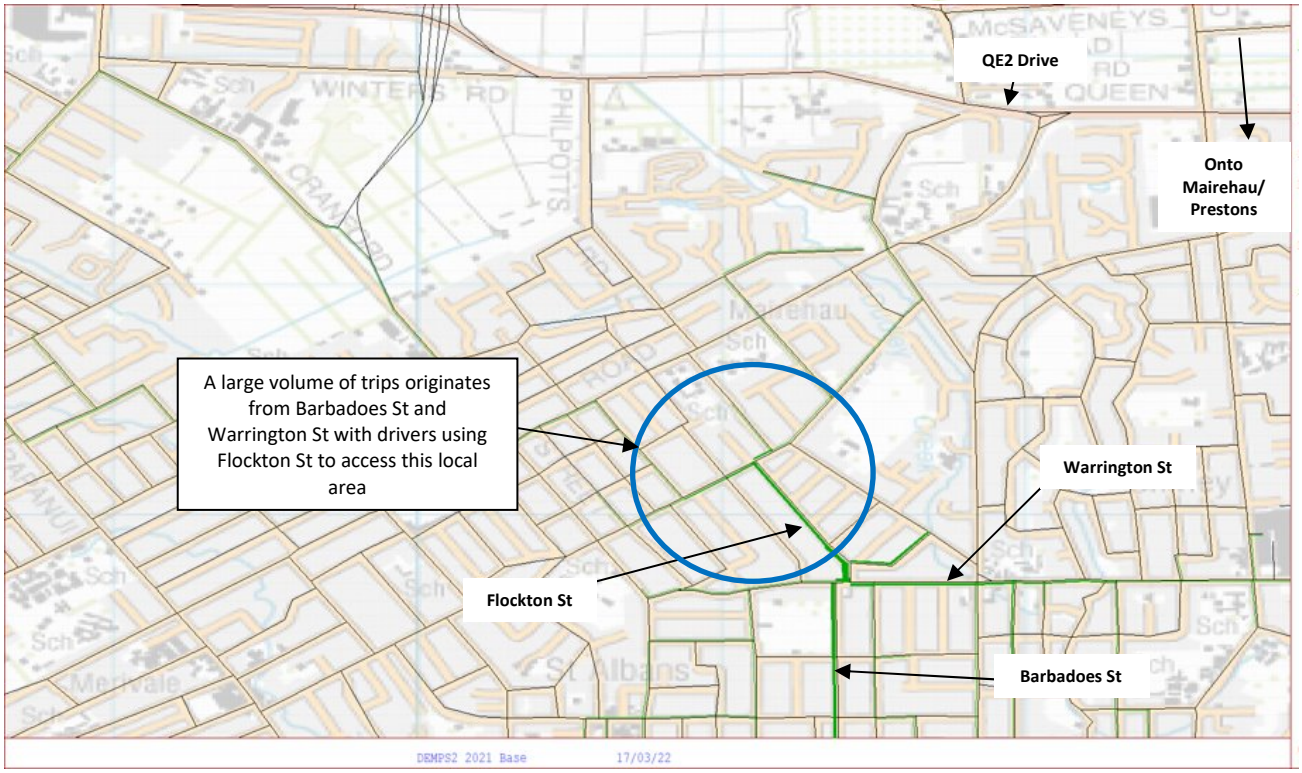


Figure 9: Flockton Street PM Peak Northbound

5 Design Options Modelled

The CAST traffic model was used to test several design options. These design options were developed based on a combination of transport engineering experience, local knowledge of the area and community feedback. Resulting model outputs (including traffic flow changes and intersection delay changes) were then assessed to inform the likely effectiveness of each option.

Several different options have been tested in the model. Options A to D investigates the effectiveness of easing access to or along the wider transport network as detailed below:

Option A – Traffic signals at Hills Road / Akaroa Street intersection

Signalising the intersection of Hills Road and Akaroa Street was hypothesized to ease access onto Akaroa Street – which could in turn reduce the potential for vehicles to divert onto Westminster Street, and then onto Francis Avenue and Flockton Street. Signalising this intersection could also improve the safety of right turn movements from Hills Road onto Akaroa Street.

Option B – Traffic signals at the Aylesford Street / Hills Road intersection

Signalising the intersection of Aylesford Street and Hills Road was hypothesized to increase the attractiveness of Aylesford Street, which could in turn, help distribute the traffic currently using Francis Avenue and Flockton Street. Signalising this intersection could also improve the safety of right turn movements from Aylesford Street onto Hills Road.

Option C – Traffic signals at the Flockton Street / Warrington Street intersection

The community survey indicated that residents of Flockton Street experienced delays at the intersection of Flockton Street and Warrington Street. Furthermore, residents indicated that turning movements at this intersection felt unsafe. Signalising this intersection was hypothesized to reduce delays for drivers and to also improve the safety of right turn movements onto Warrington Street.

Option D – Opening Forfar Street (four-way traffic signals with Warrington Street and Madras Street)

Respondents to the community survey indicated a preference for Forfar Street to be reopened. This option was tested to understand the potential impacts of reopening Forfar Street.

Option A to D are shown geographically in Figure 10 below.

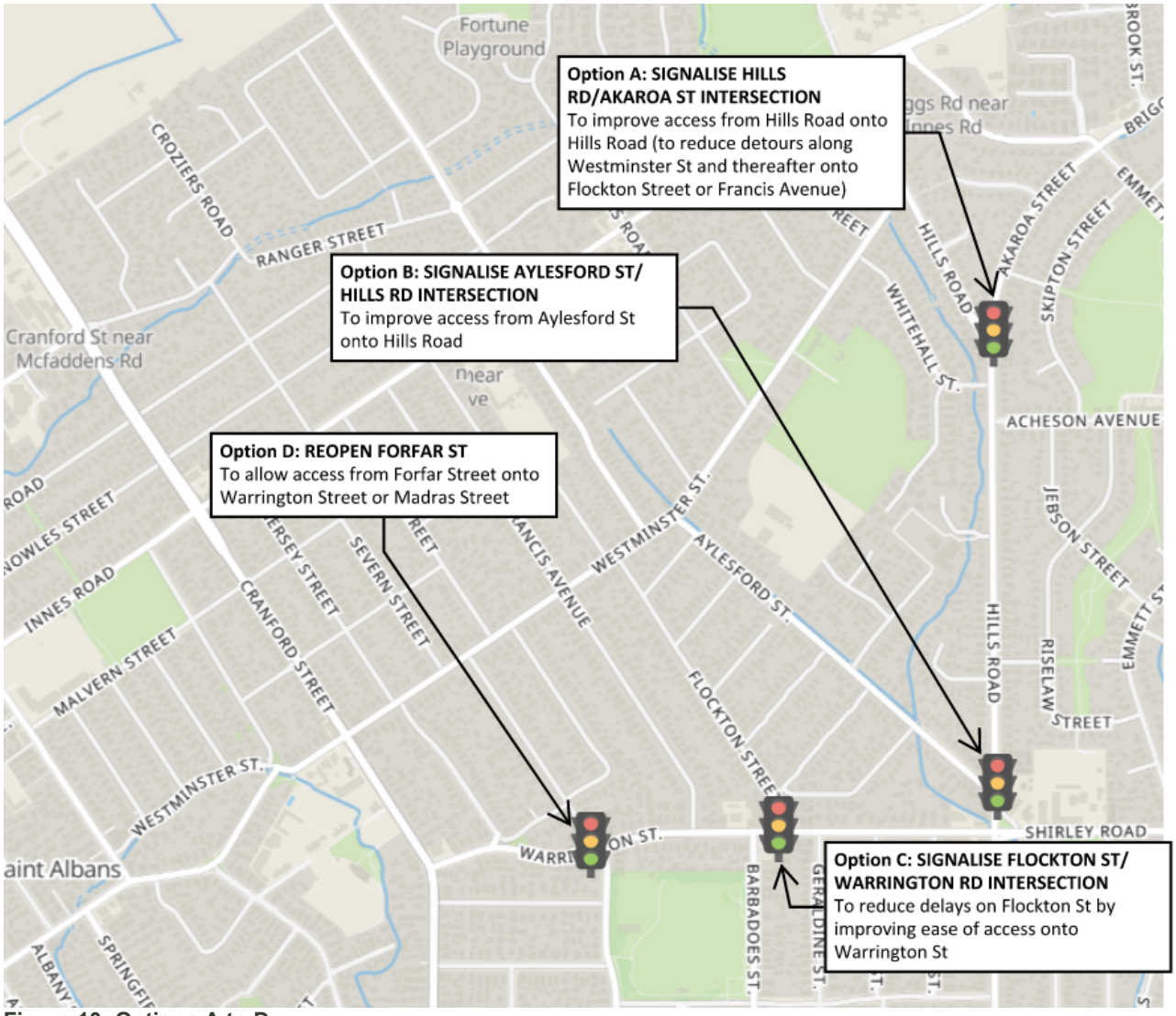


Figure 10: Options A to D

At community seminars held on the 7th and 12th of April (online session with Flockton Street and Francis Avenue residents respectively) and the 25th of May (street meetings with residents), residents of Francis Avenue and Flockton Street requested that additional modelling be undertaken to more deeply consider variations to re-opening Forfar Street. In response to this feedback, the following options were modelled:

Option D2 – Re-open Forfar Street with traffic calming along Forfar Street

To understand if traffic calming would help to mitigate the impacts of opening Forfar Street fully.

