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AECOM

Retail Quarter George Street Detailed Business Case (DBC)

15th September 2021

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Retail Quarter George Street Detailed Business Case (DBC)

Client: Dunedin City Council

Co No.: N/A

Prepared by

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Document Retail Quarter George Street Detailed Business Case (DBC)

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Prepared by Robyn Hyde, Torin Smith and Kaylie Bramley

Reviewed by Geoff Prince

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Rev	Revision Date	Details	Authorised	
			Name/Position	Signature
1	15/09/21	Final	Geoff Prince	

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1.0 Executive Summary

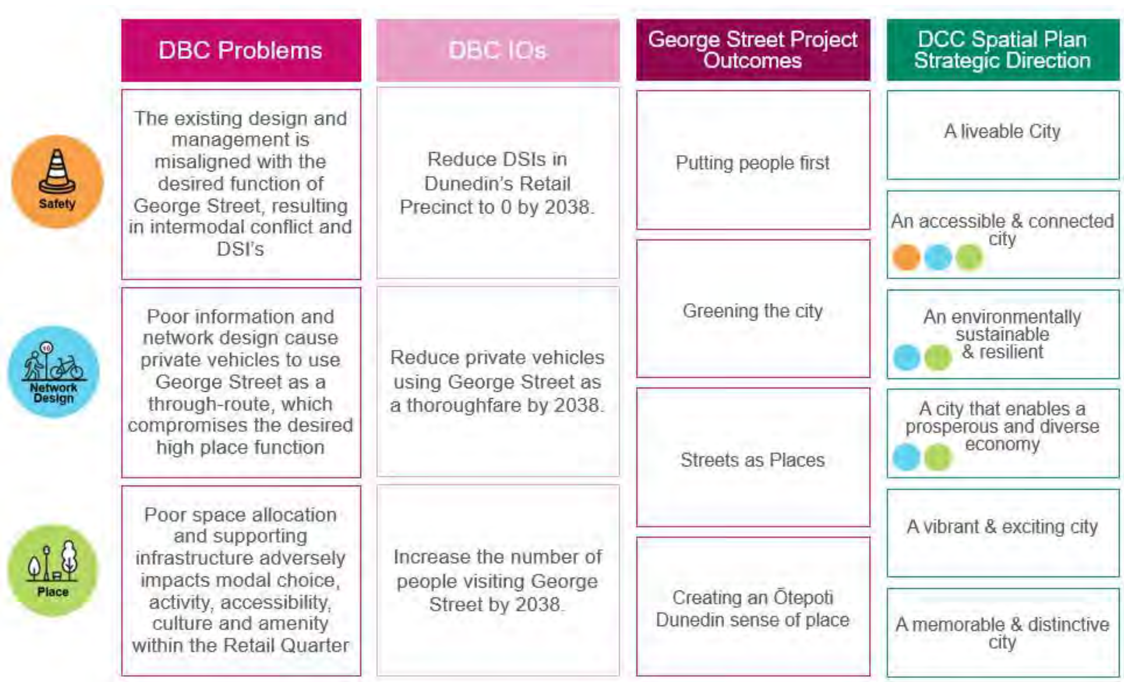
George Street is the city's premiere retail destination, and as signalled in Dunedin's CCP is a foundation project to realise the vision for Dunedin's central city to be a place focused on people that is a vibrant, safe and attractive, and a compelling destination to live, work, play, visit, learn and invest.

With below-ground three waters infrastructure having reached the end of its serviceable life, a significant opportunity exists to coordinate underground infrastructure renewals with upgrading the look, feel and functionality of George Street, in a way that celebrates Dunedin's heritage while ensuring Dunedin's key retail hub remains viable in the future. The last major upgrade in the central city was more than 30 years ago, meaning the paving, lighting, and other furniture is now dated and deteriorating quickly. The overall look and feel is tired, and as a consequence, the Retail Quarter has not kept pace with changes in how people move around and want to use the city today. There are several factors that contribute to this decline and not all can be addressed by the Council or through this business case. However, there is a declining sense of satisfaction with the look and feel of the central city and this is contributing to the Retail Quarter's decreasing share of Dunedin's overall retail share and impacting the area's ability to compete with other areas and online shopping.

Upgrades to George Street, and the surrounding Retail Quarter presents a significant opportunity to embody Kāi Tahu cultural values and status as Ōtepoti mana whenua. This will have significant positive benefits for enhancing local and cultural identity, cross-cultural communication and place making outcomes for all.

Coordinating the infrastructure renewals with amenity and safety improvements in the Retail Quarter will enable cost savings and limit the extent and period of disturbances for businesses, visitors, and residents.

The DBC development process updates and expands on the evidence presented in the Indicative Business Case previously endorsed by DCC and Waka Kotahi to solve the problems identified through the foundation Dunedin City Centre Access, Mobility and Safety Programme Business case. The DBC refines the problem statements and investment objectives specific to the project and the project objectives and wider DCC strategic direction as shown below.



The three problem statements and corresponding investment objectives are broadly linked to Safety, Network Design and Place. The following table summarises evidence presented in the DBC.

Problem	Evidence
Safety	• Recent crash statistics suggest a potential improvement in the Retail Quarter, with the number of serious incidents decreased, possibly associated with the recent installation of Barnes Dance crossings. Historical crash data however does not capture risk or near misses and whilst some safety improvements have been made, safety risks could become more pronounced in future as more vulnerable road users are attracted to the area. Safety risks are amplified through the poor allocation of space as outlined further under problem three. • The network in the central city is not managed in a way that meets aspirations laid out in the Dunedin Network Operating Framework and Waka Kotahi One Network Framework. This leads to the ongoing risk of intermodal conflict if not addressed.
Network Design	• The current design of George Street leads users to view the corridor as a through-route, which conflicts with aspirations for the Retail Quarter to be viewed as an attractive destination. • Modelling indicates a significant proportion of vehicular traffic on George Street is either travelling through (and therefore not directly contributing to the local retail economy) or circulating in search of parking (and therefore eroding the sense of place and amenity and increasing safety risks). • Inefficient use of George Street is compounded through a lack of information on where to find off-street parking, real-time parking availability, and a limited allocation of public space. Large amounts of road space are allocated to turning lanes to reduce travel times, and consequently encourages its use as a through-route which contradicts the desired function of the road
Place	• Space allocation along George Street is disproportionately catered toward motor vehicles (60%), despite data indicating a significant portion of users are pedestrians or arrive by other means. • Reallocation of some of the space currently allocated to motor vehicles by reducing lane widths and removing dedicated turning lanes provides opportunities to expand the space for other uses. • Stakeholders and users indicate the current environment is unattractive, and unwelcoming. There are limited spaces to encourage social interaction and other activities that could support people spending more time in the area. • The existing space allocated for pedestrians and all other non-vehicular uses along George Street is cluttered, in poor condition and compromises accessibility, particularly to those with disabilities or mobility issues and is perceived as unsafe by some. • George Street does not presently reflect the diversity, culture, and sense of place of Ōtepoti that regular users or visitors expect in modern streetscapes and retail areas It is seen as uninspiring, out-of-date and has practically no representation of mana whenua values or culture.

The benefits of addressing these problems have been identified as:

- Improved safety
- City streets operating with the desired place and movement function
- Improved access and sense of place
- Improved amenity.

Three options (in addition to the Do Minimum) were developed and assessed by both stakeholders, partners, and the technical team.

- Do Minimum – Three waters replacement and reinstatement of George Street to existing road layout with minor improvements such as replacement of pavers, while retaining the 30km/hr speed limit.
- Option 1 - George Street to be made one-way northbound with a 10km/hr speed limit

- Option 2 – George Street to be made one-way southbound with a 10km/hr speed limit
- Option 3 – George Street to be retained as two-way with a 10km/hr speed limit

There is also a strong desire for George Street to have a high level of flexibility and ability to evolve over time from a main street, to a distinctive, attractive space for all. To facilitate this, a 'Smart Street' approach has been developed and can be applied to any selected option. The Smart Street approach centres on using retractable (electronically operated) bollards at the beginning and end of each block, and LED (or similar) lighting sensors in parking spaces and/or e-signs to communicate more flexible parking space utilisation within the street design to control access with a more flexible approach.

Overall, the transport assessment demonstrated that all options work well from a traffic perspective and there are only very marginal differences between each. There is little difference across the wider network in terms of change in travel times or congestion and they all provide more space for pedestrians and cyclists and other micro mobility users and a safer environment for users. Reducing vehicle speed in the area has a positive benefit on the safety of other road users (particularly vulnerable road users) and discourages the use of the area as a through-route, diverting vehicles to other parts of the network.

Similar amounts of on-street car-parking on George Street can be retained under either one-way or two-way options.

Place and place-making improvements can be achieved through either one-way or two-way options. The one-way option offers a greater amount of public space not allocated to vehicle movements, that can be used for a range of other activities, in order to encourage more people to visit the area, spend more time in George Street and subsequently spend more in the Retail Quarter. It also offers more potential for arts and culture, social interaction and for increasing the use of the area by a more diverse range of visitors.

From a stakeholder perspective, there was a strong preference to one-way by some stakeholders, particularly students, young people, Pasifika Trust, Plunket, and disability groups. Whereas the two-way was strongly supported by commercial groups (retailers), landlord/developers, Grey Power, Bus Users Support Group Ōtepoti and Urban Access Dunedin. The, two-way option was more broadly acceptable to all, having less variation between negative and positive scores, and a more neutral-to-positive assessment overall. The do minimum was not supported, demonstrating that a level of change is desired.

Care must be given when interpreting these results as engagement has been limited to stakeholders with the Central City Advisory Group. This group is not fully representative of the general public, and some stakeholders are representative of thousands of people (OUSA) and some are representing themselves.

The question of which of the options beyond the do minimum will have the greatest positive impact on maintaining or enhancing the retail and other commercial activity in the Retail Quarter is a more difficult question to answer definitively. A key factor in the most successful examples appears to be good cooperation between the public and private sector and broader community, both in terms of working together to come up with a design that encourages people to visit, but also in terms of working together to leverage the maximum benefits from any changes. An attractive amenity upgrade will not succeed in turning retail fortunes around if there are not good shops, products, and other attractions to keep people wanting to return to and spend money in the area. At a time when retail faces numerous challenges including the growth of online commerce, appealing to a wider range of potential visitors and shoppers should be a key consideration. Locations where the amenity upgrades are accompanied by strong private sector investment and collaborative efforts to manage the area differently appear more likely to succeed than those that rely solely on public realm improvements alone

In terms of the Multi Criteria Analysis undertaken, all options scored well against the investment objectives except for the do minimum. Managing the disruption, technical feasibility, and affordability the two-way option scores highest as it is generally the most acceptable to stakeholders. In terms of the assessment of effects there is significant opportunity to embed the vision of the Spatial plan and CCP plan objectives in all the options except the do minimum. The one-way options score slightly higher over these variables as the space available for uplift is greater than in the two-way option.

The following table presents a summary of the multi-criteria analysis (MCA) results and capital costs for each option.

Criteria	Do Minimum	One way Northbound	One Way Southbound	Two Way Slow
Investment	0	6	7	5
Ability to implement	0	-2	-3	-1
Assessment of Effects	0	13	13	9
Capital cost	$9M	$19M	$19M	$18M

The following table summarises the detailed economic analysis undertaken to assist in determining the option that is likely to optimise the relative value for money. Analysis represents a base case scenario. Note, the costs outlined are solely associated with each option and do not include the costs of the enabling works.

	One way Northbound	One Way Southbound	Two Way Slow
Present value of monetary benefits	$46.5M	$29.2M	$36.3M
Present value of costs	$23.2M	$23.2M	$22.3M
BCR	5.4	3.6	5.1
Appraisal period	40 years		

It is important to acknowledge that the options for this project are very similar. Essentially the assessments undertaken through the business case process reveal that there is no one option that is a resoundingly better investment than another. For this reason, due to the highly political nature of this project and the risks associated with that, the directive to the project team by DCC staff is for the DBC not to make a recommendation and for DCC Councillors to decide whether to endorse the existing preferred option (one-way) or to select the two-way slow street option.

Once the preferred option has been confirmed, further assessment using the Valuing Urban Realm Tool may be used to understand the value of the urban realm benefit. Additionally, an assessment against Waka Kotahi's Investment Prioritisation Method will be undertaken to progress an application for funding of the transport components of this project with Waka Kotahi.

The procurement for the design and delivery of this project was completed prior to the development of this business case. An Early Contractor Involvement (ECI) delivery model was selected to allow DCC to have the contractor involved early in the project development, so they can influence and take ownership of the project design, with a view to achieving greater cost effectiveness and cost certainty in construction as well as expediting overall delivery.

Procurement for professional services and construction was tendered on the open market and the Ō3 consortium, consisting primarily of Isaac Construction, AECOM and Jasmax was awarded the contract in July 2019. The key roles of the Ō3 Consortium are:

- Infrastructure investigation and renewal/upgrade planning for road network, Three-Waters and third-party utility operators
- Investigation, consultation, and design of streetscape upgrade
- Staged design development (concept through to detailed design) for infrastructure renewals/upgrade and streetscape upgrade
- Physical works management and completion.

Project delivery costs estimated for this DBC are based on a scheme design which has been informed by an initial geotechnical investigation, topographical survey, and Three-Waters considerations. A summary of the expected costs for project delivery are provided in the following table.

Description		Base estimate One way options	Base estimate Two way options
Design and project documentation costs including consultancy fees		$6.2M	
Three-Waters construction costs	Enabling works	$14.2M	
	George Street	$10.2M	
Transport and amenity construction costs	Enabling works	$5.4M	
	George Street	$19M	$18M
	Total estimated costs	$54 - $55 million	

In comparison to the project cost estimate of $62.44M[1] (high value) presented in the financial case of the IBC, early indications and understanding of costs through the DBC suggest a savings of approximately $2M from these early estimates. The long-term plan has an allocation of $29.8m for transport and $29.4m for Three Waters, suggesting that the most recent costs are within the budget.

This project is scheduled to continue to progress through the pre-implementation phase and implementation is due to commence in October. The Three-Waters infrastructure is committed for funding by DCC, including the cost of the street reinstatement.

Whilst DCC has funding approved to progress to the next phase, there is opportunity for co-investment with Waka Kotahi through the NLTF. As a key potential funding partner DCC and the project team have engaged with Waka Kotahi throughout the life of this project. There has been a high level of collaboration and transparency of information to make sure the project has the best opportunity of meeting Waka Kotahi funding guidance and criteria.

The Waka Kotahi funding assistance rate (FAR) for qualifying activities for Dunedin City Council is set at 51% for the next 2021/24 NLTP. Waka Kotahi are guided by the GPS for Land Transport and their priorities for investment as informed by the Investment Prioritisation Method (IPM) for funding from the 2021/2024 NLTP. Improving safety outcomes across the network, providing better travel options including supporting town centre upgrades to enhance the environment are key priorities that Waka Kotahi invest in[2]. From a transport perspective the primary benefits arising from this project are the health benefits arising from increased pedestrians on George Street.

There is a risk that this project will not receive funding support from Waka Kotahi. Initial indications from Waka Kotahi are that the project is unlikely to achieve the level of funding anticipated in the IBC and that they will be restricted to a percentage contribution of walking and cycling benefits and any identified safety improvements.

Once a preferred option is selected by Council, the DBC will outline the case for investment to Waka Kotahi and demonstrate to the degree that this project meets their funding criteria. This project will then need to be assessed in relation to other funding applications and priorities. It is worth noting that the NLTF is a limited resource to fund all transport projects and is already over-subscribed for the next three-year period. The exceptional circumstances brought about by COVID 19 have also placed additional pressure on this funding source.

The proposed investment project is an integral part of the Dunedin Central City Plan. Should this investment proposal receive formal approval, the project delivery will be phased with the commencement of the enabling works package followed by the George Street works. Developed and detailed design for the enabling works and Three-Waters is underway with construction due to start in October 2022. The completion of the George Street upgrade aims to be completed by early 2024.

[1] Table 22-2 from the IBC
[2] https://www.nzta.govt.nz/assets/planning-and-investment/docs/waka-kotahi-investment-proposal-2021-31.pdf

Glossary of Acronyms

Acronym	Description
AA	Automobile Association
ADT	Average Daily Trips
2GP	Dunedin City Council's Second Generation District Plan
BCR	Benefit Cost Ratio
CAS Data	Crash Analysis System Data
CBD	Central Business District
CCAG	Central City Advisory Group
CCP	Dunedin City Council's Central City Plan
CPTED	Crime Prevention Through Environmental Design
DBC	Detailed Business Case
DCC	Dunedin City Council
DMM	Dunedin Microsimulation Model
DPA	Disabled Person Assembly
DSI's	Deaths and Serious Injuries
ECI	Early Contractor Involvement
IBC	Indicative Business Case
IPM	Investment Prioritisation Method
IQA	Investment Quality Assurance
FENZ	Fire and Emergency New Zealand
GPS	Government Policy Statement on Land Transport 2021-2031
KPI	Key Performance Indicators
LGA	Local Government Act 2004 / 1974
MCA	Multi Criteria Analysis
MBCM	Monetised Benefits and Costs Manual
NLTF	National Land Transport Fund
NLTP	National Land Transport Programme
NOF	Dunedin Network Operating Framework
NPS-UD	National Policy Statement on Urban Development 2020
NPV	Net Present Value
ONF	One Network Framework
ORC	Otago Regional Council
OPSA	Otago Polytechnic Students Association
OUSA	Otago University Students Association
PBC	Programme Business Case
PCCG	Project Change Control Group
PCG	Project Control Group

Acronym	Description
PBIOs	Problems, Benefits, and Investment Objectives
PERS	Pedestrian Environment Review System
RAMM	Road Asset and Maintenance Management
RLTP	Otago Southland Regional Land Transport Plan 2021-2031
RMA	Resource Management Act 1991
SFDT	Shaping Future Dunedin Transport
SH 1	State Highway 1
SMART goals	Specific, Measurable, Achievable, Realistic and Time bound
TGSI	Tactile ground surface indicators
VMS	Variable message signs
VKT	Vehicle Kilometres Travelled
VPH	Vehicles per hour
VURT	Value of Urban Realm Toolkit
Waka Kotahi	Waka Kotahi New Zealand Transport Agency

2.0 Introduction

AECOM has been appointed by Dunedin City Council (DCC) to compile a Detailed Business Case (DBC) for the Retail Quarter project located within the Dunedin Central Business District (CBD). The requirement for the DBC is based around the Three Waters replacement works and the desire to transform George Street into a more compelling and attractive place that appeals to visitors, helping to make the central city a prosperous, vibrant, and distinctive destination, that is accessible to all

The Three Waters Infrastructure upgrade, as identified within the City Council's Central City Plan (CCP) is being carried out due to the stormwater, wastewater and water mains being at the end of their serviceable life. Capacity issues and the current state of repair means George Street will be dug up, and all pipes replaced. As the entire surface level is being disturbed, there is opportunity to replace it with a streetscape which is safer, more attractive and more mode balanced than the current arrangement.

Notably, the CCP highlighted that. coordination of the above and below ground works to upgrade both the three waters infrastructure and improve safety and amenity on George Street will provide cost savings and limit the extent of construction disturbance on adjacent properties and the wider transport network

The CCP has identified improvements to the George Street Retail Quarter as one of Dunedin's ten transformational projects. This is a high priority central city integrated land use and transport project for DCC and focuses on infrastructure upgrades and streetscape renewals that will contribute to improving safety and the quality of the public realm across the city. This project is part of a wider programme to improve safety, accessibility, and liveability in Dunedin's central city, previously endorsed by Waka Kotahi (The New Zealand Transport Agency).

It has been determined that the Indicative Business Case (IBC) recommendation for the three waters element of the project is robust. As such, this DBC will not assess the three waters components in detail.

This project is being led by DCC in collaboration with investment partner Waka Kotahi and treaty partner Ngāi Tahu (represented by Aukaha). It builds on the 'Dunedin Retail Quarter – George Street Indicative Business Case (2020).

2.1 Work completed to date

An IBC was completed in July 2020 and approved by DCC and Waka Kotahi. Additionally, an independent review was undertaken by Urbanism+.

Whilst Waka Kotahi approved the IBC, gaps were identified that need to be addressed in the DBC including:

- Additional evidence for the network design and place problem statements
- Detailed analysis of the options and wider network impacts
- Justification of the transport amenity cost split
- An accurate Benefit Cost Ratio (BCR) demonstrating value for money provided by the project.

Design and delivery contracts have been awarded for two other key work streams (Enabling Works and Three Waters Upgrades, see Section 3.3.3 below) which are being progressed in parallel to this business case.

2.2 Purpose of the DBC

The purpose of this DBC is to identify an investment option that optimises value and the opportunities created by investing in transport and amenity upgrades in the Retail Quarter, following the replacement and upgrade of three waters infrastructure.

This document will:

- Revisit and build on the IBC strategic case for change assumptions and evidence;
- Provide an understanding of the interconnection between activities, and how changes to George Street will change the landscape of the central city transport network;
- Re-test a shortlist of options that address safety, network design and sense of place issues in the Retail Quarter, while balancing the future desired functionality and outcomes for George Street; and
- Identify and plan the necessary funding and management arrangements to successfully deliver the project.

This DBC follows the Treasury Better Business Cases guidance; it is organised around the five-case model, designed to systematically ascertain that the investment proposal:

- is supported by a compelling case for change - the 'strategic case'
- optimises value-for-money, including public value - the 'economic case'
- is commercially viable - the 'commercial case'
- is financially affordable - the 'financial case'
- is achievable - the 'management case'.

The DBC investigates options that will enable investment as outlined in the LTP of up to $29.8m for streetscape upgrades (in addition to the $29.4m for three waters renewals) in 2021-2024 to:

- upgrade George Street so it is place-based, attractive, convenient, safe to visit and encourages investment.
- improve movement, connectivity, and safety for all modes on Great King Street and Filleul Street

This investment directly aligns with the strategic directions of Dunedin's Spatial Plan to improve the central city as a people friendly place with quality facilities and an attractive, sustainable, and memorable street environment where businesses feel confident to invest. It is broadly consistent with each of the other DCC strategies and achieves numerous objectives within this wider strategic framework. It also contributes to government priorities to improve well-being and liveability of places through improving safety, access, and economic prosperity.

Part A

3.0 Strategic Case – The case for change

The Strategic Case establishes the need for the project, placing it within an overall strategic context and outlining the project scope and objectives. It presents the 'why' or business need for investment.

This section revisits the analysis of the IBC, resolves gaps identified in the Investment Quality Assurance (IQA) process, outlines changes since the IBC and provides additional material to demonstrate the project is still required and meets organisational and government requirements.

3.1 Scope

The geographic scope of George Street upgrades runs along George Street between Moray Place and Albany Street, as shown in Figure 1.This business case considers the options for upgrading this area.

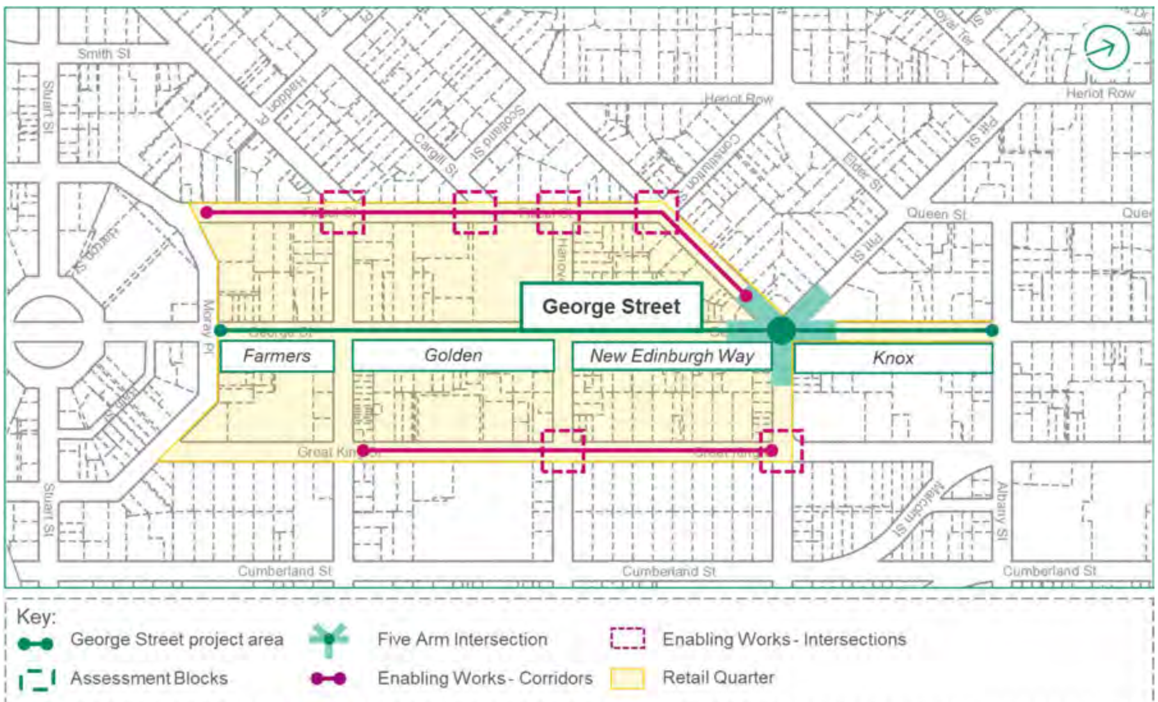


Figure 1: Site location of George Street and enabling works

The Enabling Works are a package of changes to Great King Street, Filleul Street, and streets intersecting George Street and are discussed further in Section 3.3.3. As the Enabling Works are at detailed design, they are included in all the options for George Street. Collectively these projects make up the Retail Quarter upgrades.

3.2 Context

The George Street retail strip is Dunedin's key shopping area with adjoining side streets, alleyways, malls, boutiques, and department stores making up the Retail Quarter. The street includes numerous retail and service outlets of various sizes, several accommodation providers, a growing number of apartments, as well as several larger office buildings.

Different sections of George Street have gradually developed their own character and clusters of uses, including:

- The Knox block – heavily populated by cafes, bars, restaurants, smaller local retailers
- The New Edinburgh Way block – characterised specialty boutique retail, cafes, restaurants, and a growing residential population

- The Golden block – consolidated as the heart of chain retail and anchored by the three interconnected malls – The Meridian, Golden Centre and Wall Street
- The Farmers block – featuring a greater focus on service-based businesses, mixed retail and a large department store.

The surrounding areas of Filleul Street and Great King Street have taken on different functions to George Street, with vehicle-based businesses such as, supermarkets, convenience retail, and retailers of larger goods. Filleul Street offers access to the central city's largest off-street parking buildings and a growing medium-high density residential cluster. Great King Street is also home to the central city bus hub, Hospital and University of Otago's health sciences precinct.

The scope of works also includes the 'five-arm intersection', an existing junction at George Street/London Street/Pitt Street/Fredrick Street, located between the New Edinburgh Way and Knox block. The junction is a main intersection providing access from the North West of the City to State Highway 1 (via Fredrick Street). It also provides a key connection to other suburbs such as Maori Hill, Roslyn and Wakari. While this is a key junction on the network it also presents several safety and efficiency challenges for the Retail Quarter project.

Figure 2: Five-arm intersection layout

3.3 Why invest in upgrading George Street now?

This section summarises why investment along George Street is needed, and why now. The investment story for upgrading George Street centres on the opportunity to coordinate underground infrastructure renewals with upgrading the look, feel and functionality of George Street as the city's premiere retail destination. This opportunity is signalled in Dunedin's CCP and is a foundation project to realise the vision for Dunedin's central city to be a place focused on people that is a vibrant, safe and attractive, and a compelling destination to live, work, play, visit, learn and invest.

Coordinating the infrastructure renewals with amenity and safety improvements in the Retail Quarter will enable cost savings and limit the extent and period of disturbances for businesses, visitors, and residents.

As noted previously, the investment is driven by the need to upgrade the three waters infrastructure, that is well-past its serviceable lifespan. However, above ground infrastructure is also in need of replacement. The last major upgrade in the central city was more than 30 years ago, meaning the paving, lighting, and other furniture is now dated and deteriorating quickly. The overall look and feel is tired, and as a consequence, the Retail Quarter has not kept pace with changes in how people move around and want to use the city today.

As will also be demonstrated later in the business case, the Retail Quarter's share of Dunedin's overall retail share has been decreasing. There are a number of factors that contribute to this decline and not all can be addressed by the Council or through this business case. However, it is clear that there is a declining sense of satisfaction with the look and feel of the central city and this will be impacting the area's ability to compete with other areas and online shopping.

3.3.1 Problem statements

Mapping of the investment logic for this project was completed as part of the IBC, as shown in the IBC Investment Logic Map Figure 3: IBC Problems, Benefits and Investment Objectives

The IBC developed problem statements and benefits based on the themes of the Dunedin City Centre: Access, Mobility and Safety Programme Business Case.

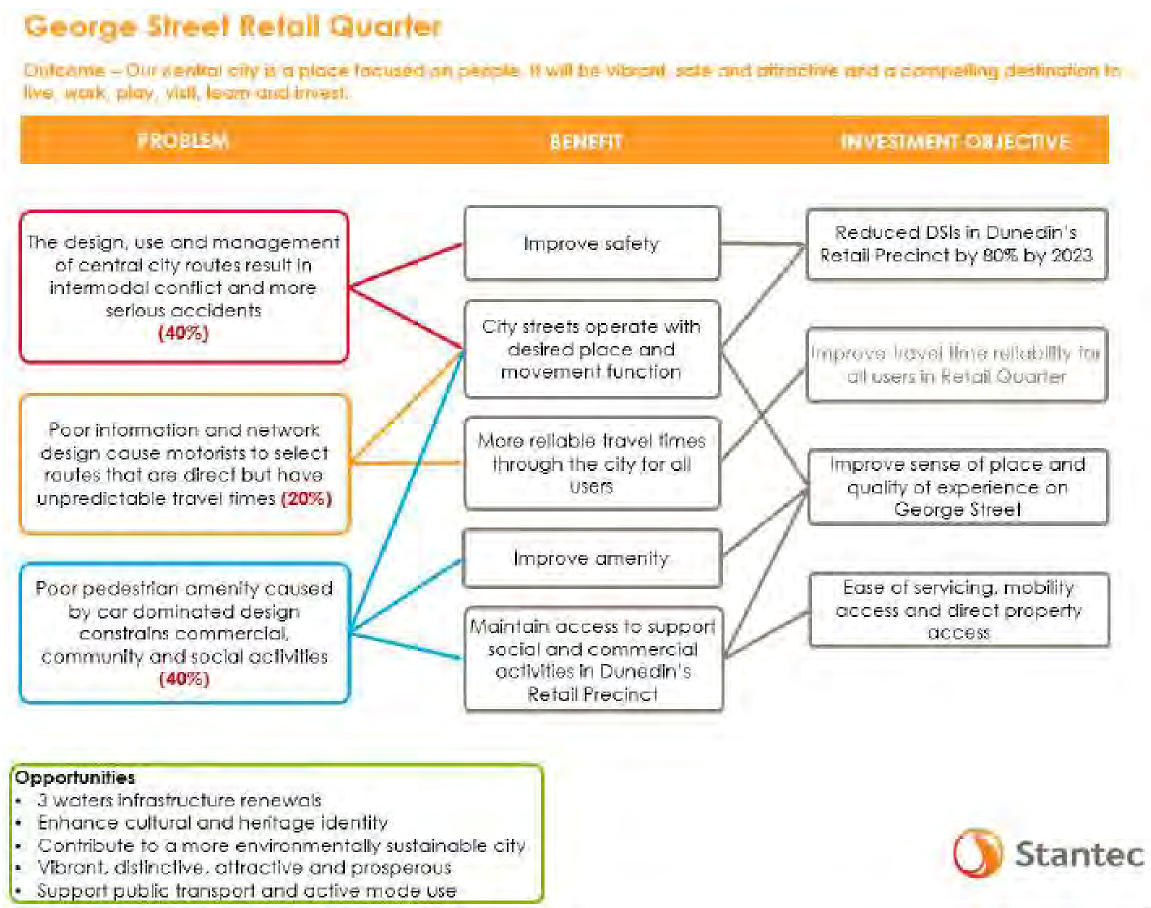


Figure 3: IBC Problems, Benefits and Investment Objectives

The DBC problems, benefits, and investment objectives (PBIOs) maintain the IBC themes of safety, network design and place, but have been amended to better represent the sentiment of the problems. These centre around the opportunity to improve safety and accessibility for all users and create a compelling and attractive space where people want to spend time, with associated benefits for retail and the community. The evolution of the PBIOs, key drivers and evidence to the problems, are discussed further in Section 4.0.

Furthermore, this DBC has aimed to align more closely the largely transport objectives with the key project outcomes developed by DCC's Retail Quarter George Street upgrade project team. These support the strategic outcomes of the CCP and Spatial Plan and have a greater emphasis on improving the place focus of George Street. Table 1 outlines these outcomes and how they will be achieved through the Retail Quarter George Street upgrade.

Table 1: George Street Project outcomes

Project outcome	How it will be achieved
Putting people first	• Improving the pedestrian experience of the city • Improving safety • Celebrating our walkable city • Creating meeting and resting points • Increasing pedestrian space in the central city.
Creating an Ōtepoti Dunedin sense of place	• Celebrating Dunedin's distinctive heritage, culture, and character • Enhancing the city with input from its residents • Reflecting Dunedin's past and develop its future.
Greening the City	• Creating a green network of trees and plants in the central city to reduce carbon emissions • Greening the streets to contribute to stormwater improvements • Restoring wildlife corridors and habitats for birds and insects.
Streets as Places	• Promoting George Street as a destination • Creating: - A memorable and distinctive place - An accessible city - Places for people to meet.

3.3.2 Three Waters upgrade

A key driver for the timing of this project is the need to replace and upgrade the underground Three Waters infrastructure on George Street which has reached the end of its useful life. As outlined in the IBC, the case for investment also aims to reduce the frequency and severity of flooding incidents on George Street, improving stormwater discharge quality, providing backflow protection for commercial properties, and reducing the overall number of utility services and accesses on George Street. There is also opportunity to incorporate new technology and water-sensitive urban design.

The case for investment, including problems, benefits and investment outcomes are well evidenced in the IBC and a preferred way forward was approved by DCC.

No changes have occurred with this position since the IBC, and the scope of the preferred programme outlined in Table 21-1 (page 84) of the IBC is being worked through with DCC and AECOM design teams. Design and scope are being addressed iteratively to provide the best outcomes within the designated budget.

The IBC highlighted the need for further information in several areas related to the Three Waters upgrades, including a condition assessment, which is being carried out through the developed design process. This data will inform renewal via either pipe lining where feasible, or relay where required. All of this will be reported in the Three Waters detailed design, due to be completed in August 2021.

3.3.3 Enabling works

The existing management of George Street, and the parallel corridors of Filleul Street and Great King Street, no longer aligns with the intended function outlined via strategic directions from DCC.

The CCP and the One Network Framework (ONF) work completed for this DBC, have identified that George Street will have more of a people and place focus, with the intention of reducing through traffic movement along the corridor to align with this purpose. Consequently, Filleul and Great King Street have been identified to accommodate more traffic movement, to provide motorists with an alternative to George Street. To allow for this expected change in traffic flows, Filleul Street and Great King Street will be upgraded as part of the enabling works. The scope of the enabling works is shown in Figure 1. The intent of the enabling works package is to:

- Provide alternative options to George Street for traffic through movement, assisting in making the street a more people-focused place in the long-term
- Make Great King Street an efficient, convenient, and attractive route for buses
- Improve access to off-street parking opportunities and reduce traffic circulation
- Improve east-west connectivity and reduce the transport impacts of several construction projects on the central city transport network, including the road closures associated with the George Street upgrade itself

In addition, Three Waters infrastructure in the Great King Street and Filleul will also be upgraded as part of the enabling works package.

The design approach of the upgrades to Great King Street and Filleul Street has focused on safely providing for, and welcoming all transport modes by:

- Improving pedestrian crossing movements using Barnes Dance signal phasing and buildouts to reduce crossing distances as well as prioritising the safety of vulnerable users through the identification and provision of safe road crossing facilities
- Supporting efficiency by providing intersection and mid-block layouts designed to facilitate increased traffic flows
- Increasing the size and accessibility of bus stops and expanding infrastructure for bus users
- Providing more cycle parking opportunities
- Minimising on street parking loss from safety and intersection improvements.

Additional detail of the transport modelling, assessment and specific design considerations can be found in Appendix B. No specific optioneering has been undertaken as alternatives for these works was limited. Instead, the layouts and designs have been developed collaboratively between the design team and DCC with safety and operation being the key drivers for decision-making. The enabling works will be included as part of each option assessed for George Street.

The enabling works need to be completed prior to construction of the George Street upgrades to ensure diversion routes can accommodate construction-related road closures. Consequently, the enabling works have been expedited to progress the preliminary design as quickly as possible.

AECOM, as the design consultant, will manage the design of both the Three Waters and enabling works. Preliminary design has been completed and AECOM are working through developed and detail design with DCC.