Option D3 – Re-open Forfar Street partially (allowing left turn out only)

To reduce the traffic volumes expected along Forfar Street by restricting right turn and through movements.

Option D4 – Install a left turn out along Berwick Street onto Warrington Street

To provide an alternative means of access onto Warrington Street for residents located along Forfar Street, Mayfield Street and Mersey Street.

Option D5 – Install a left turn out along Berwick Street onto Warrington Street with traffic calming along Mersey Street

To understand if traffic calming would reduce the potential for attracting excessive volumes of traffic onto Mersey Street if a left turn out of Berwick Street was provided.

Option E – Cul de sac both Francis Avenue and Flockton Street (midblock)

Effectively restricting these two streets to be used for access only and not through routes.

Options D2 to E are shown geographically below.

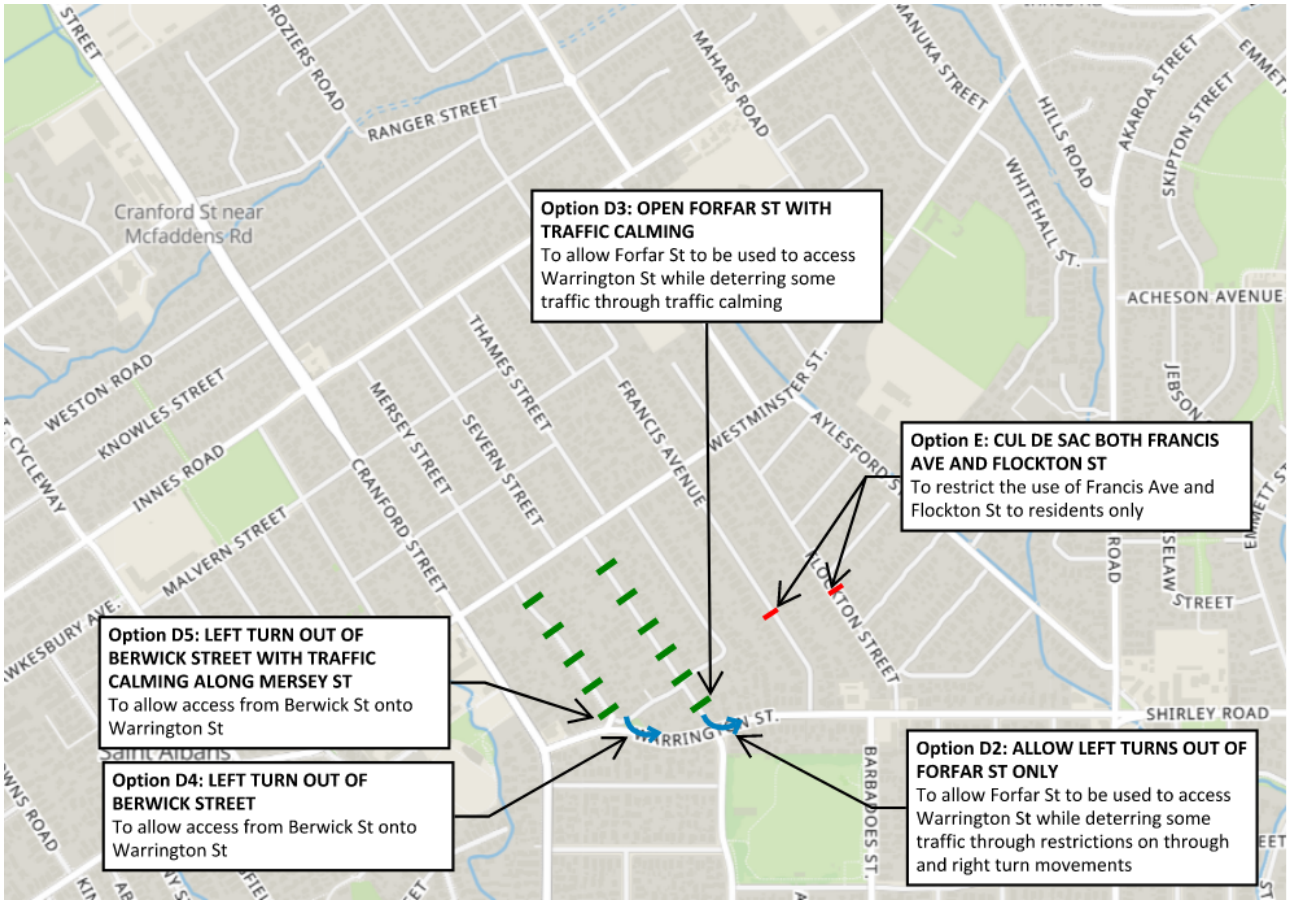


Figure 11: Options D2 to E

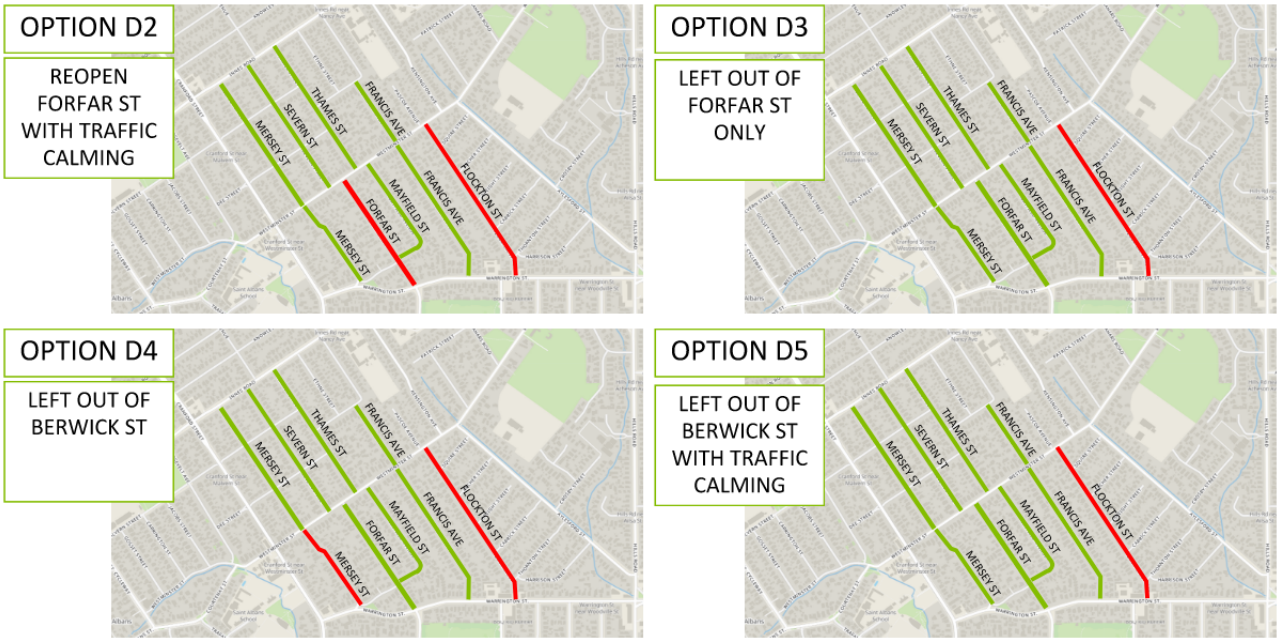
Option F: We also investigated the potential impacts of removing the temporary bus lanes along Cranford Street between Innes Road and Berwick Street in order to install a peak hour traffic lane or T2 lane to understand if this option would attract traffic to Cranford Street and (as a consequence) reduce vehicle volumes along Francis Avenue and Flockton Street.

6 Modelling Results

The model outputs that are most useful for understanding potential impacts of the options tested are **changes in traffic flows** and **changes in travel time (delay).** Traffic flows and delays for each option has therefore been outlined below based on the traffic model outputs.

6.1 Assessment of Local Road Threshold

As noted in Section 3.1, it is generally recommended that the daily vehicle volumes along a local road are maintained at or below 2000 vpd. The images below demonstrate the roads which will meet this threshold (in green) or exceed this threshold (in red) under each option tested in the model.



The modelling indicates that Options A, B, C, D, D2, and D4 all result in more roads exceeding the threshold of 2000 vpd when compared to the existing situation. The modelling further indicates that Options D3 (Left out of Forfar Street) and D5 (Left out of Berwick Street with traffic calming) will result in outcomes similar to the existing situation (where only Flockton Street exceeds this threshold).

The indicated changes in traffic volumes along streets in the study area under each option tested are described in more detail in the following sections.

6.2 Option A - Install Traffic Signals at Hills Road / Akaroa Street Intersection

The model indicated that signalising the intersection of Hills Road and Akaroa Street would result in the change in daily vehicle volumes shown in Figure 12.