The enabling works are not dependent on any specific design option on George Street, so it is expected that construction will commence in late 2021. A summary of the construction timeframe in the wider Retail Quarter is summarised in Figure 4.

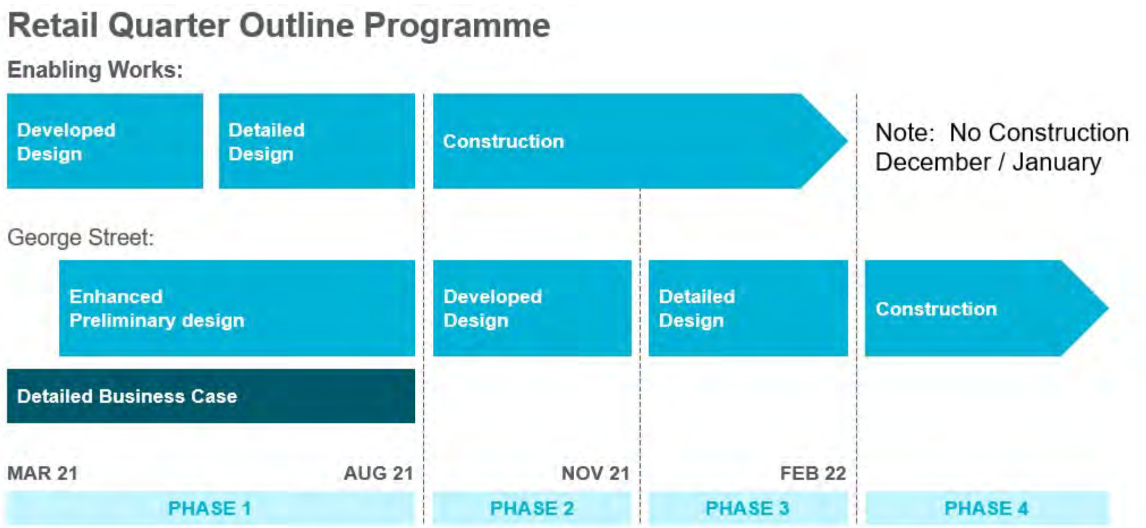


Figure 4 Retail Quarter Programme

3.4 What has changed since the IBC?

3.4.1 Project evolution

An independent review was undertaken by Urbanism+ following the submission of the IBC. In November 2020, Council's Planning and Environment Committee endorsed their preferred options to continue further assessment. These processes and decisions are further detailed in Appendix A - Optioneering History.

3.4.2 Waka Kotahi IQA

The Waka Kotahi IQA of the IBC endorsed the project to proceed to the DBC phase, noting strong alignment with national, regional, and local policy and the urgency in coordinating these upgrades with the replacement of below-ground infrastructure. It was acknowledged that the project was initially urban design led and the IBC therefore lacked critical analysis and evidence surrounding transport components. The IQA presented the following key points requiring further assessment in the DBC:

- Further evidence required for network design (problem 2) and place (problem 3) problem statements. Waka Kotahi were satisfied that the safety problem statement was well-supported by evidence.
- Detailed analysis and modelling of short-listed options, including solid justification of the transport/amenity cost split.
- Comprehensive testing of a do-minimum scenario in order to provide better analysis of costs and benefits from a transport perspective, test the IBC assumption that a two-way option will not meet placemaking objectives, and assist in answering questions from the business community that oppose moves towards placemaking.
- Detailed assessment of the impact on the wider network from traffic diverting to adjacent roads.
- Integration with assumptions and findings from the Shaping Future Dunedin Transport (SFDT) PBC, which is currently still in a draft format.
- Calculation of an accurate BCR, demonstrating the value for money of the project, including wider network impacts.

The project team have been collaboratively working with Waka Kotahi during the DBC phase to work to resolve these points raised in the IQA. The outcomes will be discussed through the relevant sections of this DBC and any future Waka Kotahi DBC or application for funding.

3.4.3 Change in travel behaviour

The COVID-19 pandemic has changed travel and consumption behaviour. COVID-19 lockdown during 2020 reduced travel to essential services only, and whilst these tight restrictions on movement have been lifted, working from home (at least some of the week), mask wearing on buses, social distancing and scanning into businesses has become part of the new normal. It is thought that these measures have impacted travel and spending behaviour, such as by reducing the number of journeys made and increasing online sales and services.

The existing and potential short and medium-term effects of COVID-19 also include no international students, tourists or overseas migrants moving to the area and using the space. The effects of how the pandemic may shape the demand for travel to Retail Quarter and the impact on future growth and scale in the longer term are uncertain. These impacts will be considered in relation to any 2020 travel data used in assessments.

The change in behaviours however can be viewed as an opportunity. Whilst many may have reverted to more frequent online shopping, revitalising the streetscape of the Retail Quarter can be viewed as important in attracting people back to the central city. There is also growing anecdotal concern about reduced social interaction for the elderly and disabled communities. Increasing the accessibility of the Retail Quarter can help to reduce this trend towards greater social isolation by providing safer and more attractive opportunities to engage and interact with the community.

3.4.4 Safety improvement

The IQA of the IBC concluded that the safety problem had been sufficiently evidenced. However, factors contributing to the safety environment have since changed.

The initial analysis considered crash data for the five-year period from 2014/15 to 2018/2019 and included one fatal crash involving a pedestrian. As mentioned in the IBC, DCC have invested in improving pedestrian priority in the Central City through increased pedestrian protection, longer crossing times and the introduction of Barnes Dance crossings at 10 central city intersections in 2017/18. Recent CAS data shows less recorded DSIs (see Section 4.5.1), suggesting that these improvements have potentially improved safety in the Retail Quarter. There is also anecdotal evidence to suggest that the introduction of Barnes Dances at the Albany Street/Great King Street and Frederick Street/Great King Street intersections means many pedestrians now avoid crossing at the five-arm intersection, and instead utilise this crossing, which has improved safety and efficiency for pedestrians.

Consequently, from the perspective of Waka Kotahi, this project would no longer strictly meet their safety improvement funding criteria. As a result, the weightings of problem statements for this DBC have been removed in recognition that the safety problem is not greater than the other two problems.

However, it is also important to note that this data only covers two years (one of which was impacted by Covid-19 lockdowns), which does not create a statistically robust dataset. It is also suggested that while the pedestrian prioritisation initiatives may have improved safety in the current vehicle-focused retail quarter environment, they alone would be unlikely to deliver comprehensive safety improvements for all vulnerable road users in the desired multi-modal future environment of George Street. Failing to invest in additional safety measures could create unintended safety consequences as more pedestrians and other vulnerable modes are encouraged to utilise the Retail Quarter.

Thus, the DBC contends that there is still a safety risk that exists, and further safety improvements can be made and should be co-invested in by Waka Kotahi. The safety problem has been retained and discussed in this context in Section 4.5.1.

3.4.5 Policy update

As outlined in the IBC, the project aligns with several national, regional, and local strategic documents.

Documents assessed in relation to the Three Waters component in the IBC included:

- Health Act 1956.
- Health (Drinking Water) Amendment Act 2007.
- Resource Management Act (1991).
- Otago Regional Council Partially Operative Otago Regional Policy Statement 2019.

- DCC Three Waters Strategic Direction Statement 2010-2060.

A policy update has not been undertaken for the Three Waters element given that this portion of the investment has been agreed upon based on evidence in the IBC.

Documents assessed in relation to the transport and urban design component in the IBC included:

- Government Policy Statement (GPS) on Land Transport 2018-2028.
- Waka Kotahi Road to Zero Safety Strategy (2020-2030).
- Otago Regional Council Regional Land Transport Plan 2015-21 (updated 2018).
- DCC Council Strategies: Integrated Transport Strategy (2013), Spatial Plan (2012), Ara Toi (Arts and Culture Strategy)(2015), Environment Strategy (2016), Social Wellbeing Strategy (2013), Economic Development Strategy (2013) and, Parks and Recreation Strategy (2017)
- DCC Central City Plan.
- DCC Long Term Plan 2018-2028.
- DCC Second Generation District Plan (2GP).

Of the policy documents reviewed, several have since been updated or new policy documents have evolved which are relevant to this project. Table 2 summarises the updated or new strategic policy documents and the alignment to this project.

Table 2: Strategic Alignment

Policies and Plans		
Status	**Document**	**Alignment**
Updated	GPS 2021-2031	Strategic alignment with the GPS 2018 was outlined in the IBC. The new GPS 2021-2031 builds on the safety and access strategic priorities of the previous GPS, with updated priorities for climate change reflecting recent policy work (as detailed below). The Retail Quarter George Street upgrade has a very strong alignment with the 'safety' and 'better travel options' strategic direction. The changes in layout will provide better infrastructure for greater modal choice and transport options to access social and economic opportunities along George Street. The reduction of motor vehicles along certain parts of the corridor will make it safe and more attractive, encouraging uptake of active modes. The GPS 2021 includes Climate Change as one of the four strategic directions. While the project is not expected to make a significant contribution to a reduction in city-wide emissions, the intent of the project is to improve access to George Street for all modes. George Street upgrades will assist in reducing circulating traffic movements, improving localised ambient air quality.
New	Waka Kotahi Road to Zero (2020)	Road to Zero (2020) focuses on reducing deaths and serious injuries along streets, cycleways and footpaths by 40% over the next 10 years. The focus areas which relate to George Street include 'infrastructure improvements and speed management' through reducing the existing speed; and 'road user choices', with changing the public realm to accommodate a balanced choice for modes and attracting vehicles to use the network appropriately for each trip.
Updated	Otago Southland Regional Land Transport Plans (RLTP) 2021 - 2031	The Regional land transport plan (RLTP) provides direction and priority for to apply for funding from the National Land Transport Programme (NLTP) for regional transport projects. Since the IBC, the RLTP has been updated with greater focus on safety and land use integration. A street that has a stronger focus on pedestrian amenity and place value, (rather than traffic throughfare) assimilates safety and land use functions.

Policies and Plans		
Status	**Document**	**Alignment**
		This project has been specifically identified as giving effect to one of the RLTP's key priorities of investing in target high risk area.
Updated	DCC Draft Long Term Plan 2021 - 2031	The Long-Term Plan has funding allocated for this project. Consultation feedback received was supportive of Central City cycle and pedestrian improvements; including George Street upgrades.
New	National Policy Statement on Urban Development (NPS-UD) 2020	The NPS-UD took effect in August 2020 and sets out objectives and policies supporting planning decisions that contribute to well-functioning urban environments, and sufficient development capacity to meet the needs of growing communities. This document identifies Dunedin as a Tier 2 urban environment, and as such notable policy directions include: • District plans to enable height and density in urban environments commensurate with accessibility to existing/planned active or public transport for a mix of commercial and community activities. This may inform future land-use within and around the Retail Quarter, particularly adjacent to the Bus Hub and the planned pedestrian improvements along George Street • Strong direction and recommendation to manage parking in urban environments through comprehensive parking management plans. This is an already identified problem for George Street and the broader central city and is discussed below in relation to the Dunedin Parking Roadmap.
New	Climate Change Response (Zero Carbon) Amendment Act 2019	There has been legislative change in the form of the Climate Change Response (Zero Carbon) Amendment Act 2019 to develop and implement climate change policies under the Paris Agreement. Ināia tonu nei a low emissions future for Aotearoa, 2021 plan centres on reducing reliance on cars, and supporting people to walk, cycle and use public transport which this project will contribute to on a very minor scale.
New	Keeping Cities Moving, 2019	This plan outlines how Waka Kotahi aims to address high levels of car dependency through better balancing the transport system. A key objective of the George Street upgrade is to redress the balance of space within the Retail Quarter.

Related Strategies or Documents		
Status	**Document**	**Alignment**
New	Dunedin Parking Roadmap (2020)	The Dunedin Parking Roadmap aims to reduce congestion, improve liveability, and provide accessibility by developing polices and management plans regarding parking. This strongly aligns with the desired place making changes for George Street and the need for parking to be managed in line with wider objectives of the city. Lack of wayfinding and real-time parking availability information has been identified in this business case, so the action to develop a wayfinding signage plan for the city will strongly support this project and aid in reducing localised congestion. The use of George Street as a through-route, which compromises the desired high place function, can also be managed through the recommended options in this document.
New	Network Operating Framework (NOF) (2020)	The NOF (which is still in development) provides a framework for DCC to assess the wider functionality of each of their roads to ensure a balance across the network. The NOF has been developed by assessing the existing network, priorities, national policy, strategic guidelines, local

Related Strategies or Documents		
		policy, and aspirations. In relation to George Street, the NOF identifies George Street as a 'primary pedestrian route' and a 'primary cycle route'.
New	One Network Framework (ONF) (2021)	The ONF is Waka Kotahi's national classification system that defines the movement and place function of our roads and streets. This framework is fundamental to the integration of land use with the transport network and is discussed fully in section 3.4.5 given how important it is to this project.

3.4.6 Movement and Place Assessment

The ONF is the new Waka Kotahi national classification system that defines the movement and place function of our roads and streets. This supersedes the previous One Network Road Classification, which exclusively categorised roads according to their movement purpose. In comparison, the ONF acknowledges the transport network has a 'place' function and roads and streets are destinations for people as well as transport corridors. Released in early 2021, the application of this approach is in its infancy and aspects are still under development. This project has worked collaboratively with DCC to classify the project area utilising the information as it has become available. This will need to be tested more widely as DCC review and implement classifications for the rest of their network. Presently, DCC implementing the ONF city wide, applying classifications to the rest of the network. However, this DBC preceded this work, meaning the project team had to apply and assess the Retail Quarter based on the ONF prior to this.

In practice, the ONF framework establishes the existing and intended function of a transport corridor, to help plan for levels of service and investment based on future aspirations for the corridor. This process of assigning a typology considers the role the transport network plays as part of the public realm and the effect this has on adjacent land use. The assessment allows for the identification of differences between existing and aspirational function along the corridor and within the wider network to guide investment decision making.

As a part of this assessment, several sources were used to inform the movement and place assessment and classifications of the existing environment. The sources are summarised below, and provided in greater detail in Appendix C, including explanations of metrics and reasoning behind the classification of each corridor.

- **Movement** - the movement assessment is based on the overall people movement along a corridor, which has been informed by the following:
  - Vehicle counts (Road Asset and Maintenance Management (RAMM))
  - Bus Routes / Network (Orbus)
  - Cycle and pedestrian counts and networks (MioVision)
  - Freight connections and Over-dimension routes.
- **Place** – A qualitative assessment of the surrounding land use, informed by:
  - DCC GIS maps
  - DCC Zoning Maps
  - Google Maps to ascertain 2GP District Plan land-use patterns
  - Pedestrian counts (which is in accordance with ONF Place metrics, explained in Appendix C)
  - An on-street walk over.

Figure 5 summarises the assessment results and the applicable 'street family' (see the place/movement matrix for urban roads) for the road corridors within the Retail Quarter. Some of these corridors have been split into multiple sections, as both the place and movement function can vary along a corridor, resulting in multiple classifications.

This assessment of the existing conditions establishes a baseline to be used when considering the future aspirations for the corridors.

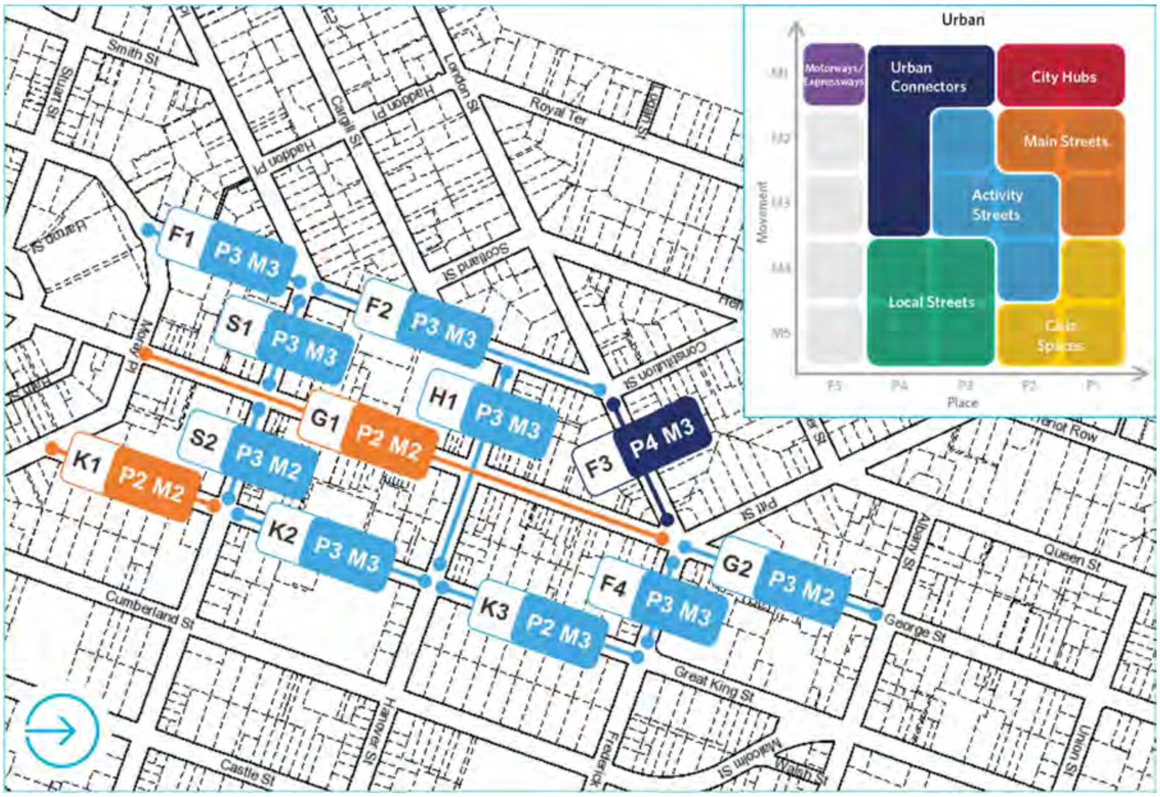


Figure 5: Existing Movement and Place assessment

Assigning an aspirational future classification is based on knowledge of any future transport projects, land-use plans and strategies, and the desired future intentions of the corridors that derives from those and how they integrate with the wider network. Accordingly, Figure 6 summarises the desired future aspiration for the Retail Quarter corridors (further detail is found in Appendix C).

Most notably, the rationale behind the George Street classifications is as follows:

- G1 (Moray Place to Frederick St) has changed from a Main Street to an Activity Street. This is primarily due to the desired reduction in movement value because of the intention to reduce through-traffic and re-route buses along Great King Street (in turn increasing movement values along the Great King Street corridor).
- There is no change in place value, because despite the expectation that the upgrades will contribute a sense of 'attractiveness' along the street, they cannot influence the intensity or type of adjacent land-use on their own. Additionally, from a holistic perspective, The Octagon is more likely to be a P1 compared to George Street.
- G2 is expected to have minimal change, as general traffic is likely to continue to use this corridor up until London St, and buses will still use this section until Frederick St, where they will re-route to use Great King Street.