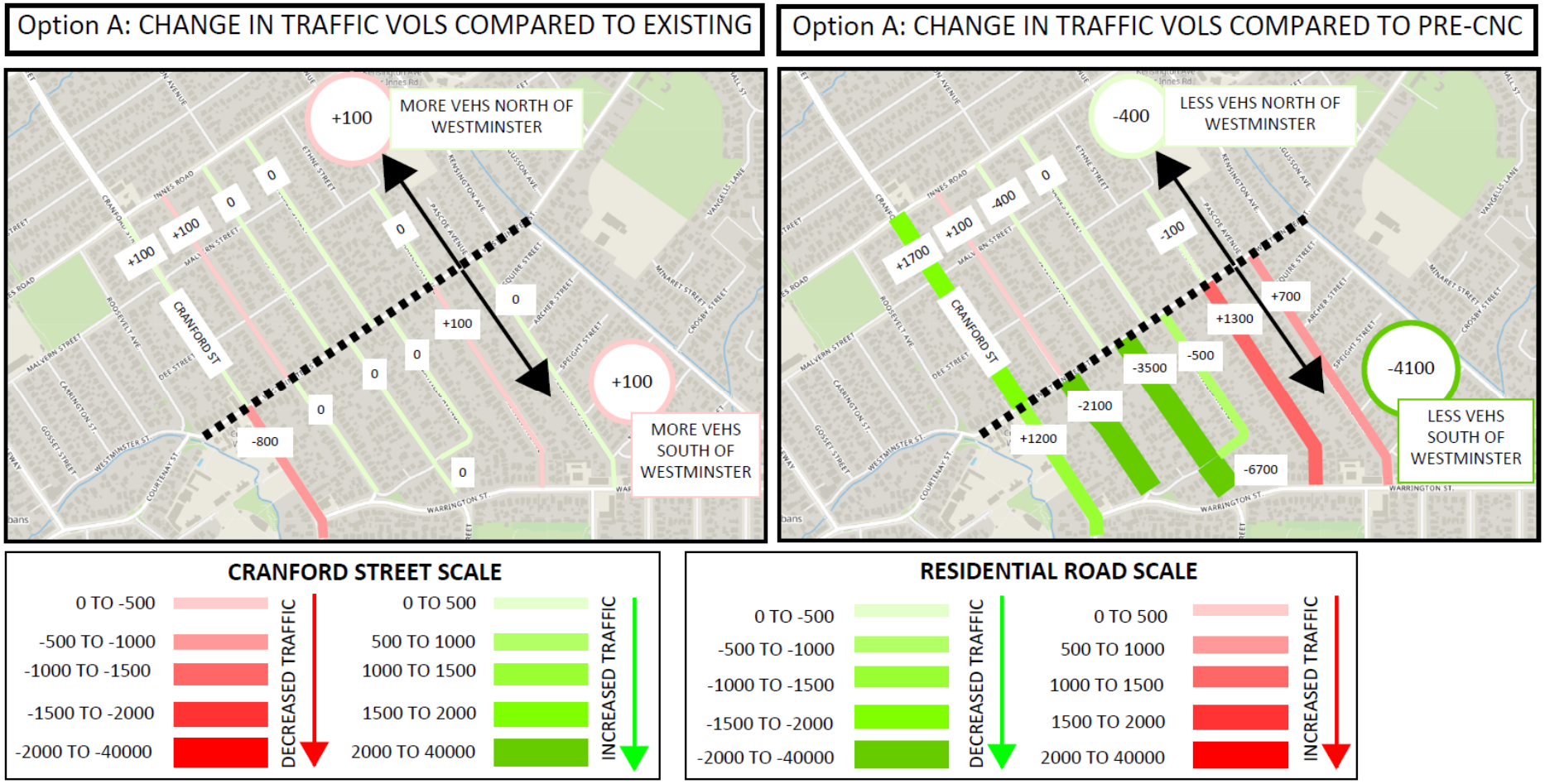


Figure 12: Option A Change in Vehicle Volumes

Traffic modelling indicates that signalising the intersection of Hills Road and Akaroa Street is unlikely to be effective at reducing daily vehicle volumes along Francis Avenue or Flockton Street when compared to the existing situation. This option is also found to introduce delays of approximately 10 seconds on Hills Road (north and south). Overall, this option appears ineffective at reducing vehicle volumes along Francis Avenue and Flockton Street, however it could provide safety benefits for vehicles turning at this intersection.

6.3 Option B - Install Traffic Signals at Aylesford Street / Hills Road Intersection

The model indicated that signalising the intersection of Aylesford Street and Hills Road would result in the change in daily vehicle volumes shown in Figure 13.

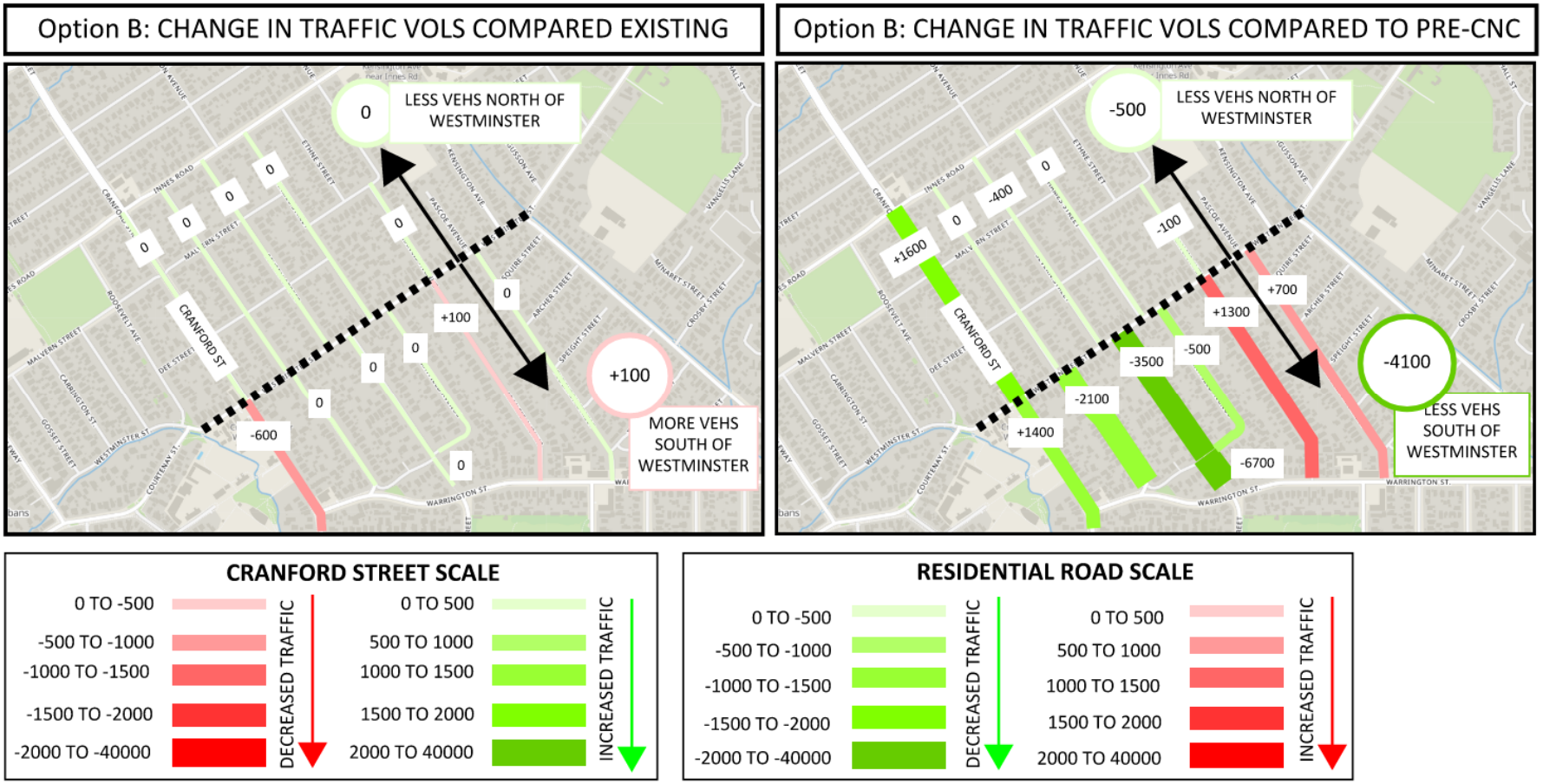


Figure 13: Option B Change in Vehicle Volumes

Traffic modelling indicates that signalising the intersection of Aylesford Street and Hills Road has the desired effect of attracting some traffic to Aylesford Street due to the improved right turn onto Hills Road. However, this option is unlikely to be effective at reducing daily vehicle volumes along Francis Avenue or Flockton Street when compared to the existing situation. Every other street in the study area is indicated to continue to accommodate vehicle volumes very close to the existing situation. This option is also estimated to introduce delays of approx. 5-10 sec on Hills Road (north and south). Overall, this option is estimated to maintain vehicle volumes along roads in the study area very close to the existing situation, however it could provide safety benefits for vehicles turning at this intersection.

6.4 Option C - Install traffic signals at the Flockton Street / Warrington Street Intersection

The model estimated that signalising the intersection of Flockton Street and Warrington Street would result in the change in daily vehicle volumes shown in Figure 14.

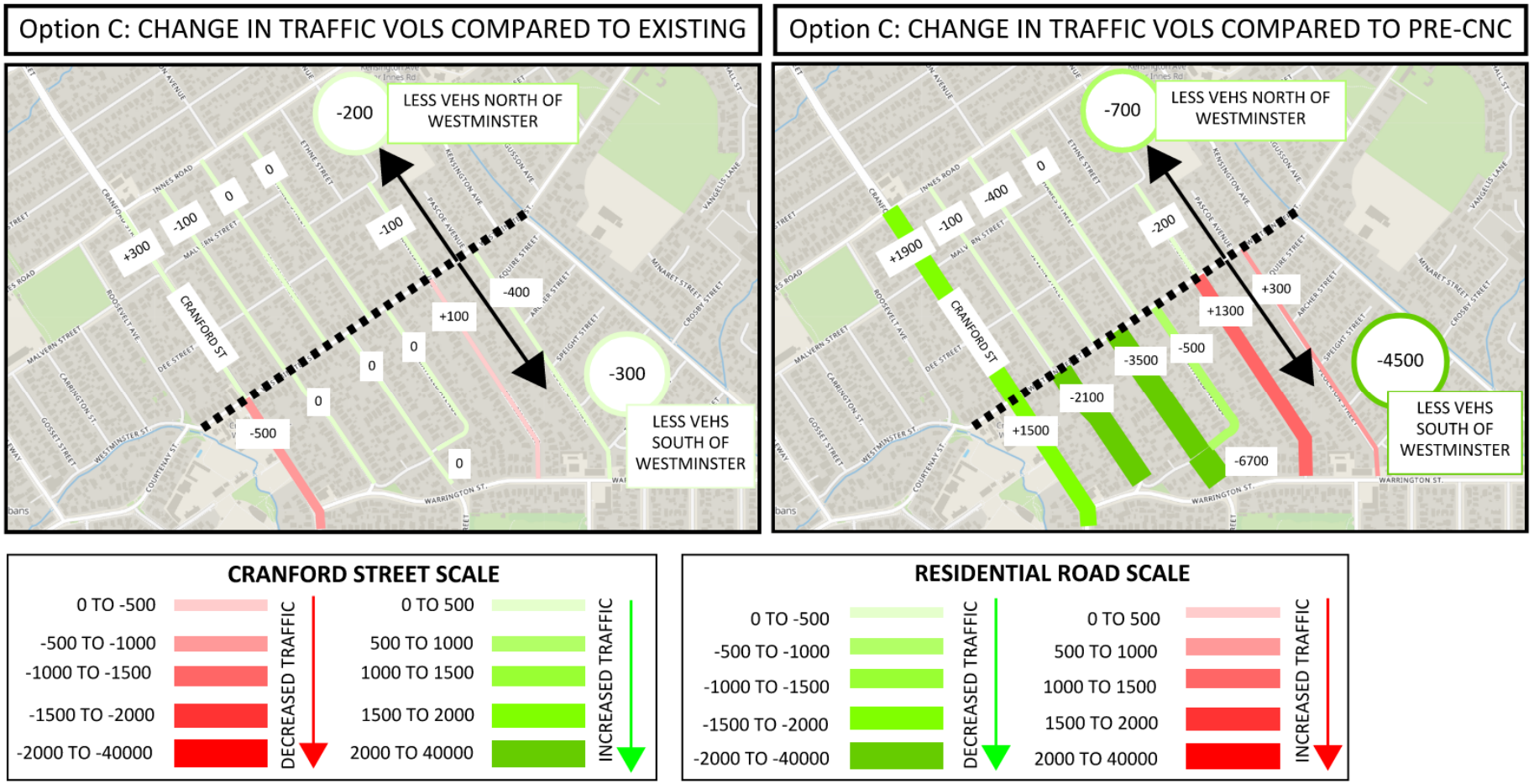


Figure 14: Option C Change in Vehicle Volumes

Traffic modelling indicates that signalising the Flockton Street/Warrington Street intersection could act to reduce (slightly) daily vehicle volumes along Flockton Street. It must however also be noted that signalising this intersection has the potential to make Flockton Street feel and operate more like a 'collector road' due to easier access onto Warrington Street. Modelling also indicates that traffic signal timings associated with Option C will result in similar or increased delays along Flockton Street. Overall, this option is estimated to maintain vehicle volumes along other roads in the study area very close to the existing situation.

6.5 Option D - Reopen Forfar Street

The model indicates that reopening Forfar Street (four-way signalised intersection with Madras Street and Warrington Street) would result in the change in daily vehicle volumes shown in Figure 15.

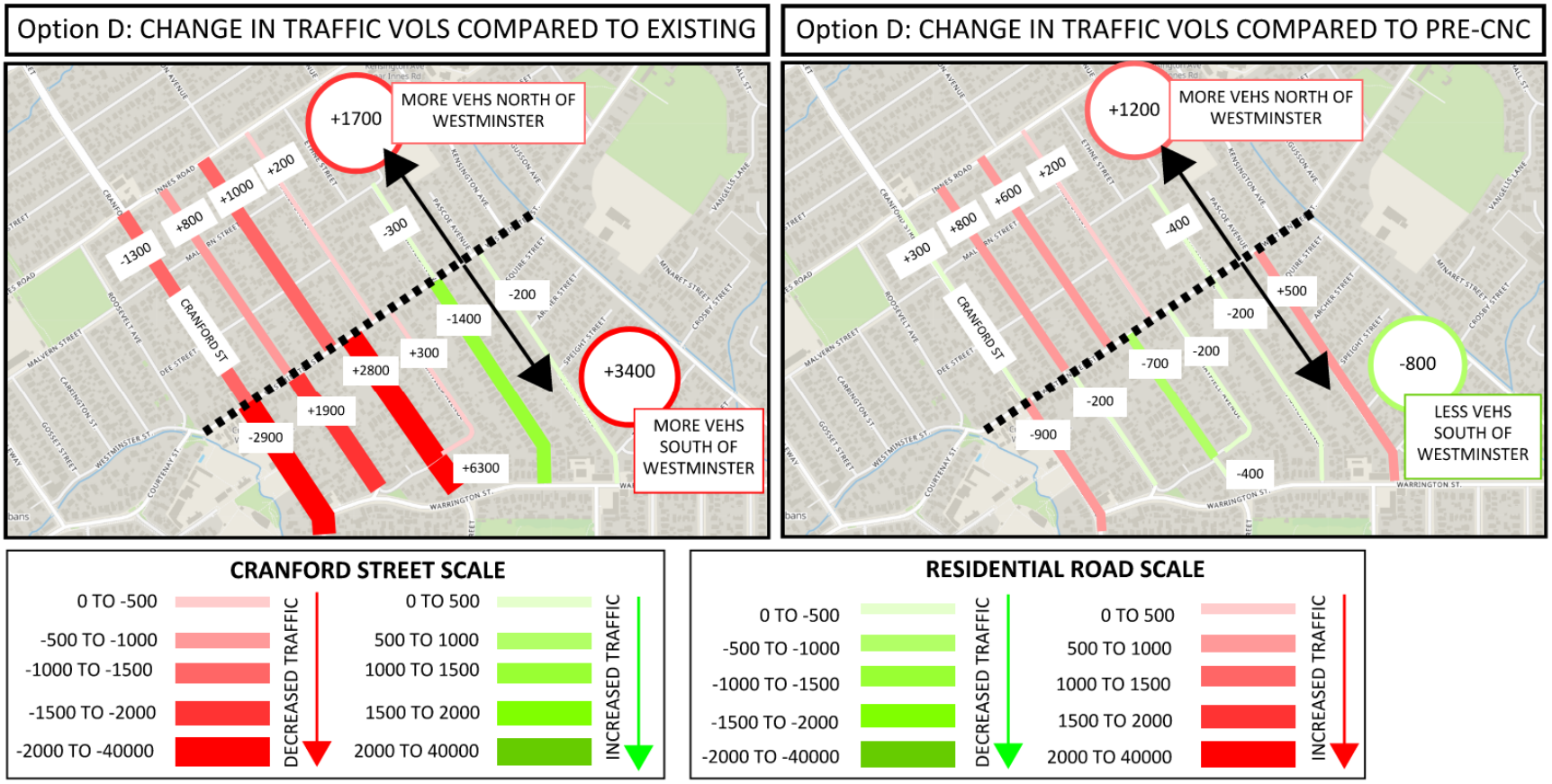


Figure 15: Option D Change in Vehicle Volumes

Compared to the existing situation, traffic modelling indicates that Option D will primarily reduce daily vehicle volumes along Francis Avenue, with Flockton Street estimated to experience only a very minor reduction. Modelling indicates that every other street in the study area will experience an increase in traffic, with Mersey Street (south of Westminster) and Forfar Street exceeding the threshold for a local road. Option D also reduces vehicle volumes along Cranford Street, as more traffic is pulled onto local roads (3400vpd south of Westminster and 1700vpd north of Westminster). While Option D reverts Francis Avenue, Forfar Street and Mersey Street (south of Westminster) close to pre-CNC volumes, it will increase vehicle volumes along Mersey Street (north of Westminster Street), Severn Street and Thames Street above what was experienced prior to CNC opening.