As noted, achieving this desired future state for George Street is dependent on reduction in movement occurring along the corridor. Consequently, the current management of the road does not achieve this.

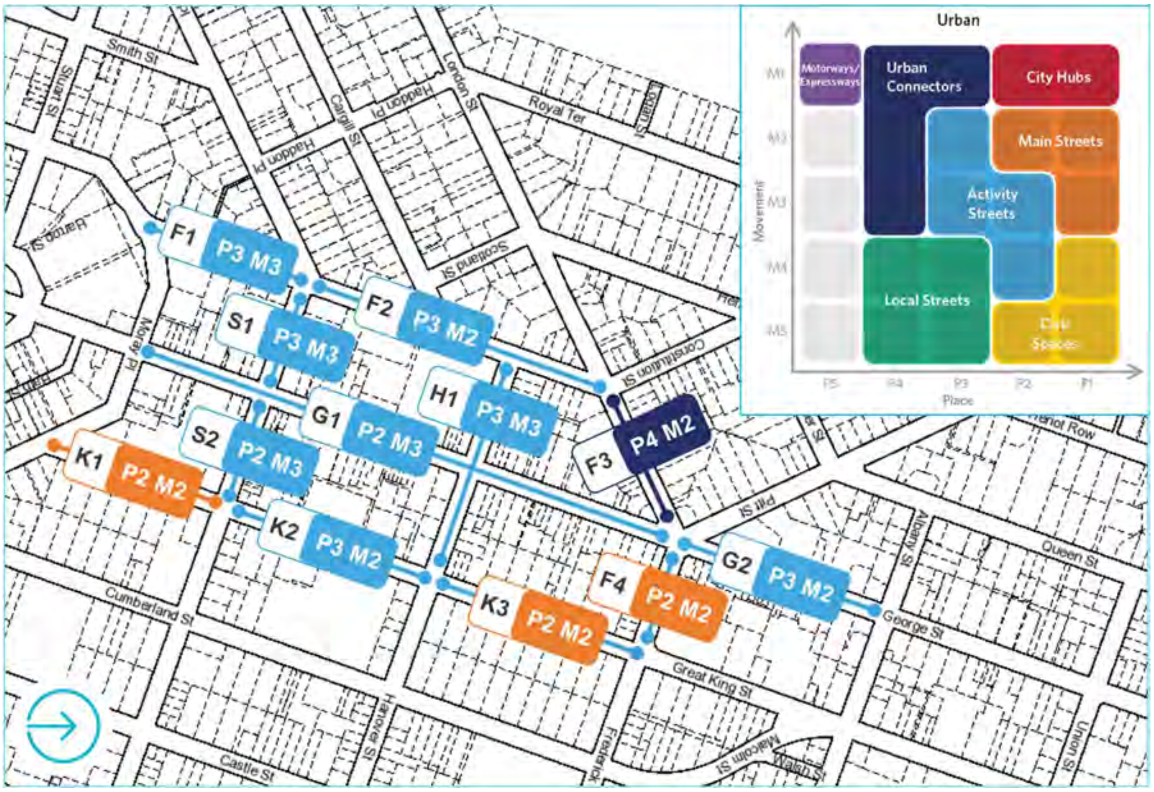


Figure 6: Future Movement and Place assessment

3.5 Related projects

This section outlines how the George Street Retail Quarter upgrades fit among the variety of projects in progress throughout Dunedin. Table 3 describes the relationship between these projects and highlights the level of dependency with the Retail Quarter upgrades.

Table 3: Relationship between surrounding Dunedin projects and the Retail Quarter upgrades

Project(s)	Relationship with Retail Quarter upgrades	Dependency
Central City Parking Management (SFDT)	A Parking Management Policy will be developed to guide the supply and management of parking to ensure it meets community needs, aligns with the city's strategic objectives including net carbon zero, and supports businesses and visitors to the city. A plan that considers the price, location, availability, and direction to parking will ensure that the parking managed by the Council provides desired benefits. This will consider wayfinding, technology to manage and enforce parking, an updated resident parking scheme and the feasibility of car sharing	Critical Dependency
New Dunedin Hospital	The preferred design for a new Dunedin Hospital broadly aligns with the preliminary site masterplan – with Outpatients (15,000 sqm) on the Wilsons block and Inpatients (73,500 sqm) on the Cadbury site. Outpatients is due to be completed early 2025, and inpatients early 2028. The Retail Project will be delivered ahead of the hospital so network impacts of the hospital relocation will be assessed with any new Retail Quarter layout as part of the SFDT project. It is also important to note that the existing Hospital site is adjacent to the Retail Quarter, in closer proximity than the new Hospital site. The new facility also caters for a similar number of people. This means that while the location of some network impacts may shift, it is	Supports / complements the project

Project(s)	Relationship with Retail Quarter upgrades	Dependency
	unlikely the new hospital will result in a radically increased impact on the broader central city network.	
Tertiary Precinct	There is a strong people movement between the Tertiary Precinct and the Retail Quarter. With renewal of three water infrastructure there is also an opportunity to improve the place and transport elements in the Tertiary Precinct through speed management and safety improvements, refinement to bus routes and bus stop locations and amenity uplift. This project is currently on hold.	Supports / complements the project
Other Dunedin CCP Upgrades	The CCP outlines the place-based upgrades (following three waters renewals) planned over the next 10 years. The changes in the Creative Quarter and Cultural and Entertainment Quarter will have the greatest impact on the Retail Quarter (George St) upgrades and planning is already underway to ensure they are all well-aligned and contribute to a safer, more vibrant and attractive central city.	Supports / complements the project
Central City Pedestrian and Cycling Improvements (SFDT)	Completing/ joining up safe cycling and walking routes in the inner city. Cycleways at George/Bank, Albany and St Andrew streets so there is a direct link from the harbour to the city centre via the University of Otago. This project also includes footpath improvements to make it safer to walk along this route.	Supports / complements the project
Waterfront Connection walking and cycling Bridge	Providing a pedestrian/cycle link from the central city area to the Harbourside/Steamer Basin Area. Is an important link to encourage more active modes coming into the city and safely crossing the railway and eastern bypass from the Peninsula Connection shared path and other suburbs east of the city, Will also provide a direct connection to the harbour/waterfront.	Supports / complements the project
Park and Ride at Mosgiel and Burnside (SFDT)	This project will see the development of park and ride facilities located within the Mosgiel and Burnside areas of Dunedin to support mode shift and encourage more people to use public transport to travel to the central city.	Limited dependency
Dunedin Museum Masterplan	The Otago Museum is developing a $50 million masterplan to cover the institution’s long-term strategic development, largely involving upgrading its many galleries. While this project may have limited direct impact on the Retail Quarter upgrades, the museum is a key Dunedin attraction and additional visitors will benefit from improved connectivity and streetscape amenity throughout the central city.	Limited dependency
University of Otago Health Science Precinct	This project seeks to concentrate research, laboratories and health businesses alongside the new Dunedin Hospital discussed above. network impacts of the hospital relocation will be assessed with any new Retail Quarter layout	Limited dependency

4.0 Problems, opportunities, and outcomes

This section aims to:

- Summarise the key project outcomes sought and how these align with DCC's strategic direction and Kāi Tahu cultural values
- Provide an update of the problems and opportunities identified in the IBC incorporating the additional evidence to support the case for investment
- Show how the problems/opportunities align with the investment objectives and benefits.

4.1 Project outcomes

The city centre, being the primary commercial area for Dunedin, is a point of pride for the city and has distinctive heritage and cultural value. As per the Dunedin Central City Plan, the overarching vision for the central city is to create a place focussed on people that is vibrant, safe, attractive, and is a compelling destination to live, work, play, visit, learn and invest.

DCC's Retail Quarter George Street upgrade project team developed key project outcomes that closely align with the strategic outcomes of the CCP and Spatial Plan, whilst being more targeted to the area's role as the preeminent retail area of the city. These outcomes and how they will be achieved through the Retail Quarter George Street upgrade project are detailed in Table 4.

Table 4: George Street Project outcomes

Project outcome	How it will be achieved
Putting people first	• Improving the pedestrian experience of the city • Improving safety • Celebrating our walkable city • Creating meeting and resting points • Increasing pedestrian space in the central city.
Creating an Ōtepoti Dunedin sense of place	• Celebrating Dunedin's distinctive heritage, culture, and character • Enhancing the city with input from its residents • Reflecting Dunedin's past and develop its future.
Greening the City	• Creating a green network of trees and plants in the central city to reduce carbon emissions • Greening the streets to contribute to stormwater improvements • Restoring wildlife corridors and habitats for birds and insects.
Streets as Places	• Promoting George Street as a destination • Creating: - A memorable and distinctive place - An accessible city - Places for people to meet.

In achieving the outcomes described in Table 4 there are several opportunities associated with upgrading the Retail Quarter. These opportunities are outlined in the following sections.

4.2 Cultural opportunities and outcomes

4.2.1 Mana Whenua culture and values

Dunedin and the wider region has a rich cultural history. There are several pā sites within the region, notably Pukekura at Taiaroa Head, as well as other settlement areas including Ōtepoti, Whareakeake, Pūrākaunui, Mapoutahi, Huriawa, Taieri Mouth, Ōkia, Harwood, Warrington, St Clair and Otokia. There are also key Mahika kai sites, including Nga Moana e rua, Mataukareo, and Tutai Matauira. Within this Takiwā, there are two key Rūnaka who hold mana whenua, Te Runanga o Ōtakou, and Kati Huirapa Runaka ki Puketeraki. Aukaha work on behalf of these Rūnaka for these projects.

Upgrades to George Street, and the surrounding Retail Quarter presents a significant opportunity to address issues identified by Kāi Tahu, and consequently realise the enhancement of local and cultural identity, cross-cultural communication and place making outcomes for all.

As a treaty partner, DCC are engaging with Mana Whenua to address past shortfalls, which is evident in the present street design. As such, Kāi Tahu have identified the following issues that can be addressed through this work:

- An absence of Mana Whenua involvement in past planning and decision-making processes within the Retail Quarter
- Consequently, George Street does not presently reflect the diversity, culture, and sense of place of Ōtepoti
- The existing street design is Eurocentric in appearance, lacking Mana Whenua representation, which consequently does not reflect the whakapapa and history of Kāi Tahu along the street and urban realm.

Overall, Mana Whenua have identified overarching aspirations they are seeking through projects such as this, which have been conveyed by Aukaha. For George Street, these can be incorporated into the project to rectify problems identified above. Aspirations include:

- Mātauraka Kāi Tahu and Kāi Tahu history is visually reflected in the built environment of the takiwā
- Expressions of Kāi Tahu cultural identity, history, values and narratives (before and since colonial settlement) are embedded in projects of significance throughout the takiwā
- Te Tiriti o Waitangi is honoured, and statutory partnerships are respected
- Mātauraka Kāi Tahu utilised is of the highest scholarly standard and can be maintained and protected by the custodians, Mana Whenua
- The usage of te reo Māori, especially Kāi Tahu-specific kupu (words) and mita (dialect), is embedded in the development and function of all visual outcomes.

More specifically, Kāi Tahu values of high importance for the George Street have been collaboratively identified and will contribute to achieving the overarching aspirations. These values are shown in Figure 10. The values of higher regard are displayed in the centre, with supporting values shown in outer tiers that are relevant for other areas and projects in the rohe. Table 5 defines these terms, indicating how they are to be interpreted for the project.

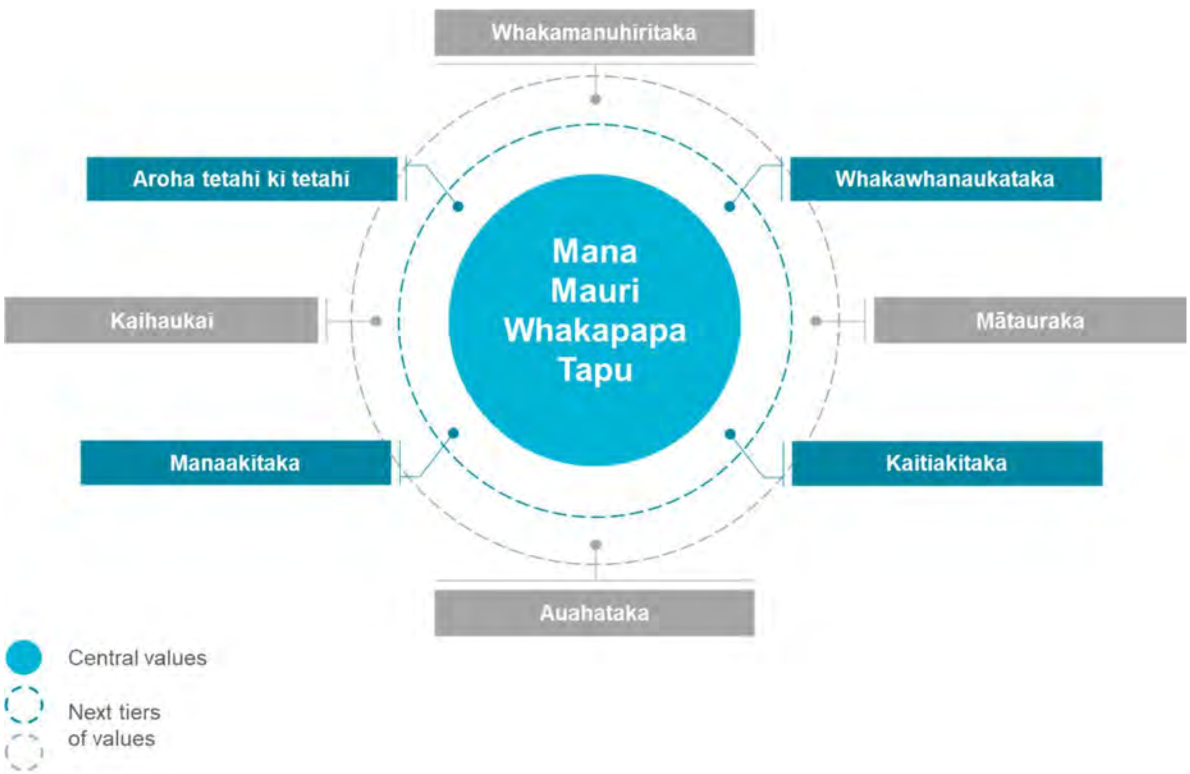


Figure 7: Kāi Tahu cultural values of highest import for George Street[3]

Table 5: Kai Tahu cultural values for George Street[1]

Kāi Tahu cultural values	Meaning
Mana	For Kāi Tahu, mana is inherited from their tipuna, their rights and responsibilities have never been extinguished and it is at the forefront of how they see themselves in the city. This involves discussion about the prestige of Ōtepoti Dunedin and how it can be enhanced together.
Mauri	Mauri is the protector of the health of a person or place: it is an active phenomenon in all things.
Whakapapa	Acknowledging the whakapapa of place and people is important, creating deeper understanding of who we are as individuals and as a community
Tapu	Tapu is the strongest force in Māori life. It has numerous meanings, but can be interpreted as sacred, protected or having a spiritual restriction.
Aroha tetahi ki tetahi	Aroha tetahi ki tetahi is about respect and reciprocation. Caring and having consideration for others, whilst acknowledging and respecting each other's customs.
Whakawhanaukataka	Whakawhanaukataka encompasses relationships, sense of family connection and kinship, describing relationships

[3] Retail Quarter Upgrade Preliminary Design Report

Kāi Tahu cultural values	Meaning
	through shared experiences and working together providing people with a sense of belonging.
Manaakitaka	From a modern perspective, it can take to mean to be hospitable, generous and show general respect. It is underpinned by acknowledging the mana of each individual as a reciprocal process.
Kaitiakitaka	Kaitiakitaka relates to the interconnection and interdependence with our natural environment in the past, present and future. Underpinned by the ethic and responsibility of guardianship – a responsibility for all of us to respect the environment and take care of our resources as both an individual and as a community.
Wahakamanuhiritaka	Is about hospitality, catering for people when they arrive to a place. To provide sustenance to others and live comfortably in a shared space, sharing resources together.
Kaihaukai	Being dependent upon the sustainable harvesting and preservation of local resources (looking after our economy in our own back yard). This is the traditional practise of trading and exchanging. A fundamental component is the building of relationships through regular exchanges that strengthen within and extending out to new communities. It is dependent on tikaka practices to ensure correct procedures are acknowledged in order for exchange to happen.
Mātauraka	Knowing our stories to gather an authentic and informed knowledge of what has happened in the past.
Auahataka	Is the creative essence imbued within a thing or a place that gives it its special presence and uniqueness?

Incorporating these values into the different stages of the project will contribute to addressing the key problems identified above. Careful consideration will be given to Mana Whenua values, and aspirations throughout the business case and design process to address identified issues.

The project outcomes detailed in Section 4.1 and Kāi Tahu values for George Street are closely linked, as shown in Figure 8. There is a strong line of sight between these values and project outcomes, demonstrating alignment of aspirations for both DCC and Mana Whenua.

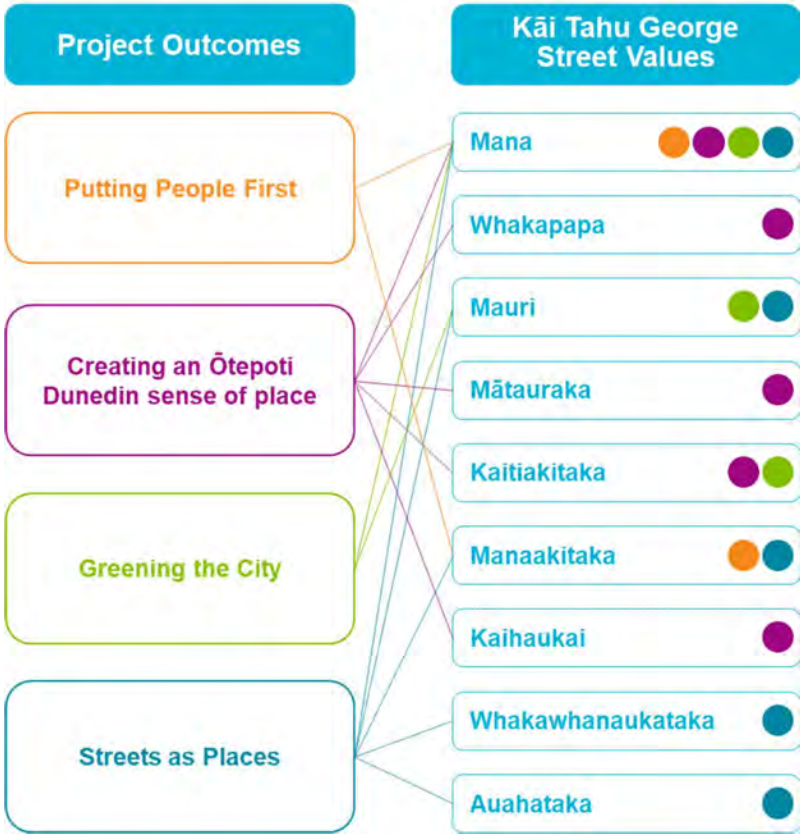


Figure 8: Line of sight between Project Outcomes and Kāi Tahu Principles

4.3 Wider opportunities

4.3.1 Economic prosperity and retail opportunities

The Retail Quarter offers a space for an assortment of retail options for local, national, and international brands. Diversity in retailers is necessary to attract a variety of people to George Street and there is a strong desire for the space to facilitate social interaction and be appreciated and enjoyed by all.