6.6 Option D2 - Reopen Forfar Street (with traffic calming along Forfar Street)

The model indicates that reopening Forfar Street (with traffic calming) would result in the change in daily vehicle volumes shown in Figure 16.

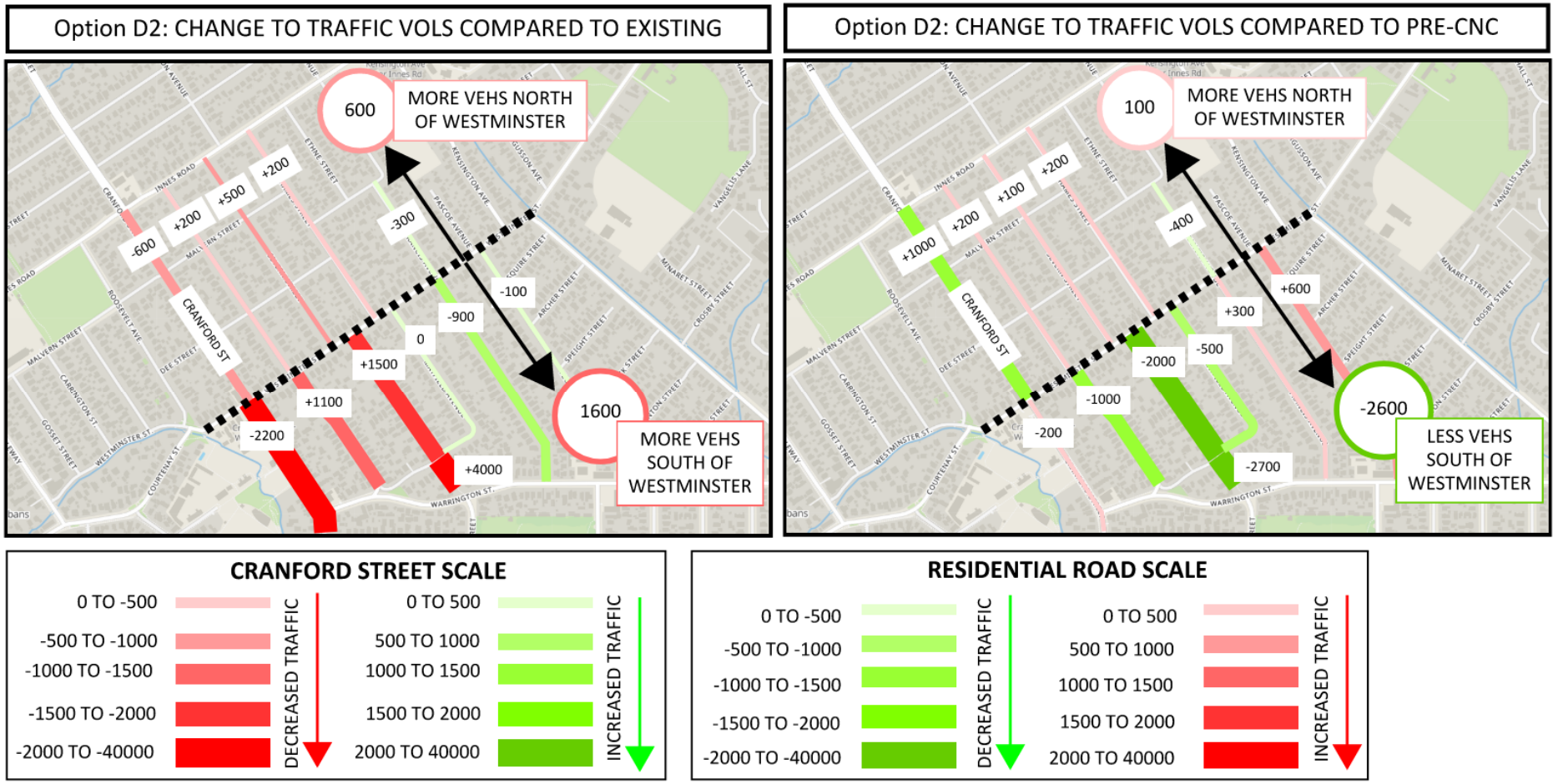


Figure 16: Option D2 Change in Vehicle Volumes

Compared to the existing situation, traffic modelling indicates that Option D2 will, similar to Option D, primarily reduce daily vehicle volumes along Francis Avenue. Vehicle volumes along Flockton Street will remain close to existing. Every other street in the study area, with the exception of Mayfield Street is estimated to experience an increase in daily traffic. Forfar Street is indicated to exceed the threshold for a local road. Option D2 also reduces vehicle volumes along Cranford Street, as more traffic is pulled onto local roads (1600vpd south of Westminster).

6.7 Option D3 - Restrict Forfar Street to Left Turn Out Only

The model indicates that reopening Forfar Street (allowing left turn out only) would result in the change in daily vehicle volumes shown in Figure 17.

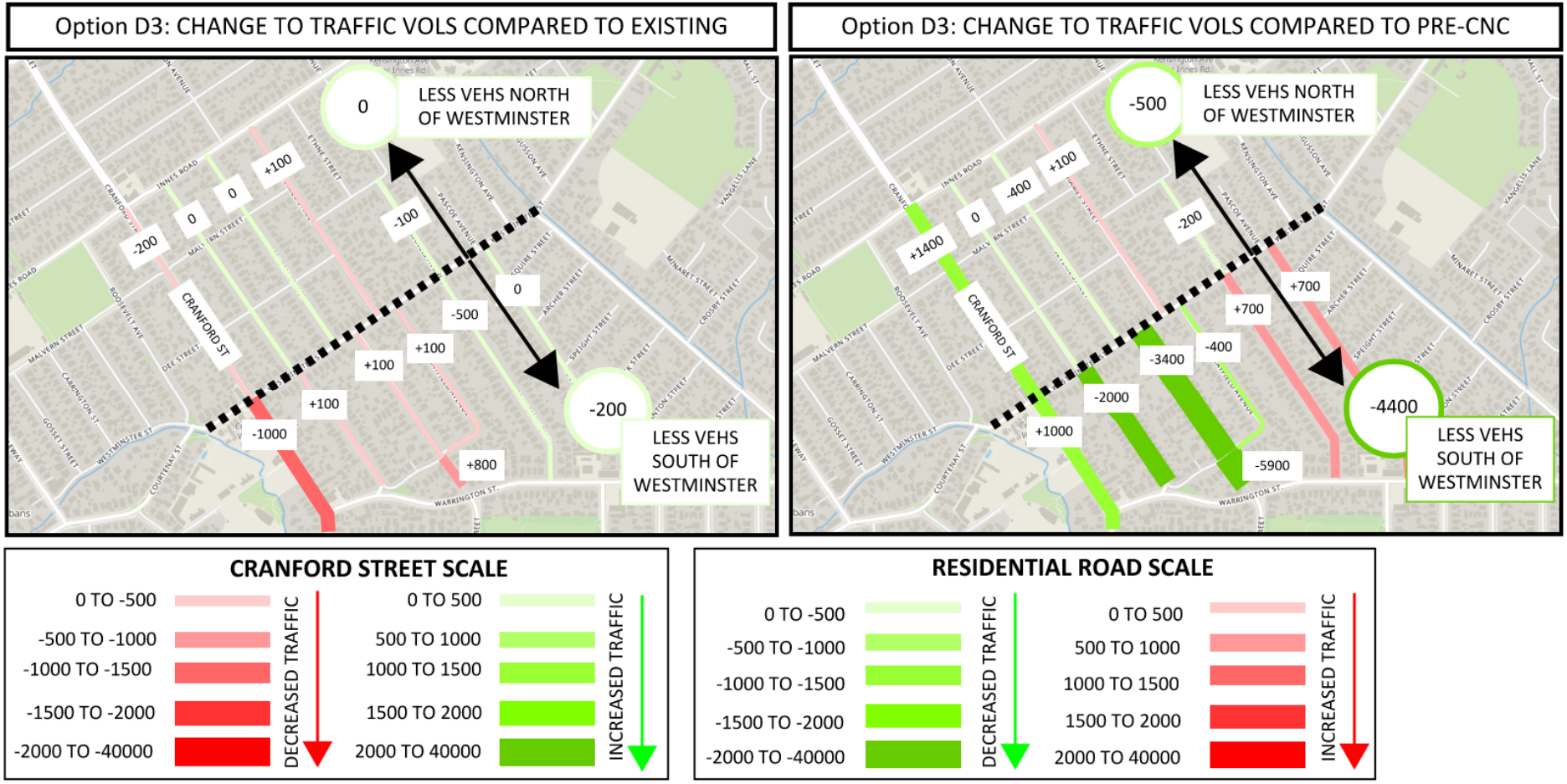


Figure 17: Option D3 Change in Vehicle Volumes

This option is indicated to result in only minor changes to the existing situation, with a modest amount of traffic (around 800 vpd, or 80 vph) indicated to use the left turn out of Forfar Street. While Francis Avenue may see some relief in traffic (500vpd compared to existing), Flockton Street will remain close to existing. Other streets in the area will see minor increases in daily volumes, with the exception of Mersey Street (north of Westminster) and Severn Street. Negligible changes in delay are indicated for this option, except for the added left turn from Forfar Street which is found to experience a high delay to avoid compromising the major through movement along Warrington Street

6.8 Option D4 - Left Turn from Berwick Street onto Warrington Street

The model indicates that installing a left turn out of Berwick Street would result in the change in daily vehicle volumes shown in Figure 18.

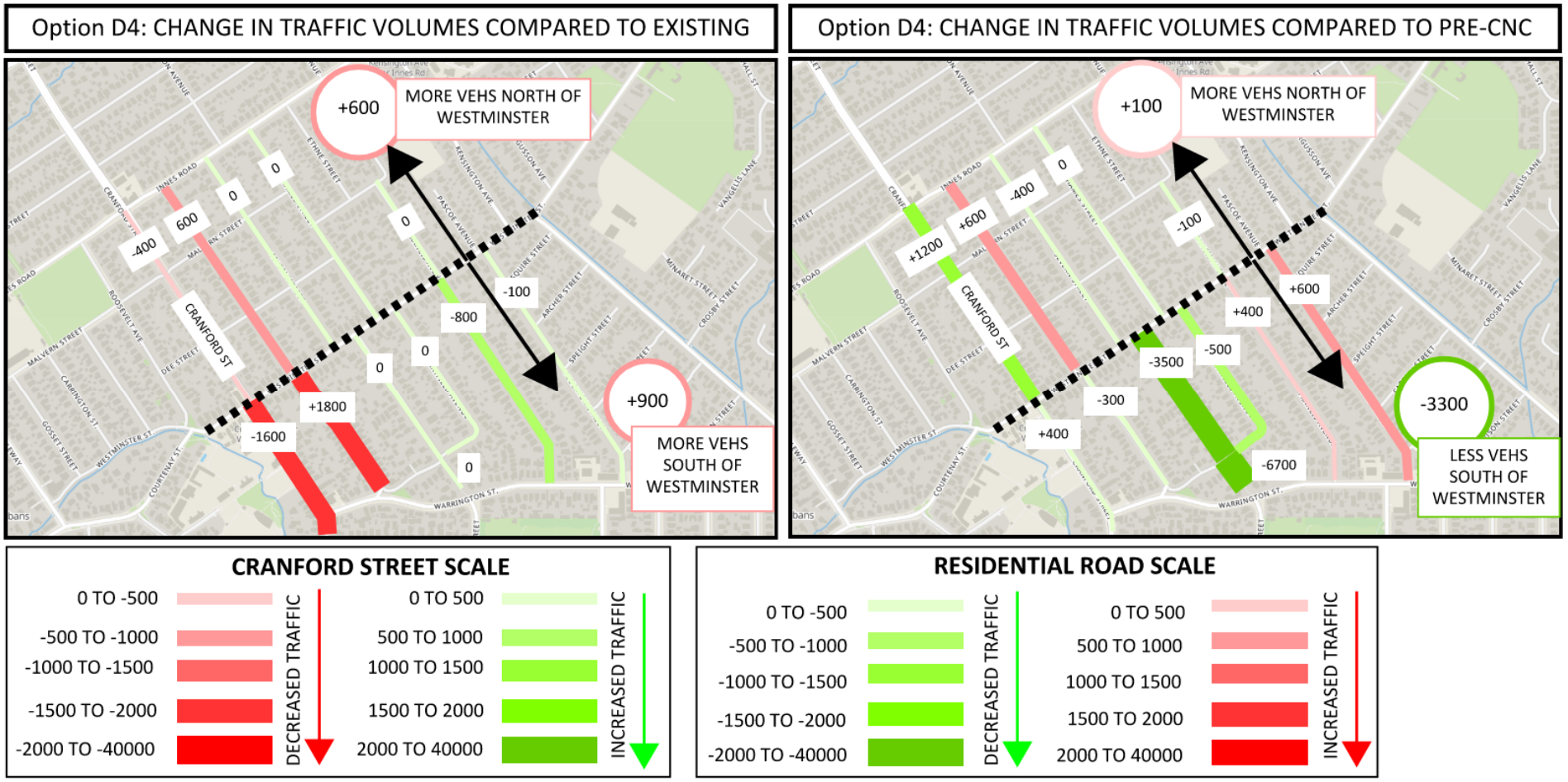


Figure 18: Option D4 Change in Vehicle Volumes

This option is indicated to provide some relief to Francis Avenue (less 800vpd compared to existing) with Flockton Street seeing only a minor change. Traffic volumes along Mersey Street, both north and south, are shown to increase by approximately 600vpd and 1800vpd respectively. Mersey Street (south of Westminster) is indicated to exceed the threshold for a local road. Every other street in the study area is indicated to remain close to existing. This option also pulls some traffic off Cranford Street onto local roads in the area.

6.9 Option D5 - Left Turn from Berwick Street onto Warrington Street (with traffic calming on Mersey Street)

The model indicates that installing a left turn out of Berwick Street would result in the change in daily vehicle volumes shown in Figure 19.

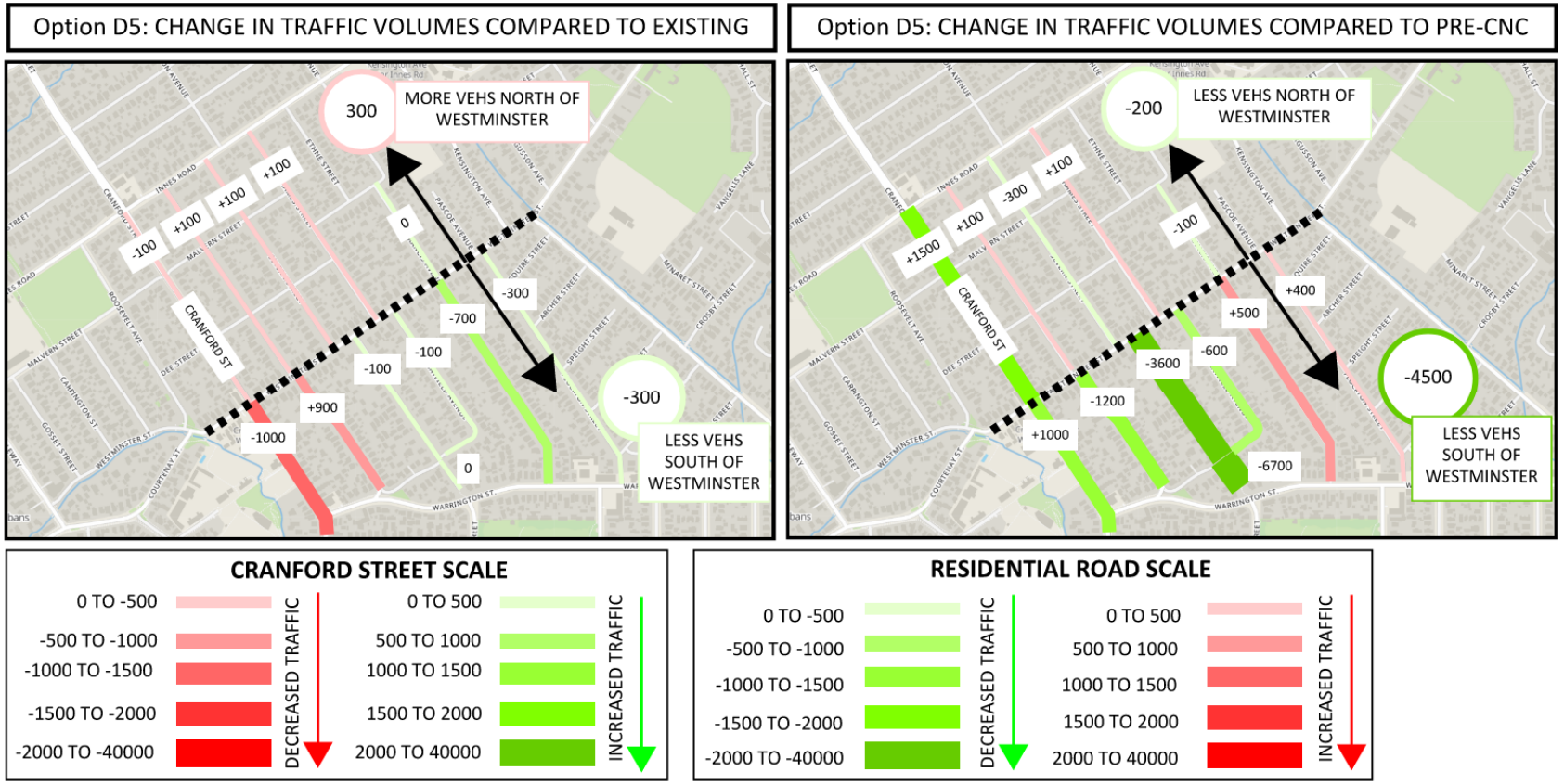


Figure 19: Option D5 Change in Vehicle Volumes

This option is indicated to provide some relief to Francis Avenue (700vpd compared to existing) and Flockton Street (300vpd). Traffic volumes along Mersey Street, both north and south, are shown to increase by approximately 100vpd and 900vpd respectively. While traffic volumes along Mersey Street (south of Westminster) are shown to increase, it is indicated to remain below the 2000vpd threshold. This increase in vehicle volumes will also remain lower than the volumes Mersey Street accommodated pre-CNC. Overall, this option appears to distribute some traffic from Francis Avenue and Flockton Street while maintaining other roads in the study area close to the existing situation.