The current car-centric design of the Retail Quarter streets supports the movement of motor vehicles at the expense of pedestrian connectivity, encouraging the use of the area as a through-route rather than a destination. This coupled with the outdated streetscape environment contributes to the Retail Quarter being a less desirable place to visit for some groups including those with different or specific accessibility needs such as families, the elderly, those without cars and those with impaired mobility. This has flow on implications for local businesses as it restricts their potential customer base.

At a time when online retail is expanding exponentially and impacting the profitability of brick and mortar retail, attracting as many potential customers to the Retail Quarter is important. Many vendors now face the task of appealing to different consumer groups and adapting to a changing retail environment to survive. Whilst retail has changed significantly in the last decade, as has Dunedin's social and economic fabric and transport patterns, the current layout of George Street has not changed in almost 30 years.

Investment in this project seeks to focus on opportunities to create a vibrant George Street Investing in the Retail Quarter streets to improve their desirability and connectivity is a key opportunity to further establish the area as a destination and foster an environment that people enjoy visiting, shopping, and spending time, particularly groups who may have not felt welcomed or have struggled with accessibility. This supports economic prosperity and will give effect to all project outcomes.

Within Dunedin, there remains a strong community desire to retain and enhance the Retail Quarter. The current vacant and underutilised spaces have potential to be activated and expanded for the benefit of businesses and other local land-use activities. There is potential for a coordinated approach to managing events and marketing for attractions within the Retail Quarter as a post-implementation opportunity.

While there is widespread desire for George Street to be an attractive and prosperous destination, there remains some contention surrounding the best way in which this can be achieved. While some are in favour of removing parking spaces and reducing through traffic along George Street, other retailers believe this will harm the economic viability of their businesses and the wider Retail Quarter. Ongoing consultation and engagement between the project team and key stakeholders within the Central City Advisory Group (CCAG) will ensure the final option offers a balanced solution, which addresses the concerns of retailers and meets the needs and aspirations of the wider Dunedin community.

It is also important to note that while this infrastructure-led project can enhance the public realm, encouraging more people to visit, turning that footfall into sales to support the economic health of the businesses relies on retailers adapting the way they do business, offering different products, services and experiences to attract people back to shopping (or at least collecting) in-person. While the types of support and initiatives required to make this shift is outside the specific scope of this infrastructure, transport and amenity project, the DCC acknowledges that partnership in this space is also important, particularly around placemaking, events and campaigns to encourage people to visit and dwell in the area. For this reason, it has developed a draft Retail Quarter Revitalisation Plan to work with a range of stakeholders to ensure a more holistic approach is taken to ensuring the future vitality of the area.

4.3.2 Student demographic opportunities

In addition to the rich cultural history discussed in Section 4.2, Dunedin's tertiary institutions, including the University of Otago and Otago Polytechnic are integral components of the city's social fabric, namely through the iconic student culture. Dunedin is nationally recognised as a vibrant student city, with tertiary students numbering around 28,000, or 21% of the city's total population. The university and polytechnic attract people from all walks of life, contributing to a diverse and interesting youthful atmosphere. Whilst not all individual students are likely to remain in Dunedin after their studies are completed, students are likely to contribute significantly to the population and their needs should be considered in the upgrade of the Retail Quarter.

Of note is the highly social and engaging lifestyle led by the student community, who regularly gather to socialise in groups of all sizes throughout the city. In line with this, students often frequent cafes, bars, pubs and hospitality venues adjacent to tertiary institutions as well as further into the central city, resulting in a regular migration of student groups up and down George Street. Recent years have, however, seen the closing of several popular establishments around the campus and it is speculated that this, along with ease of access to alcohol at supermarkets has led to an increase in gatherings at private residences as much as it has encouraged students to visit other venues in town.

Significant opportunity exists to cater to this student culture and lifestyle through upgrading the Retail Quarter. By enhancing the streetscape and providing safe and accessible pedestrian connections, the Retail Quarter will be solidified as a key component of the central city and a place where students will enjoy visiting, navigating, and spending time. In doing so, some of the negative impacts of venue closures described above may be mitigated as students are encouraged to visit and socialise in a safer and more controlled environment, while supporting local businesses.

It is also important to recognise the actual and potential contribution of the student population to the Retail Quarter. While they do not typically have high incomes, they do spend a large percentage of this income on food, beverage and retail goods and have the potential to contribute more to the success of the local retail sector. Providing attractions and opportunities for this sector of the community to shop locally, rather than online, should be a favourable outcome. Students also make up a significant percentage of workers in retail and hospitality in the central city. Providing safe, economic, and convenient options for them to get to work and access employment opportunities is also important, just as it is for other workers in the central city.

In addition to better addressing the aspirations of the student demographic, there is also significant opportunity to harness the enthusiasm of this population through their inclusion in CCAG. Some Dunedin tertiary student groups are typically highly politically engaged and care deeply about the environment, growth, and prosperity of their city. They tend to be early adopters of change and technology and have different perspectives on the future. The project therefore presents an opportunity to take on board the innovative ideas and insights of tertiary students, ensuring the outcome is widely supported and provides benefits for generations to come.

These opportunities are being realised in the option development process, through engagement with the CCAG. There is strong student representation on the CCAG, with representatives from the Otago University Student Association (OUSA) Otago Polytechnic Student Association (OPSA) and Generation Zero attending engagement events and presenting ideas from a student perspective.

4.3.3 Community opportunities

Enabling community opportunities, place activation, and social interaction and cohesion has been raised by members of the CCAG during engagement. As it stands, (and detailed further in section 4.5.3), several groups feel both excluded and deterred from spending time within the Retail Quarter, namely due to a perception that it is an unwelcoming, unsafe, and an unattractive environment. Additionally, several communities felt their cultures and/or identity is not expressed in the area, meaning they were less likely visit. As a consequence, it can be argued that the design of George Street currently contributes to feelings of social isolation, or at least does nothing to alleviate those perceptions.

Public spaces and street environments are key facilitators of both formal and informal social interaction. Therefore, there is currently a significant missed opportunity to utilise George Street to enhance opportunities for social interaction. The scope of this project includes ways to address this, which can include increasing the space allocated to both pedestrian movement and activity, as well as embedding arts and culture into the street environment. However, there are other avenues outside of this DBC where this opportunity can be further progressed. For example, opportunities may include:

- Implementing a management type body, similar to those seen in shopping malls, to manage street closures and coordinate street activities
- Opportunities for community groups, for example the Pasifika community, to take lead on and run street events
- Opportunities to improve arts and culture along George Street and within the Retail Quarter through the associated Retail Quarter Revitalisation Plan.

4.4 Problems, benefits, and investment objectives

Since the development of the IBC Strategic Case, whilst no significant changes have occurred to the project, the DBC team recommended adjusting the problem statements, particularly regarding IBC problem statement two (network design).This problem statement implied that travel time is a key issue within the Retail Quarter, which was not supported by evidence in the IBC. Furthermore, it was considered that addressing unpredictable travel times would not give effect to the project objectives and outcomes sought. Consequently, the problem statement was reframed to discourage the use of George Street as a thoroughfare, with impacts of travel times on the rest of the network being considered as part of the wider transport assessment.

The problem statements for the DBC have maintained the IBC themes of safety, network design and place with changes in wording to better articulate the sentiment of the problems outlined in Figure 9. The new problem statements were tested and agreed with the project partners.

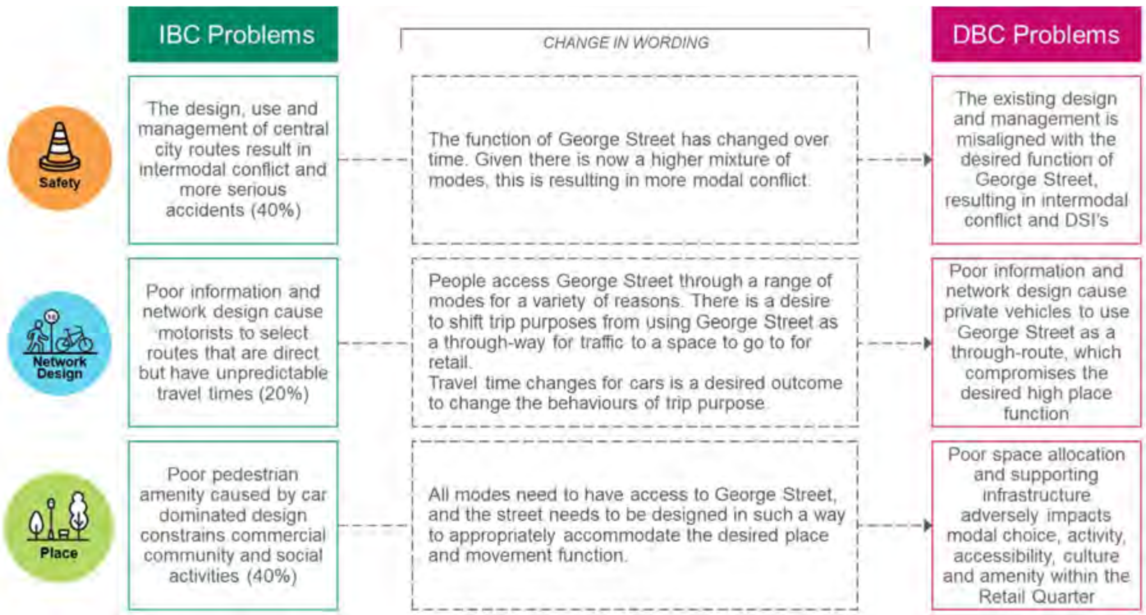


Figure 9: Problem Statement Update from IBC to DBC

Similarly, the investment objectives have been amended to be as SMART (specific, measurable, achievable, realistic and timebound) as possible and reflect the updated problem statements. For assessment purposes, 2038 has been used as a base year for assessment to align with the modelling. Updated investment objectives are summarised in Figure 10.

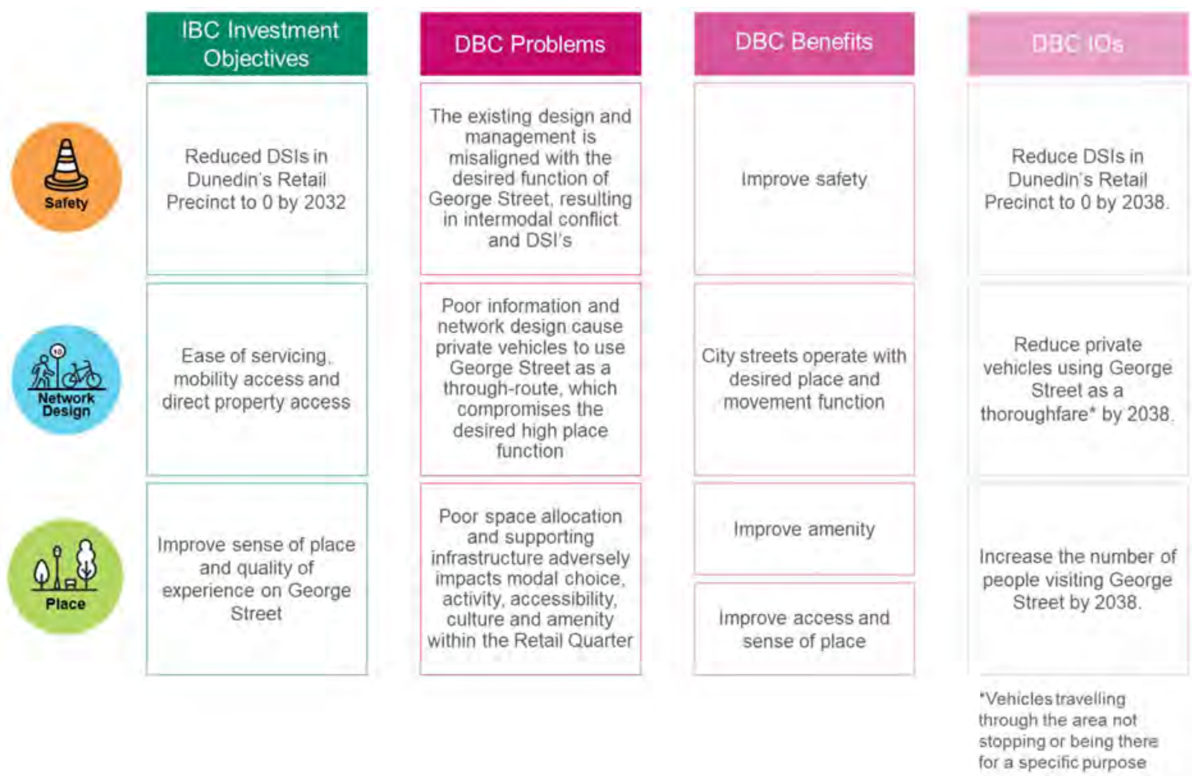


Figure 10: Investment Objective Update from IBC to DBC

Additionally, the relationship between the problems, benefits, and investment objectives investment shown above have been mapped in Figure 11 to show a clear line of sight with DCC's Spatial Plan strategic objectives and George Street project outcomes.

DCC has eight strategic documents. These are listed below:

- Spatial Plan
- Economic Development Strategy
- Social Wellbeing Strategy
- 3 Waters Strategy
- Arts and Culture Strategy
- Integrated Transport Strategy
- Environment Strategy
- Parks and Recreation Strategy

Each of the strategies has relevance and some bearing on the Retail Quarter upgrade. The DBC however, has focused on the Spatial Plan outcomes as this plan integrates key elements of each area of Council's work. While the other strategies may be too detailed for the Retail Quarter Business Case, where possible, relevant benefits, measures and monitoring elements have been pulled from each strategy to ensure a holistic approach is taken in the overall assessment of the project.

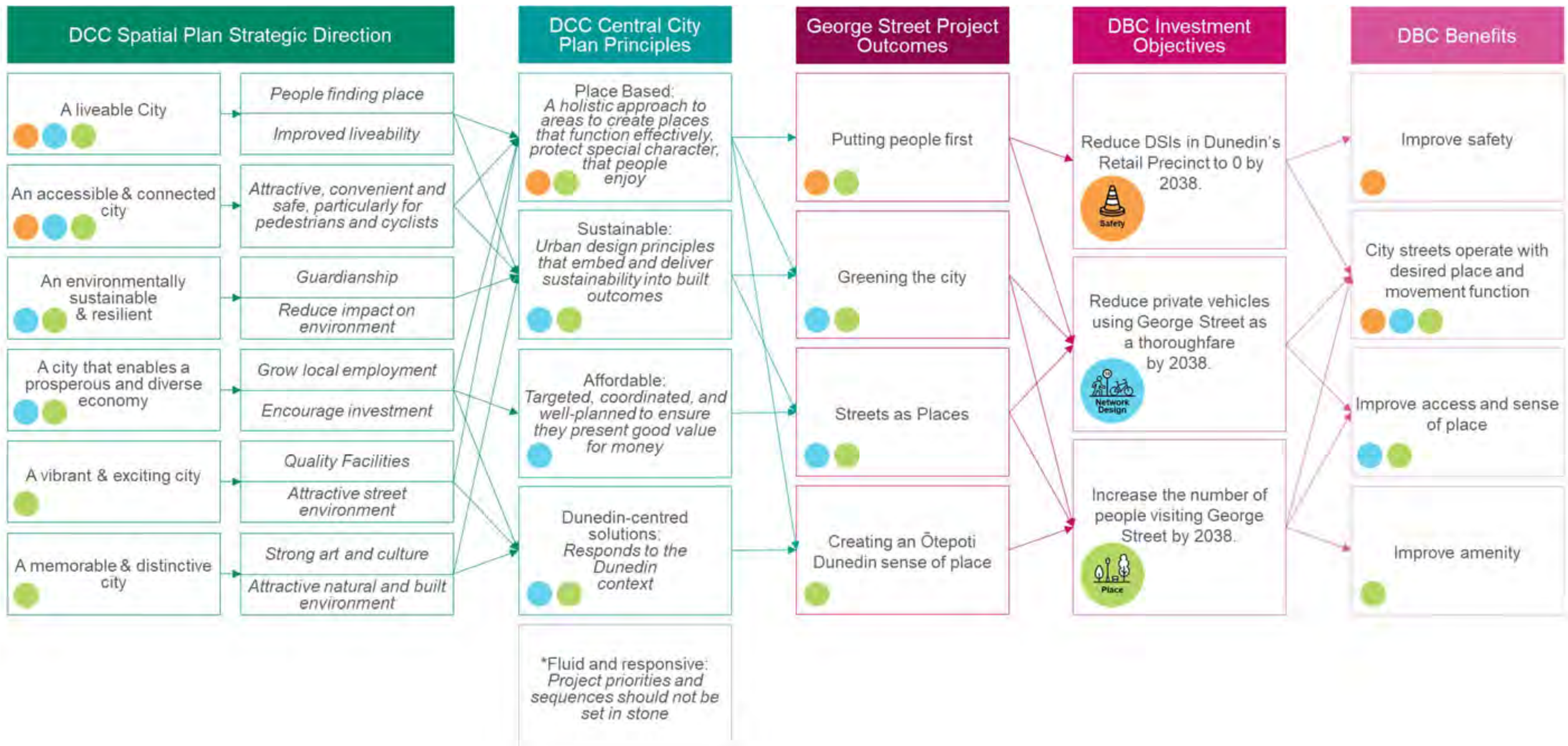


Figure 11: Summary of Benefits and Investment Objectives, with Dunedin City Council's Strategic Framework

4.5 Problem statement evidence

Evidence has been identified for each of the problem statement themes to validate the importance of each issue. The information in this section complements evidence presented in the IBC and has been updated where appropriate.