6.10 Option E - Cul de Sac both Francis Avenue and Flockton Street

The model indicates that installing a cul de sac along both Francis Avenue and Flockton Street (midblock) would result in the change in daily vehicle volumes shown in Figure 20.

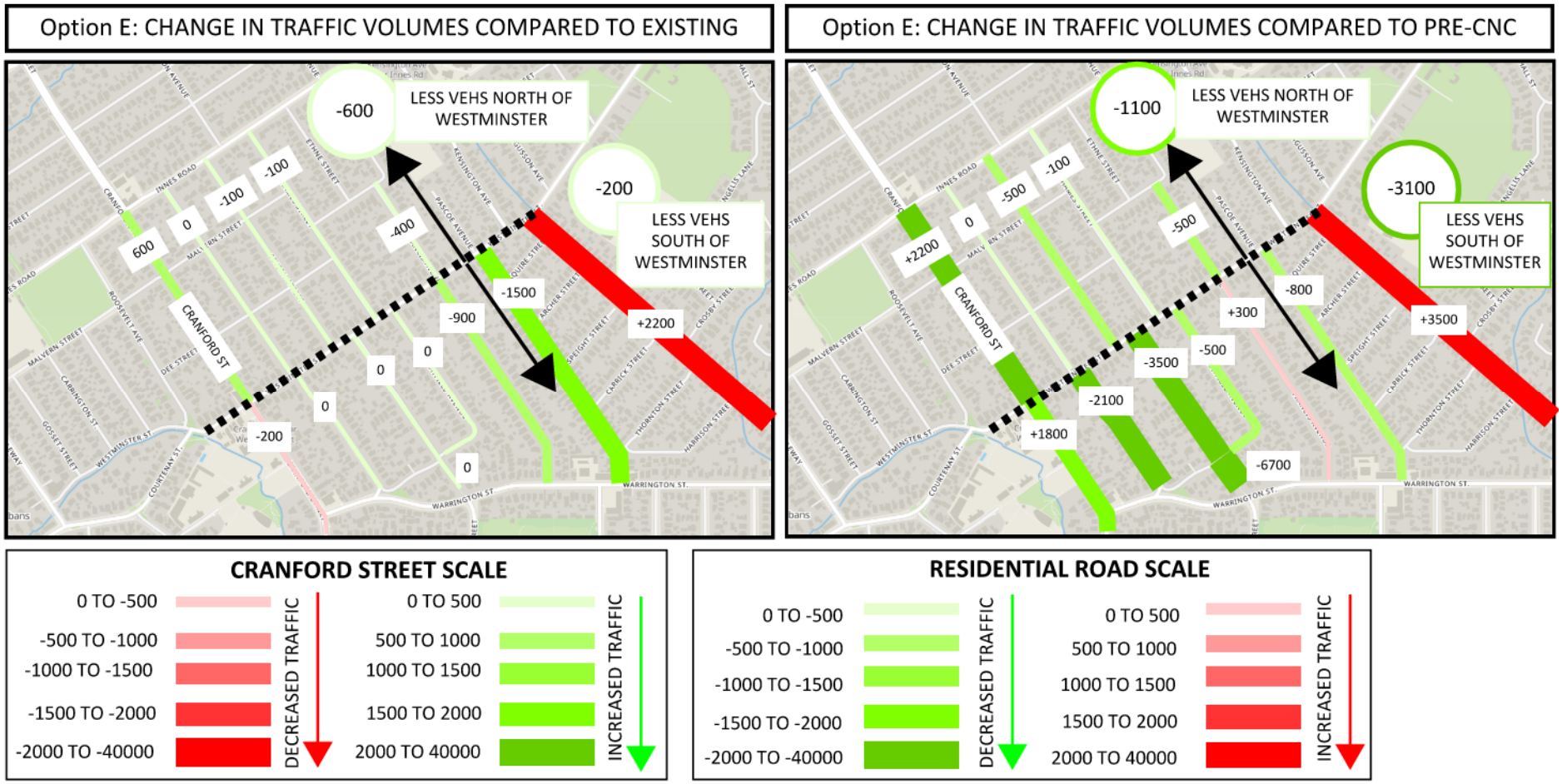


Figure 20: Option E Change in Vehicle Volumes

Modelling indicates that this option will reduce vehicle volumes along both Francis Avenue and Flockton Street. However, a significant volume of traffic will be shifted onto Aylesford Street (an increase of approximately 2200vpd compared to existing). Every other street in the study area is indicated to experience a reduction in traffic or to remain close to existing. This option would have significant impact on the ease of vehicle accessibility for residents in the area between Westminster Street and Warrington Street, as it effectively cuts off through access (with the exception of left in at Berwick) between Cranford Street and Aylesford Street.

6.11 Option F - Removing Bus Lanes Along Cranford Street

Modelling indicates that maintaining the temporary bus lanes (as they are now) has negligible impact on vehicle capacity on Cranford Street, because the main capacity constraints are associated with intersections along Cranford Street (most notably the Cranford Street/Innes Road intersection during both the morning and evening peak).

The modelling further indicates that the addition of traffic lanes along Cranford Street would have negligible impact on the traffic volumes along Francis Avenue or Flockton Street compared to the existing situation. This is shown in the Flow Difference Plots provided below, which via the width of lines, demonstrates the estimated decrease (green) or increase (red) in traffic along roads under this option.