The problem statement themes are:

- Problem 1 – Safety
- Problem 2 – Network Design
- Problem 3 – Place and Amenity

It should be noted that strong interrelationships exist between each problem statement. For example, the network design may cause modal conflict, which in turn has implications for safety and place value. While efforts have been made to ensure evidence is presented under the most appropriate problem statement, common themes exist throughout, and certain pieces of evidence may be applicable under multiple problems.

4.5.1 Problem 1 – Safety

Problem Statement 1: The existing design and management is misaligned with the desired function of George Street, resulting in intermodal conflict and DSI's

The IBC provided strong evidence that the current design and use of George Street results in intermodal conflict, contributing to Deaths and Serious Injuries (DSIs) and near misses along the George Street corridor. Evidence of modal conflict leading to safety implications was largely obtained from the Waka Kotahi Risk assessment tools and Crash Analysis System (CAS).

The IBC stated the George Street corridor was defined as having a 'high collective risk', based on Safer Journeys Risk Assessment Tool 2013-2017. Furthermore, 56 traffic incidents were reported on George Street between 2014 and 2019, with 17 of these involving vulnerable road users, exemplifying the historic high crash risk associated with the corridor. The evidence in the IBC suggests there is some urgency in progressing this project. Safety issues relating to poor pedestrian crossing provision on George Street mid-block and at the five-arm intersection with Frederick and London Street are well documented in the IBC. This is demonstrated in the following IBC IQA assessment:

"Problem 1 safety issue is supported - George Street has a high collective and personal crash risk and the project is considered to be strongly aligned with the GPS Safety and Access priorities and the NZTA Road to Zero Safety Strategy. George Street has a high collective and personal crash risk and the shortlisted options are estimated to reduce DSIs by 73-80%".

Crash data provides a snapshot of safety outcomes at a point in time and therefore fluctuates over time. With DCC's continuous approach to improving safety on their network, this section of the DBC seeks to update the evidence of current intermodal conflict and DSIs, as well as the alignment of the existing design with the desired function and use of George Street in terms of safety.

Updated Retail Quarter crash statistics

In addition to the crash evidence suggesting modal conflict and safety are major issues within the Retail Quarter, the IBC also notes the installation of Barnes Dance crossings throughout the precinct in 2018. Noting at that time it was too early to draw any conclusions of their impact on safety, more recent crash data suggests it is possible that they have contributed to improved safety outcomes, particularly improved severity of incidents.

displays a comparison of crash incidents from the IBC study period to the DBC study period.

Figure 12: Incident locations in the Retail Quarter from 2014-2019 (left) and 2016-2021 (right)

The above figure displays crash incident locations for the period considered in the IBC (2014 to 2019) on the left, alongside updated crash statistics for the DBC over a five-year period (mid-2016 to mid-2021) on the right. Table 6 and Figure 13 provide a more detailed comparison between these two periods and appear to show a decreasing trend of severe incidents in the updated DBC period.

Table 6: Comparison between IBC and updated crash data

Crash severity	IBC period (2014-2019)	Updated DBC period (2016-2021)
Fatal	1	1
Serious	6	3
Minor	19	17
Non-injury	75	82
Total	**101**	**103**

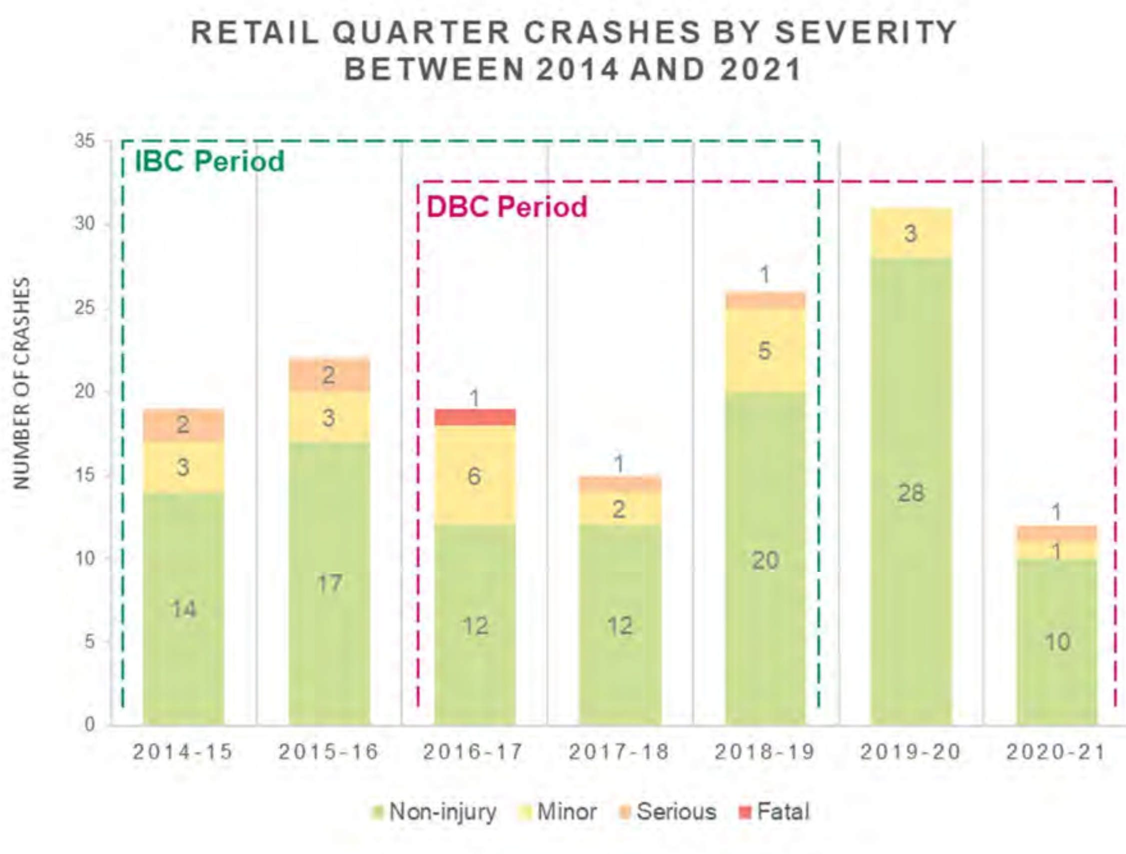


Figure 13: Comparison between IBC and updated crash data

As shown, the total number of DSIs is small, and while the total number of incidents increased slightly between the IBC and DBC periods, this increase is largely seen in non-injury crashes and importantly, a reduction is visible in both Serious and Minor injury incidents. The one fatal incident relates to a pedestrian being hit by a turning vehicle from Great King Street while crossing St Andrew Street. This incident occurred in 2017 prior to the installation of Barnes Dance crossing at this intersection. This fatality is captured in both the IBC and DBC data periods. The decrease in minor and serious incidents in the DBC period has resulted in an overall social cost decrease of $1.8 million.

Early indications from the most recently available data suggests that recent safety interventions in the Retail Quarter have potentially impacted the number of serious incidents in the area, and this may continue in the future. There are, however, some limitations with the available data meaning evidence is not robust enough to determine if the safety problem within the Retail Quarter has been resolved. Such limitations include:

- The IBC and DBC periods overlap, meaning there are only two different years between each dataset, with many of the serious incidents occurring in both periods including one fatal incident from 2017. While serious incidents appear to have been declining since the installation of Barnes Dance crossings, it is currently too early to determine a conclusive trend.
- The years following the installation of Barnes Dance crossings in the Retail Quarter were impacted by the COVID-19 pandemic potentially compromising data. As previously discussed, the pandemic caused significant changes to travel behaviour in Dunedin, which may have contributed to the apparent decline in serious incidents. It is also difficult to ascertain whether the reduction in DSI incidents in the Retail Quarter was due to new crossings, or post-pandemic travel behaviour, or which of these had the greater impact.
- The difference in crash statistics between periods is small. While serious incidents in the DBC period have declined, it would only take two or three new incidents for this perceived trend of improved safety to be called into question. Data is therefore unconvincing, and more time is needed to draw a robust conclusion.
- Historic crash statistics consider current mode share conditions within the Retail Quarter. With aspirations to provide a more balanced arrangement for all modes and solidify the area as a desirable place to visit, mode share is likely to shift to an increase in vulnerable road users and alternative forms of micro-mobility such as e-scooters. There is therefore potential for future intermodal conflict to become a more pressing issue, which may warrant consideration of further safety interventions to ensure this potential conflict is adequately managed.

In summary, recent Barnes Dance crossings provided in the city centre may have reduced crashes, however there is not yet enough evidence to understand this with sufficient certainty. Despite these recent improvements, there are additional safety concerns along George Street itself, which are likely to be exacerbated in the future with more vulnerable users expected to visit George Street and the current design of the street creating numerous opportunities for intermodal conflict for those vulnerable users. This is discussed in subsequent sections.

Existing design

George Street has been designed with vehicle movement as the primary function and a posted speed of 30km/hr. DCC regular survey data indicates the corridor functions with a median speed between 24.8km/hr and 34.2km/hr. The Movement and Place assessment utilising the ONF (detailed in Appendix C) has identified that George Street has socioeconomic significance for wider Dunedin. Despite this, George Street has wide vehicle lanes (4m each), parking bays and turning lanes at intersections all of which, remove the pedestrian and cycling accessibility and in turn has impacts on safety. The current design does not allow for pedestrians to cross safely at the mid-block or for cyclists to use the space in a safe manner. The width of the footpaths is approximately 3m however it is congested at peak times and it is noted that there are several areas where this is restricted by the presence of sandwich board style signs located in front of shops. This causes issues for vision impaired users as well as conflict between mobility scooters and pedestrians.

In addition, the five-arm intersection is ranked at number 97 in the top 200 high-risk intersections, as detailed within Section 5.2.4 of the IBC. This was clearly demonstrated through a desktop and site review of the intersection design, with high vehicle, pedestrian and cycle throughput resulting in modal conflict.

Figure 14 offers an indicative assessment of space allocation at the five-arm intersection. As shown, the majority of space at this intersection is dedicated to vehicle movements. While this vehicle movement space is important for maintaining east/west connectivity, it comes at the expense of pedestrian connectivity leading to modal conflict and compromising the safety of other users. As shown, the current design forces pedestrians to cross large distances in front of multiple turning lanes. There are also signal phasing issues at this intersection, discussed further under Problem 3, which result in vehicles being allowed to make turning movements before pedestrians are finished crossing. Current phasing favours vehicles and vehicle flow, which leads to long delays for pedestrian cycles. While current signal phasing makes sense from a motor vehicle perspective, it could be optimised for vulnerable users, however this would come at the expense of queuing and delays for motor vehicles. Such phasing issues at the five-arm intersection can be confusing, frustrating, and ultimately lead to jaywalking behaviour and associated safety risks.

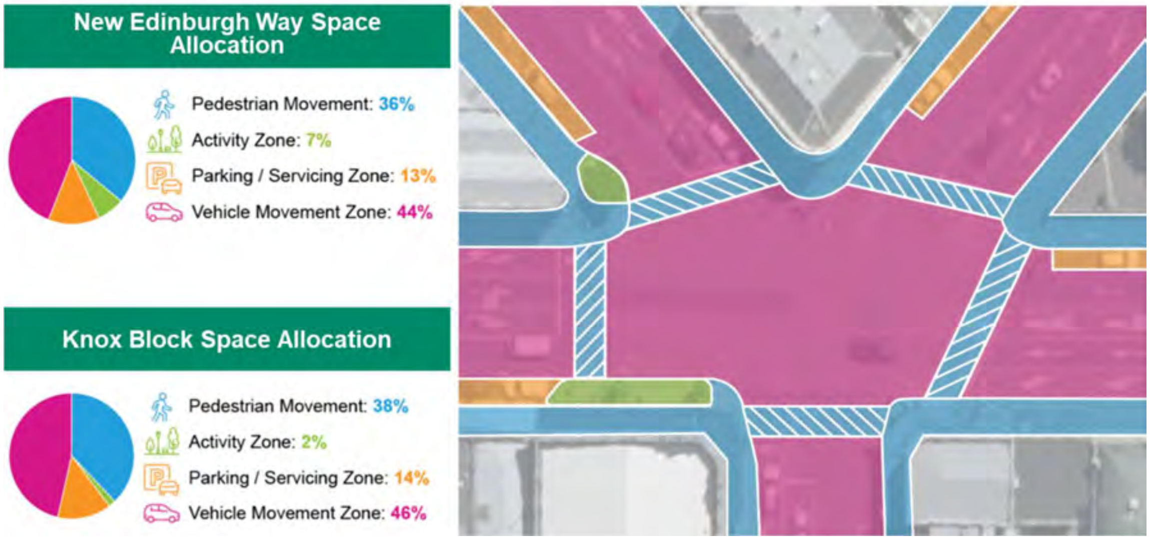


Figure 14: Space allocation at the five-arm intersection

Network management

The Dunedin NOF outlines a framework for how the transport network should be utilised to maximise effectiveness for all users. The framework considers aspirational modal networks and how they can cater for future land use growth assumptions. An overview of these aspirational modal networks in proximity to the Retail Quarter is displayed in Figure 15.

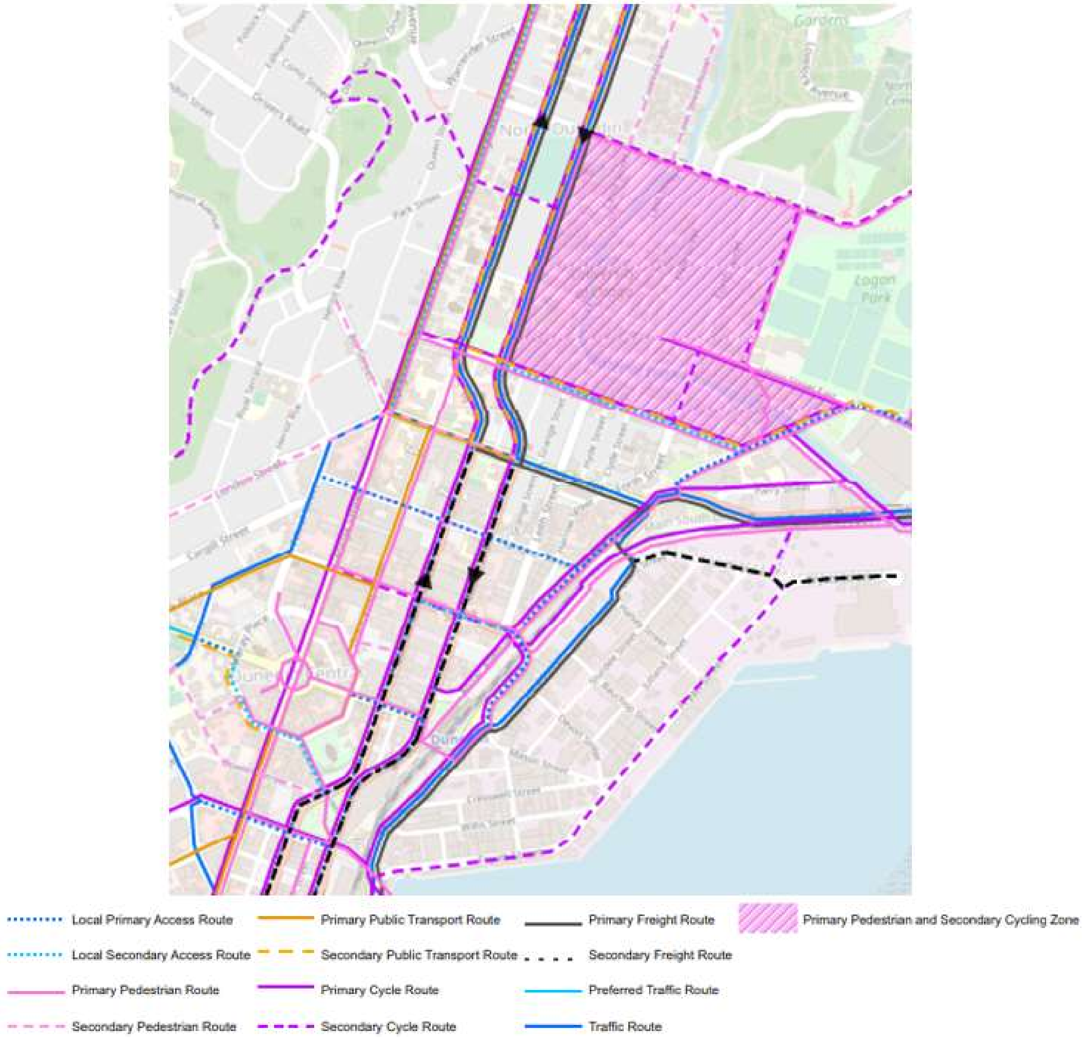


Figure 15: Aspirational modal networks around the Retail Quarter from the Dunedin NOF

As shown, under the Dunedin NOF, George Street is planned as a primary route for pedestrians and cyclists, with general traffic routed to parallel streets including Filleul Street and the State Highway 1 (SH 1) one-way pair. These parallel routes are better suited to support high volumes of vehicle through-movement.

In addition, as outlined in Section 3.4.6, the Waka Kotahi ONF provides guidance on the management of transport corridors from a place and movement perspective. Based on the existing operation of George Street, the corridor from Moray Place to Frederick Street can be assigned a place and movement ranking of 2. Under the ONF, this means George Street is currently classified as a Main Street. Following an assessment of the corridor from an aspirational perspective, the same length of George Street was assigned a place ranking of 2 and a movement ranking of 3, or a desired future classification as an Activity Street (See Appendix C for a detailed overview of the classification process). This desired future classification of Activity Street is reflective of intentions to reduce through-traffic along George Street and re-route buses to Great King Street.

Despite both the Dunedin NOF and ONF establishing aspirations for George Street to provide a balance for all modes and support active mode movements, the Retail Quarter streetscape currently caters primarily to motor vehicles at the expense of provision for other modes. This mismanagement of the network has negative flow-on effects for potential modal conflict, place value, and visitor appeal (described further under problems 2 and 3).

Summary Problem statement 1 – Safety

Updated crash statistics since the IBC indicate a possible improvement in DSIs in the Retail Quarter. This is likely a consequence of safety improvements from the introduction of Barnes Dance crossings at many intersections in the Retail Quarter, although changes in travel behaviour since the COIVD-19 Level 4 and 3 lockdowns are likely to be a factor.

The NOF and ONF, indicate there is currently mismanagement between aspirations for George Street and the existing use and layout of the road corridor. The risk of intermodal conflict therefore is still high and may be amplified in the future with a move to increased use of active modes and other forms of micro-mobility in the area.

Historical crash data does not capture risk or near misses and whilst some safety improvements have been made, safety risks could become more pronounced in future as more vulnerable road users are attracted to the area. Safety risks are amplified through the poor allocation of space as outlined further under problem three.