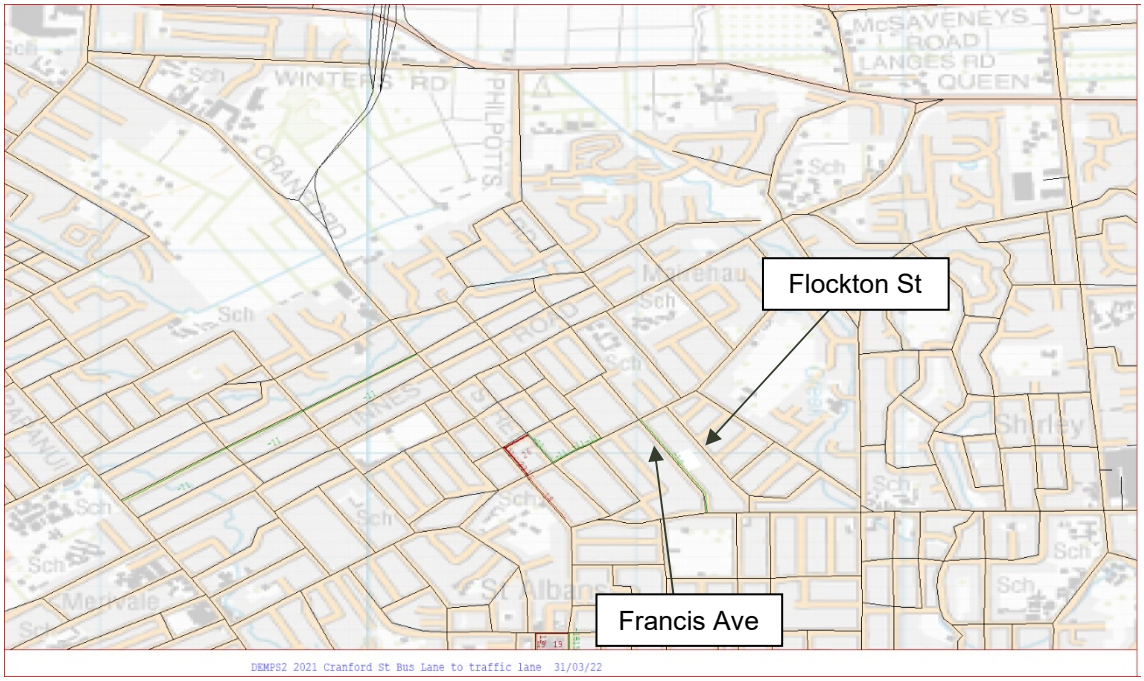


Figure 21: Option F AM Flow Difference Plot

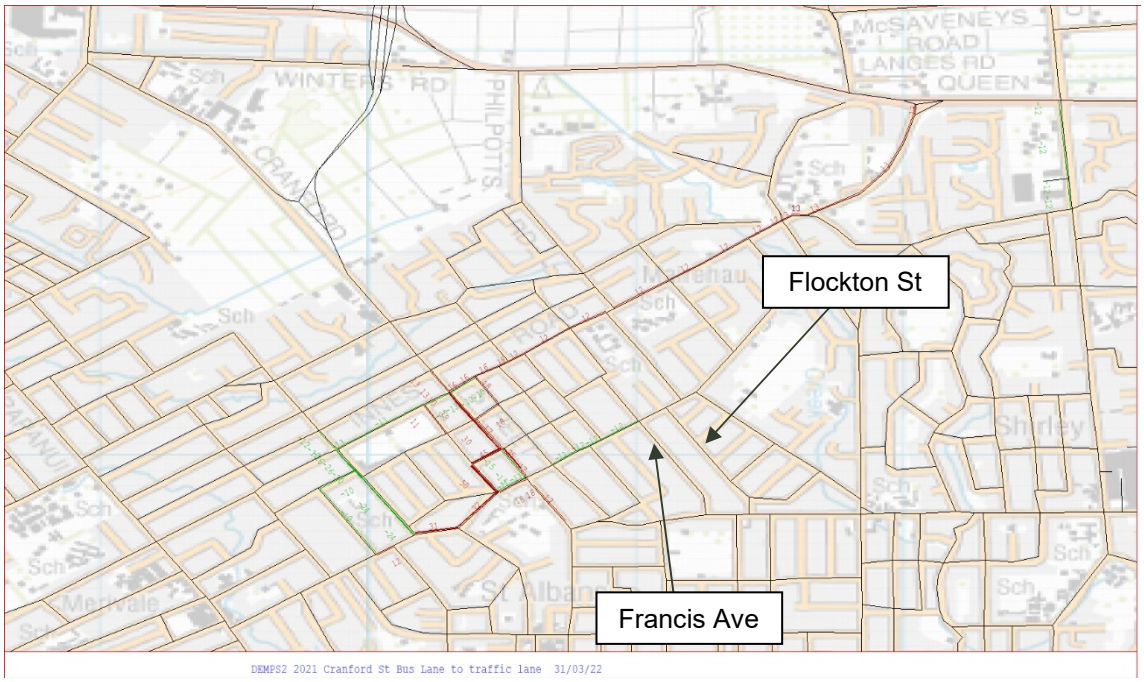


Figure 22: Option F PM Flow Difference Plot

Reconfiguring the bus lanes would also be detrimental to buses in terms of travel times and travel time reliability, which are essential aspects for a successful public transport system.

The modelling indicates that there is negligible change in delay for this option, with a slight reduction (approximately 5 sec) for traffic entering Cranford Street from Dee Street or Malvern Street due to increased opportunity for gaps with Cranford St traffic spread over two lanes instead of one.

Overall, this option is unlikely to relieve traffic volumes along Francis Avenue or Flockton Street, is not shown to increase overall capacity along Cranford Street, and would have negative outcomes for buses in terms of reliability.

7 Assessment of Options

Table 1 provides a high-level assessment of the options against the following criteria:

Cranford Street: Considers if an option attracts traffic to Cranford Street (positive impact) or takes traffic away from Cranford Street (negative impact)

Mersey Street, Forfar Street, Francis Avenue, Flockton Street and Aylesford Street: Considers if an option attracts traffic to any of these streets (negative impact) or takes traffic away from these streets (positive impact)

Other streets in the study area: Considers if an option attracts or takes away traffic from any other streets in the study area

Resident Accessibility: Considers if an option improves or restricts residents' access to their street or to the surrounding transport network

Ability to Construct: Considers the ease of constructability of an option

Table 1: Assessment of Options

Design Options	Assessment Criteria								
	Cranford Street	Mersey St	Forfar St	Francis Ave	Flockton St	Aylesford St	Other Streets in Study Area	Resident Accessibility	Ability to Construct
Option A - Traffic signals at Hills Rd / Akaroa St intersection									
Option B - Traffic signals at the Aylesford St / Hills Rd intersection									
Option C - Traffic signals at the Flockton St / Warrington St intersection									
Option D - Opening Forfar St									
Option D2 - Opening Forfar St (with traffic calming)									
Option D3 - Opening Forfar St (left turn out)									
Option D4- left turn added to Berwick									
Option D5- left turn added to Berwick (with calming)									
Option E - Cul de sac Flockton St and Francis Ave (midblock)									
A colour graded scale has been applied to the table as described below.									
	Positive Impact on Vehicle Volumes ↑							**Improved resident access** ↑	**Reduced complexity to construct** ↑

Options A (Traffic signals at Hills Rd / Akaroa St intersection), Option B (Traffic signals at the Aylesford St / Hills Rd intersection) and Option C (Traffic signals at the Flockton St / Warrington St intersection):

As demonstrated in Table 1, the modelling indicates that Options A, B and C will likely retain daily vehicle volumes along streets in the study area very close to the existing situation. This includes Francis Avenue and Flockton Street which are unlikely to see a reduction in traffic. These options do not improve or restrict residents' access and are somewhat easily constructable.

Option D (Opening Forfar St) and Option D2 (Opening Forfar St with traffic calming):

As demonstrated in Table 1, the modelling indicates that Option D and D2 will draw a significant volume of traffic away from Cranford Street. Option D will increase vehicle volumes along Mersey Street (south of Westminster) and Forfar Street above the threshold of a local road. Option D2 pushes Forfar Street above this threshold. These options are also indicated to increase the vehicle volumes along several other streets in the study area. Flockton Street is indicated to see little benefit from either option, with only Francis Avenue seeing a significant reduction in vehicle volumes. These options improve residents' access to the wider network through an additional connection onto Warrington Street but are difficult to construct. Overall, Options D and D2 are indicated to provide relief to Francis Avenue but will likely negatively impact several other streets in the study area.

Option D3 (Opening Forfar St with a left turn out only):

As demonstrated in Table 1, the modelling indicates that Option D3 will draw some traffic away from Cranford Street but will likely retain vehicle volumes along most streets in the study area very close to the existing situation. This excludes Francis Avenue which is indicated to see some reduction in vehicle volumes. Flockton Street is indicated to remain close to existing. This option improves residents' access to the wider network through an additional left turn out connection onto Warrington Street, but it is difficult to construct.

Option D4 (left turn added to Berwick Street):

As demonstrated in Table 1, the modelling indicates that Option D4 will draw some traffic away from Cranford Street but will likely retain the daily vehicle volumes along most streets in the study area very close to the existing situation. This excludes Francis Avenue and Mersey Street. Francis Avenue is indicated to see some reduction in vehicle volumes while Mersey Street (both north and south of Westminster Street) is indicated to accommodate increased traffic volumes. Mersey Street south of Westminster in particular, is indicated to accommodate a volume of vehicles above that recommended for a local road (above 2000vpd). This option improves residents' access to the wider network through an additional left turn out connection onto Warrington Street, and it is considered relatively easy to construct.

Option D5 (left turn added to Berwick with calming on Mersey Street):

As demonstrated in Table 1, the modelling indicates that Option D5 will draw some traffic away from Cranford Street but will likely retain the daily vehicle volumes along most streets in the study area very close to the existing situation. The modelling indicates that this option will reduce vehicle volumes along Francis Avenue, with Flockton Street also seeing a minor reduction. Similar to Option D4, Mersey Street (south of Westminster) is indicated to accommodate an increased volume of vehicles when compared to existing, however it will remain below the 2000 vpd threshold recommended for a local road. This option improves residents' access to the wider network through an additional left turn out connection onto Warrington Street, and it is considered relatively easy to construct.

Option E (Cul de sac Flockton St and Francis Ave (midblock)):

As demonstrated in Table 1, the modelling indicates that Option E will significantly reduce vehicle volumes along Francis Avenue and Flockton Street, with little change to the vehicle volumes along other roads in the study area. However, this option effectively transfers the volumes of Francis Avenue and Flockton Street onto Aylesford Street, significantly increasing its estimated daily vehicle volumes. This option will also reduce residents' accessibility to their streets and the wider network.

8 Summary

In regard to the existing situation, traffic counts indicate that prior to the opening of CNC, Mersey Street (south of Westminster Street), Forfar Street and Flockton Street were all accommodating daily traffic volumes greater than recommended for a local road. Since the opening of CNC (and other associated road changes), only Flockton Street continues to accommodate vehicle volumes greater than 2000 vpd. Francis Avenue has seen a significant percentage increase in traffic but remains under the desired threshold of 2000 vpd.

Of the options considered, most have either no or minor impact on reducing traffic volumes on Francis Avenue and Flockton Street, or the reduction is at the cost of further impacts elsewhere. None of the options tested to date will appease all streets in the study area.

However, out of the options modelled, Option D5 (left turn from Berwick Street onto Warrington Street with traffic calming on Mersey Street), results in the closest option which balances outcomes across the study area. However, this is at a cost to Mersey Street, which would see an increase in traffic volumes compared to existing (+900 vpd). The increase indicated along Mersey Street will still be less than what Mersey Street accommodated pre-CNC, and vehicle volumes are indicated to remain below the 2000vpd threshold.

Option D5 reduces traffic flows on Francis Avenue and Flockton Street, overall reduces throughput in the study area south of Westminster Street, while balancing the impact as much as possible across the study area. The modelling indicates that an appropriate level of traffic calming would most likely need to be applied to ensure significant volumes of traffic are not attracted to Mersey Street. This option retains vehicle access for residents of Francis Avenue and Flockton Street while maintaining volumes along other streets in the study area (with the exception of Mersey Street) close to existing.

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