4.5.2 Problem 2 – Network Design

Problem Statement 2: Poor information and network design cause private vehicles to use George Street as a through-route, which compromises the desired high place function

George Street has been classified as having a desired future high place and lower movement function as outlined in the ONF Movement and Place assessment, detailed in Appendix C. Whilst movement is still a function, the emphasis is that the George Street corridor is a high density commercial/retail environment, an important living space for day to day activities, and an integral thread of the central city fabric.

Network design leads to perception of George Street as a desirable through-route

Despite aspirations for George Street to be viewed as a destination, which attracts and encourages visitors to spend their time and money in the Retail Quarter, there is strong evidence to suggest that traffic uses the street as a thoroughfare. The Dunedin Microsimulation Model (DMM) modelling work carried out by WSP and Abley, as well as observations of the wider network and street design have been used to evidence this.

Table 7 displays a summary of modelling results for the Dunedin base network along George Street for the AM peak (AM), Interpeak (IP) and PM peak (PM) periods in 2019. Peak periods are as follows:

- AM peak – 0800-0900
- Interpeak – 1200-1300
- PM peak – 1700-1800

Table 7: One-way volumes (v/h) along George Street (2019)

Option	Period	George St Northbound (vph)	George St Southbound (vph)
Base Network	AM	170	135
	IP	245	147
	PM	351	190

As shown, north and southbound traffic volumes for the base network along George Street under a 2019 modelling scenario are averaging 305 vehicles per hour (vph) in the AM peak, 392 vph in the interpeak and 541 vph in the PM peak. Whilst some of these trips are likely completed for the purpose of accessing local businesses, modelling has shown that a significant proportion are using George Street as a though route, with no intention of stopping for retail activities. Table 8 displays a Select Link Analysis of the same base network, to demonstrate the modelled through movement of traffic along George Street, between Moray and Frederick Street.

Table 8: Select Link Analysis of George St (Moray Pl to Frederick St) under a 2019 base network scenario

	AM peak	Interpeak	PM peak
George Street Northbound			
Total flow	170	245	351
Total through flow	17	26	45
Through flow %	10%	11%	13%
George Street Southbound			
Total flow	135	147	190
Total through flow	106	80	90
Through flow %	79%	54%	47%

As highlighted by this analysis, under base network conditions in 2019, much of the traffic on George Street uses the route as a thoroughfare. Notably, 54% of southbound traffic in the interpeak (when there are high volumes of pedestrians) travel through George Street without stopping to visit the Retail Quarter.

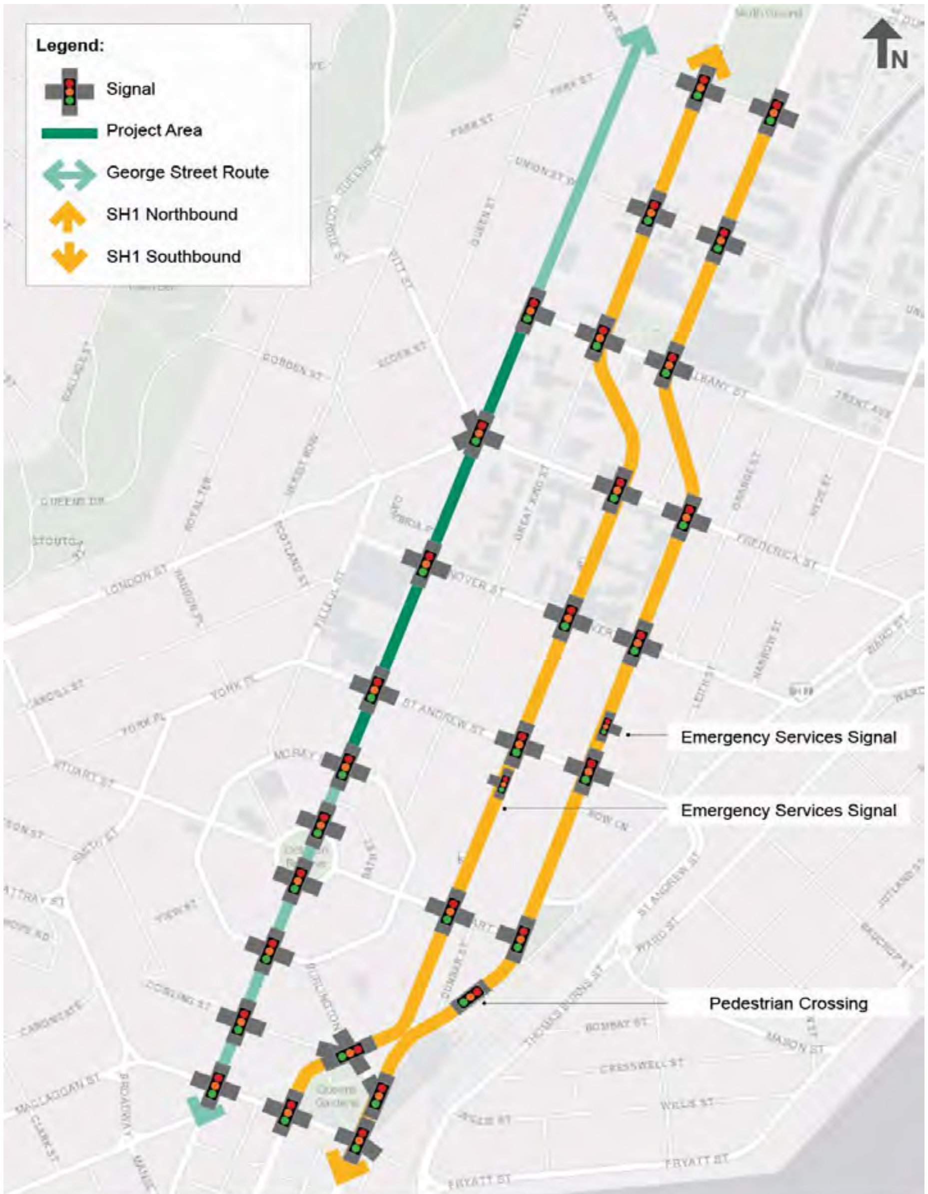
Observations of the wider network design as well as the George Street streetscape, begin to paint a picture of possible reasons for such high through-movement. As shown in Figure 16 George Street and Princes Street are attractive north-south route options and are likely to be perceived to provide a more direct route for trips to and from suburbs such as Mornington and Maryhill to North Dunedin and North East Valley.

Given the directness of George Street, this route may appear to be an appealing option despite SH 1 connections running parallel, which are much more appropriate for through trips considering the comparative place and movement functions. An assessment of travel times between George Street and the SH 1 one-way pair between St David Street and Rattray Street indicates that during peak periods it is faster to take the SH 1 system. Despite this, sizeable proportions of vehicle traffic continue to use George Street as a through-route. This may be due to a perception that George Street is less encumbered by traffic signals, particularly north of Albany Street. In addition, travel time differences between George Street and the one-way pairs are minimal, with delays of around 3-5 minutes along George Street, which may not be significant enough to alter the perception that George Street is a viable thoroughfare

As it stands, the layout and design of George Street is not indicative of a destination, instead prioritising vehicle space and movement with wide traffic lanes. These points are further discussed below.

Consequently, traffic volumes recorded within the area are not reflective of the number of people visiting specifically for commercial activities, and the Retail Quarter streets are dominated by vehicle movements that are not adding value to the local economy. Such vehicle movements result in several detrimental consequences, notably:

- An increase in modal conflict discussed above under Problem 1
- Traffic noise and air pollution that detracts from general amenity
- A disproportionate allocation of space discussed further in the following sections



Route Statistics *Between St David Street and Rattray Street*		George Street North	George Street South	SH1 North	SH1 South
Travel Time	Travel Time (mins) - Morning Peak	6	8	2.5	3
	Travel Time (mins) - Afternoon Peak	6.5	9	3	3
Types of Signals	*Intersections*	10		10	10
	Emergency Service Stop Signals	N/A		1	1
	Mid-block Pedestrian Crossing	N/A		N/A	1
Total Number of Signals		**10**		**10**	**11**

Figure 16: Central Dunedin network depicting George Street as a more direct through-route[4]

[4] Travel times extracted from WSP transport model

Poor information encourages traffic circulation and compromises place value

Despite George Street representing an integral component of the central city, there is a distinct lack of wayfinding related to both parking and general navigation. Users of George Street and the wider Retail Quarter are presented with limited information on how to optimise use of the space and where to find key attractions to spend their time and money. This further encourages George Street as a through-route, with no obvious information or encouragement to explore the heart of Dunedin. As it stands, there are no obvious existing visual cues, either in the form of signage or in the design of the street, to discourage vehicular through traffic or to identify George Street as a destination or more people-oriented place.

Some examples of wayfinding (within the pedestrian space) can be found on George Street as shown in Figure 17. These features, however, are easily missed, in poor condition and inaccessible for those that are visually impaired or do not speak English. Moreover, these boards are illegible to vehicular traffic. They are often located in places where they constrain opportunities for placemaking or further impede those with disabilities.

Furthermore, there is a notable lack of wayfinding for drivers, including parking wayfinding within a 1km radius of George Street, which is exacerbating traffic issues. The MRCagney Dunedin Parking Roadmap[5] report emphasised the detriment of a lack of any parking wayfinding in the CBD. This report noted that interviewees felt this causes localised congestion and lower utilisation of off-street parking due to drivers not knowing where available parking was located, particularly if they are not already familiar with Dunedin.

Figure 17: Example of wayfinding on George Street

This significant gap of information on location and availability of parking is evident with much of the parking signage only visible once in proximity to carparks. As a result, vehicles travelling from key routes such as SH1 do not have any obvious awareness of available parking locations, leading to congestion issues linked to traffic circulation and a high occupancy of on-street spaces.

As identified in the IBC, those seeking to park on or near George Street create a circulating effect while searching for available parking spaces. The lack of wayfinding compounds this issue, with vehicles navigating around blocks in search of an entrance to parking buildings.

This issue is compounded by the fact that parking buildings throughout the Retail Quarter can typically only be accessed from one direction. For example, the Filleul Street entrance to the Meridian Mall carpark is only accessible via a left turn on Filleul Street or from a left turn on Hanover Street. Northbound traffic is therefore forced to navigate along George Street and circle back around the block to turn left into the parking building. This circulating effect is clearly evidenced using the modelled

[5] Dunedin Parking Roadmap (Draft) MRCagney Dec 2020

northbound traffic flows on George Street summarised in Table 9. The table compares 2028 traffic flows on the existing base network with the do minimum scenario. The do minimum scenario includes the provision of a right-turn access into the Meridian Mall carpark for northbound traffic on Filleul Street.

Table 9: Northbound traffic on George St under base network and do minimum scenarios (2028)

Option	Period	George St NB (vph)
Base network	AM	195
	IP	241
	PM	319
Do Minimum	AM	91
	IP	148
	PM	182

As shown in Table 9, the implementation of a do-minimum scenario, consisting of right-turn access into the Meridian Mall carpark on Filleul Street, as well as local junction improvements, effectively halves the northbound traffic on George Street. This demonstrates a significant proportion of existing traffic movement on George Street is a result of circulating movement. Such unnecessary vehicle movements lead to an increase in the overall volume of traffic and results in an unpleasant pedestrian environment and higher risk of modal conflict.

High levels of occupancy of on-street parking in the Retail Quarter also tends to induce traffic circulation. The Retail Quarter parking study technical note in 2020 noted that 81% of existing on-street parking and 71% of existing off-street central city parking facilities are occupied at peak times, with an overall occupancy rate of 80%. The 2020 MRCagney Dunedin Parking Roadmap also notes an occupancy rate of around 81%. This level of occupancy appears consistent over time with Dunedin Parking Study (2016) stating that during peak periods, most of the on-street parking along George Street experiences 80-100% occupancy. Under these conditions, with a limited supply of on-street parking and high occupancy rates, literature suggests that motorists are encouraged to roam in search of an available space. Beyond an optimal occupancy rate of around 85%, roaming time increases exponentially with significant detrimental impacts to the network performance[6].These findings have been reinforced by anecdotal evidence from stakeholders, who have reported vehicles circulating Retail Quarter streets looking for parking spaces in the absence of adequate and updated wayfinding information.

On-street parking can often be viewed as more desirable when it appears that there are no alternative options. While George Street has approximately 50 on-street parking spaces, there are several alternative nearby options available, including:

- Meridian Mall Carpark, Wall Street Carpark, and Golden Centre Carpark (715 parking spaces total)
- Great King Street Carpark (344 parking spaces)
- Filleul Street Carpark (152 parking spaces)
- On-street carparking (P5 to P60 restrictions), with over 2,500 spaces provided within Dunedin CBD[7].

The off-street parking options can become less desirable given the lack of information in the wider network. The directness to these parking facilities is not evident, as shown by the existing wayfinding in Figure 18. They also become less attractive when people are unsure how many parks are available at any time and the growing percentage of long-term, lease parking in the buildings, which reduces parking availability.

[6] Jakob and Menendez (2020). *Optimal Parking Occupancy with and without Differentiated Parking: A Macroscopic Analysis*

[7] As detailed on Abley Dunedin Parking Study 2016 Final.pdf

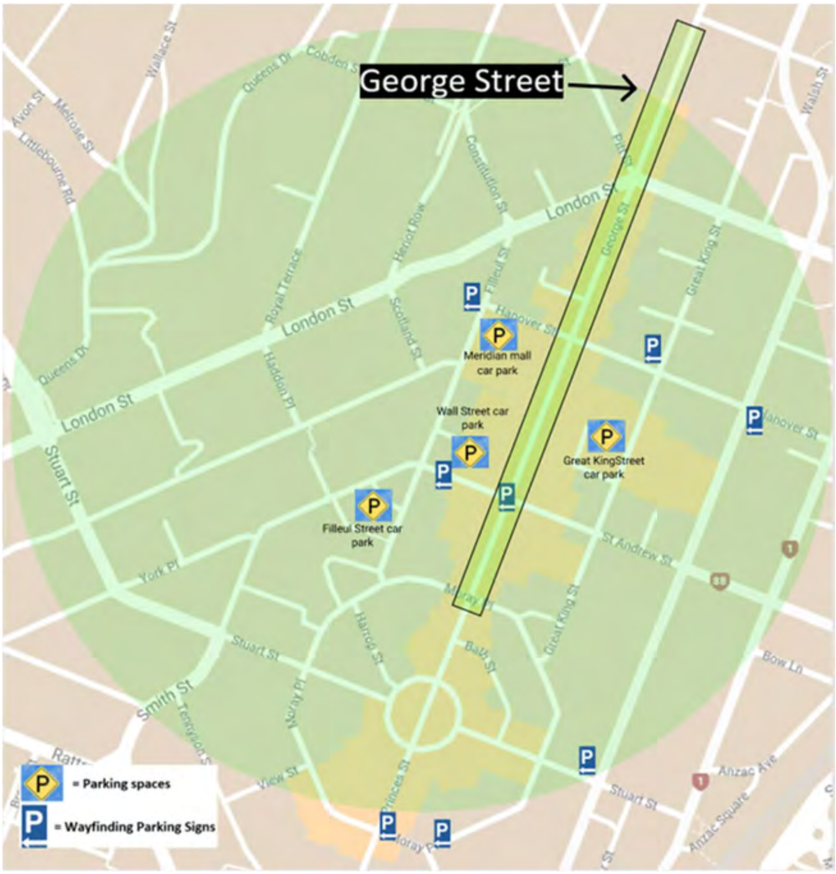


Figure 18: Parking Wayfinding signage surrounding George Street

The perception of availability of parking in the central city is evidenced within the DCC Residential Opinion Survey 2019/2020[8] where 64% of respondents stated they are dissatisfied with the availability of parking within the Central City. This dissatisfaction has increased over the last five years as shown in Figure 19, which highlights a notable trend of declining resident satisfaction with several facets of the transport system including availability of parking, flow of traffic, and ease of pedestrian movement.

[8] https://www.dunedin.govt.nz/__data/assets/pdf_file/0008/804059/Residents-Opinion-Survey-2020.pdf

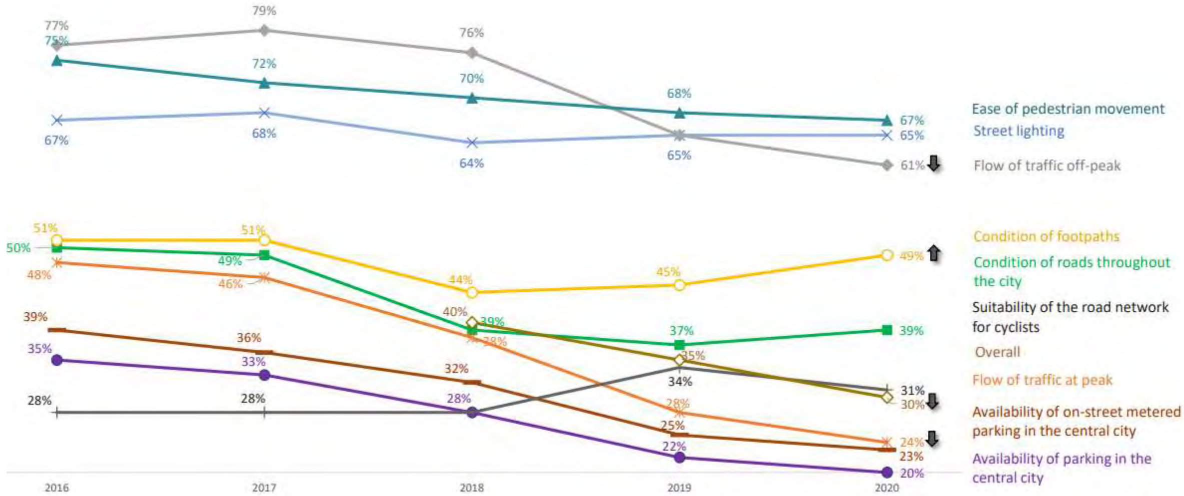


Figure 19: Resident satisfaction with the Dunedin transport system (2016-2020)

Summary Problem statement 2 – Network Design

Poor information in the form of a lack of adequate directional wayfinding and the visually direct network design of George Street results in many private motor vehicles choosing George Street to move through the central city, despite slower travel times than the State Highway. The additional lack of parking wayfinding, car park entrance design and high levels of parking occupancy encourages traffic to circulate, which significantly compromises the amenity and place value of the George Street.

4.5.3 Problem 3 – Place and Amenity

Problem Statement 3: Poor space allocation and supporting infrastructure adversely impacts modal choice, activity, accessibility, culture, and amenity within the Retail Quarter

Poor space allocation

The layout of George Street offers an unequal allocation of space that disproportionately prioritises vehicles over other transport modes. Given George Street is identified as a primary pedestrian and cycling route (refer to section 4.5.1 above), the street gives higher priority to private motor vehicles at the expense of provision for pedestrians and cyclists, as demonstrated in Figure 20.

Figure 20: Existing layout of George Street in the Farmers Block (Source: Google Maps, June 2020)

In addition to safety issues, the existing layout creates several areas of tension between users, which contributes to the erosion of a sense of place in the Retail Quarter and reduction in visitor footfall, discussed further below. It is particularly challenging for those deemed vulnerable users for the following reasons:

- Cyclists compete for space with motor vehicles, parked vehicles, and bus stops, with numerous pinch points leading to areas of conflict. The only indication that drivers must share the road with cyclists are sharrow markings along George Street. Only very confident cyclists feel comfortable in these situations (which tends to be less than 5% of people)[9].
- The restricted footpath space is further impacted by uneven surfaces (exacerbated by the age of the existing paving), poles, manholes and utility covers, street furniture, outdoor seating for cafes and restaurants and privately-owned business signs, which impact safety and accessibility for pedestrians. This problem becomes particularly challenging for those with vision impairments or mobility issues. It can also be challenging for those with prams or with young children in tow. This problem becomes exacerbated during peak times, such as during lunch rushes or at Christmas time, when footpath space is in high demand and becomes highly congested.
- These restricted, cluttered, and often busy footpaths are the only safe option for scooters, skateboards, and mobility scooters, but this brings them into conflict with pedestrians, particularly those with vision impairments or mobility issues and increases perceptions of risk for these vulnerable users.
- The restricted footpath space or small build-out areas also offer the only space for informal activities such as busking, socialising or for other placemaking activities[10], meaning the opportunities for encouraging more activities to attract people to the area to spend time and linger (with time spent likely to contribute additional spending in the area) are limited and end up impacting access and pedestrian flow when they do occur.
- Congestion and frustration at travel times leads to increased risk-taking at intersections including red light running and jaywalking. This exacerbates conflict between vehicles and vulnerable users. Red light running is particularly problematic across Dunedin and has recently been brought to light through the Star's 'Stop Running the Red Campaign'. A Dunedin Senior Sargent has described the

9 https://www.nzta.govt.nz/walking-cycling-and-public-transport/cycling/cycling-standards-and-guidance/cycling-network-guidance/cycle-network-and-route-planning-guide/principles/people-who-cycle/

10 Refer to Global Street Design guide for additional information on placemaking - https://globaldesigningcities.org/publication/global-street-design-guide/

issue as widespread, with the five-arm intersection being identified as a hotspot for this unsafe behaviour[11].

The limited quality space for users other than private motor vehicles causes conflict and leads to George Street being perceived as unsafe, inaccessible, and unattractive. It also limits the opportunities for managing the area in ways that would encourage more people to visit. Consequently, users may be deterred from visiting George Street, which ultimately reduces the economic potential of the Retail Quarter. An example of the existing layout with comparative modal space allocations is summarised for the Farmers Block in Figure 21.

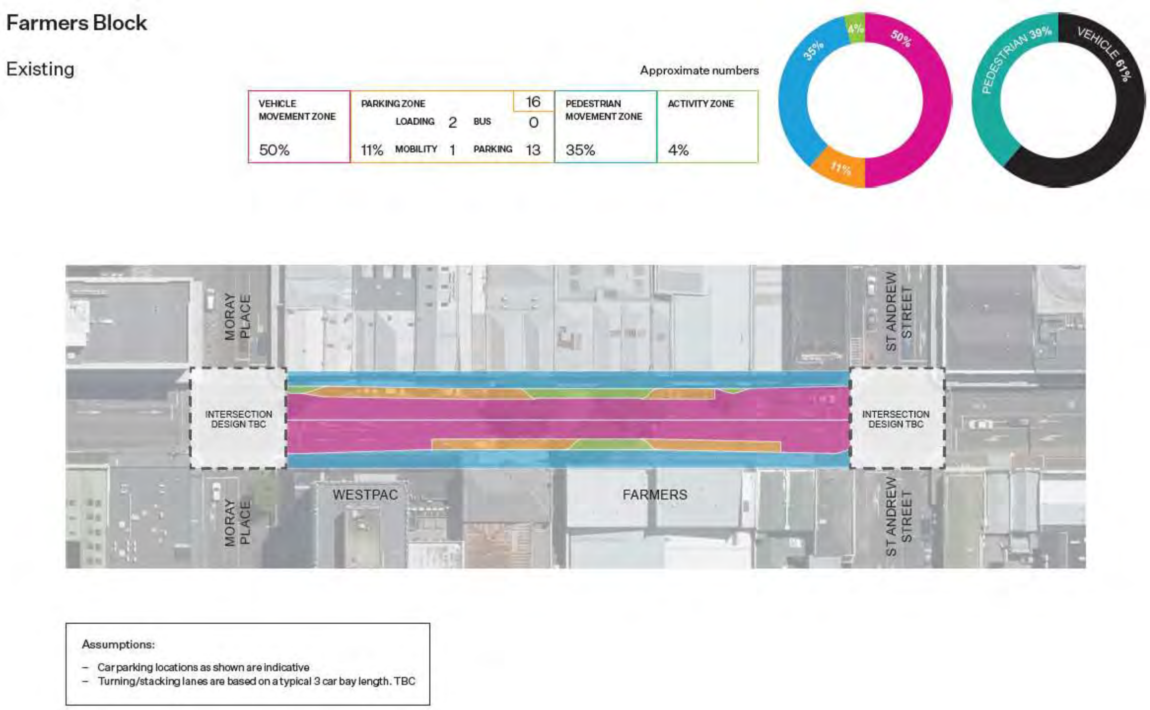


Figure 21: Existing space allocation along the Farmers Block, George Street

As shown, 61% of the public realm is allocated to motor vehicles, while 39% is allocated to pedestrians. Much of that 39% is also constrained in some way, as mentioned previously. Proportionally this is not reflective of mode share split in data from the Retail Quarter. Two data sources have been used to examine the mode split along this block. Firstly, MioVision[12] data from October 2018 has been used to compare pedestrian, cyclist and motor vehicle counts at the Moray Place/George Street intersection (8.00am-6.00pm), which forms the southernmost end of this block. Across the 8.00am-6.00pm period, there were approximately 6658 pedestrians, 75 cyclists, and 4560 motor vehicles. Notably, this data only accounts for movements at this intersection, and does not account for movement along the entirety of the block between Moray Place and St Andrews Street[13]

The second source is the more recent George Street Public Life Survey conducted in 2020[14], which showed around 10,926 pedestrians and 168 cyclists using Farmers Block between 8am and 8pm. Higher numbers could be attributed to the longer study period (two hours extra), and the inclusion of movement occurring along the length of the block as opposed to just the one intersection. Additionally,

[11] Otago Daily Times (2021). Red Light Running: ‘The complacency is quite scary’. https://www.odt.co.nz/news/dunedin/red-light-running-%E2%80%98-complacency-quite-scary%E2%80%99

[12] MioVision is DCC’s regularly monitored traffic count data capture. This will also be used to measure the impact of the future improvements along the corridor.

[13] data from the St Andrews intersection was obtained during a 2016 survey, and consequently could not be used to show mode split at the other end of Farmers block)

[14] https://infocouncil.dunedin.govt.nz/Open/2020/05/CNL_20200525_ATT_1391_PLANS_WEB.htm

and possibly most notable, there are no motor vehicle counts included as part of this survey, meaning a mode split cannot be shown using this data.

Nevertheless, whilst there are notable differences between the MioVision and the Public Life Survey data, both show that there is a significant proportion of pedestrians present along this block, with numbers potentially ranging between 6658 and 10,926 across the day.

This current space allocation along George Street disproportionately favours vehicles, despite people and customers arriving via a range of modes, with a significant proportion of this user group being pedestrians. A recent independent survey commissioned by the Golden Centre showed approximately 40% of customers did not arrive by car. This mismatch in space allocation is likely impacting the commercial viability of the Retail Quarter, which is reinforced in literature, retail spend data and personal accounts from stakeholders.

Several studies have exemplified that the uneven allocation of street space can impact on pedestrian volumes and the attraction of an area. A Waka Kotahi Research report from 2013[15] undertook a literature review of New Zealand and international examples, which examined the results of distributing space more equitably within the street. In summary, the study indicated that good urban design, and the provision of high-quality pedestrian facilities is more likely to attract visitors to shopping areas. The study also included workshops with New Zealand retailers and shoppers, with the objective of identifying elements of the street design and infrastructure that are important in shopping areas.

Notably, the key difference between the retailer and shopper groups in the survey was the importance of parking. The retailers consider parking as the most important design feature to attract shoppers. However, the evidence from the shoppers is that the majority indicated they would be willing to forgo parking in shopping centres, to ensure they had a safe and attractive shopping experience. This evidence suggests that shoppers placed a higher importance on the availability of pedestrian crossings, wide footpaths and frequency of bus services. [16] The Waka Kotahi research also highlighted that "*schemes where more pedestrian activity is experienced are often where traffic is limited in these zones. This is often achieved by creating an area which is not considered as a through-route and where more suitable vehicle routes are available adjacent to the shared space*". Put simply, too many cars in an area and too great a focus on vehicles can discourage pedestrians from using the area and seeing it as an attractive and safe place to visit.

Stakeholder engagement has highlighted similar sentiments, as summarised in Table 10 (with a more detailed stakeholder engagement summary provided in Section 9.0). As shown, a variety of groups feel that the current layout and pedestrian space allocation along George Street is inadequate and acts as a detractor to the area.

Table 10: Stakeholder sentiments towards the existing George Street Layout

Group	Perception of Existing George Street Layout	Theme
Youth / Students	• Students tend to walk to get places, and personal safety is a concern • With existing layout, there is not much to attract them to city centre	Personal Safety Lack of Attraction
Age / Disability / Accessibility Advocates	• Many disabled and elderly people do not visit George Street due to feeling unsafe, conflict with other modes, and lack of amenities • Existing layout creates risks and reduces space for pedestrians and amenities that attract people to the area • Believes George Street needs a 'shot in the arm' • Insufficient pedestrian space	Personal Safety Lack of Amenity Modal Conflict Lack of space
Retailers	• Upgrade is long overdue • Existing layout prioritises cars over public realm	Lack of Amenity

[15] https://www.nzta.govt.nz/assets/resources/research/reports/530/docs/RR-530-Reallocation-of-road-space.pdf
[16] https://www.nzta.govt.nz/assets/resources/research/reports/530/docs/RR-530-Reallocation-of-road-space.pdf Page 113

Retail activity and economic performance

As outlined above, the current space allocation along George Street is not adequately catered to all users of the Retail Quarter, with case studies and stakeholder reports suggesting that this is likely to be a significant detractor to visitor appeal. Clear evidence of this can be drawn from recent economic indicators and spending data from Dunedin.

The Dunedin Retail Quarter – Economic Resilience Report notes that the central city's share of Dunedin's overall retail spend is decreasing. Between 2018 and 2019, spending in the Retail Quarter grew 1.37% coupled with a 20% fall in footfall, which raised concerns for both retailers and property owners. In comparison, city-wide spending grew by 2%.

This trend has generally worsened since Covid-19. Where the central city sales declined by 4.2% between February and July 2021 compared to the previous year, retail sales across the city rose by 0.4%.[17] According to the same data, as in the week ending 1 August 2021, there was a 6.5% decrease in the value of spending and 8.1% decrease in number of transactions in the Dunedin CBD compared with the same week in 2020. For Dunedin generally, the same numbers were decreases of 2.9% and 3.9% respectively. While there are obvious impacts from a reduced international visitor numbers and changing patterns of behaviour following the pandemic, the general trend is that fewer people are shopping in the central city in comparison to other parts of the city.

The Dunedin Retail Quarter – Economic Resilience Report also notes that Dunedin has been lagging both regionally and nationally in terms of economic performance. The city-wide growth of 2% has the Dunedin region trailing all over main centres and nearby provincial areas, as shown in Figure 22.

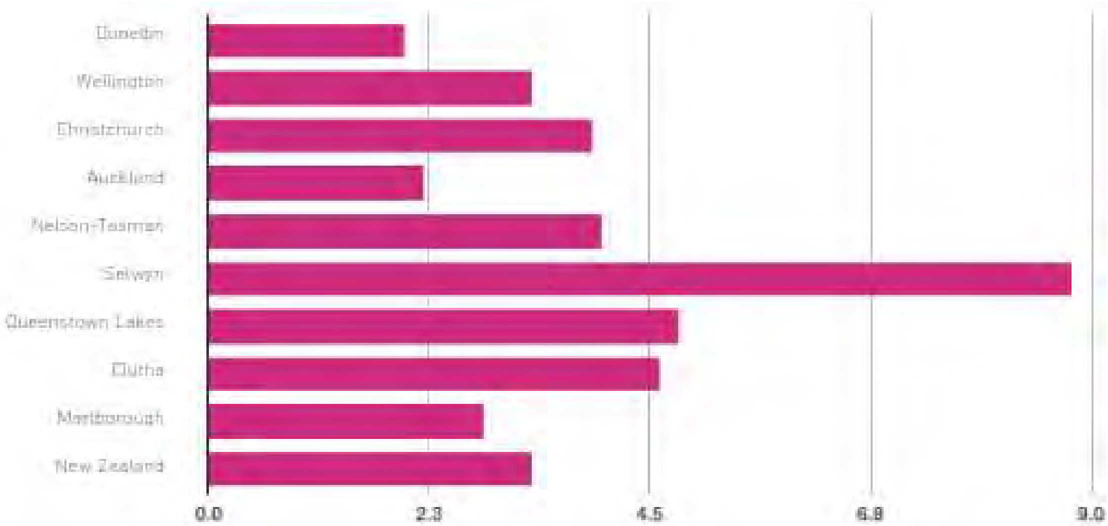


Figure 22: New Zealand regional percentage spend growth (2018-2019)[18]

An assessment of more detailed retail spend data from the Dunedin CBD and wider city reveals similar trends of economic stagnation. Figure 23 displays a summary of average quarterly spend for the Dunedin CBD and wider city from 2019 to 2021. As shown, despite a temporary dip in spending associated with the 2020 COVID-19 lockdown, spend in both the Dunedin CBD and wider city has remained relatively constant since the beginning of 2019, with minimal meaningful growth. While it is not possible in this business case to identify the broad issues for this lower city-wide growth, it is possible the declining attraction of the central city and the retailer offering there, normally a key driver of retail vibrancy, is also contributing to this stagnation.

17

18 First Retail Group Ltd (2020). Dunedin Central City Upgrade: Retail Quarter – Economic Resilience

Figure 23: Average quarterly spend in the Dunedin CBD and Dunedin City (Data provided by DCC)

This trend of stagnation in traditional retail spend is coupled with a steady growth in online shopping at a rate of 3.6%. Younger demographics are now more inclined to spend money without entering a physical store. As noted in the Retail Quarter – Economic Resilience report, these economic trends are indicative of an environment that is "satisfying, but not inspiring consumers, or welcoming additional audiences". There is evidential opportunity to enhance the Retail Quarter to ensure it remains accessible, attractive, relevant, competitive, and prosperous for as many as possible. While it is clear that reversing this trend will require more than just improvements to the look and feel of the area, and necessitates changes to the retail offering and initiatives like better marketing, amenity and accessibility are key issues that are clearly impacting the attractiveness of the central city.

Retail unit vacancy rates are often raised as a key indicator of decline in the central city. Vacant shops are highly visible and create negative perceptions of the health of the central city. Figure 24 provides an overview of retail occupancy along the Farmers Block, Golden Block and Edinburgh Way from 2014 to 2021.

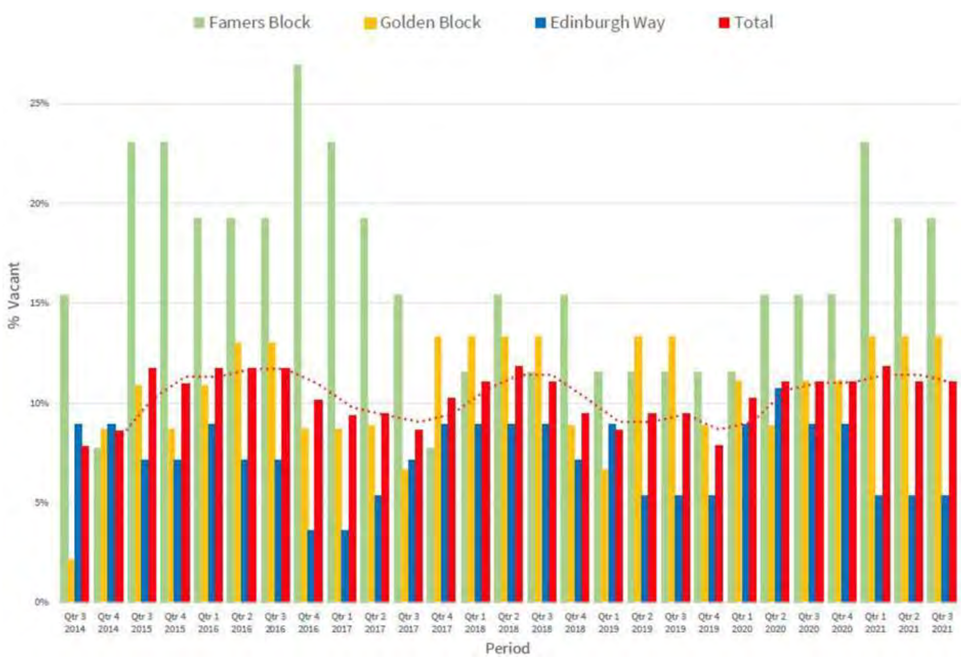


Figure 24: Retail vacancies on George Street (2014-2021)

While the data shows that retail occupancy has fluctuated over the years in question, vacancy rates have tended to be cyclical and only increased marginally overall over the time period in question. There has been a small increase in vacancy since mid-2020, which may represent the consequences of recent COVID-19 lockdowns.

The data also shows that there are a number of units that have been untenanted for long periods. Whilst Figure 24 shows that New Edinburgh Way appears to have lowest percentage of vacant units in 2021, and typically tends to have the highest occupancy, Figure 25 below shows that there are three units along this block that been untenanted for over 18 months. There are vacant units on all blocks with periods of vacancy. While this could demonstrate a longer-term issue, the low number of these long-term vacancies, and anecdotal evidence from potential tenants, businesses and realtors also indicates that there are a range of issues that contribute to vacancies, including seismic ratings, building condition, location, size and cost. While vacancy can certainly demonstrate reduced retail vibrancy in the area, the equation is more complex and warrants further research and discussion with owners before being considered a key indicator.

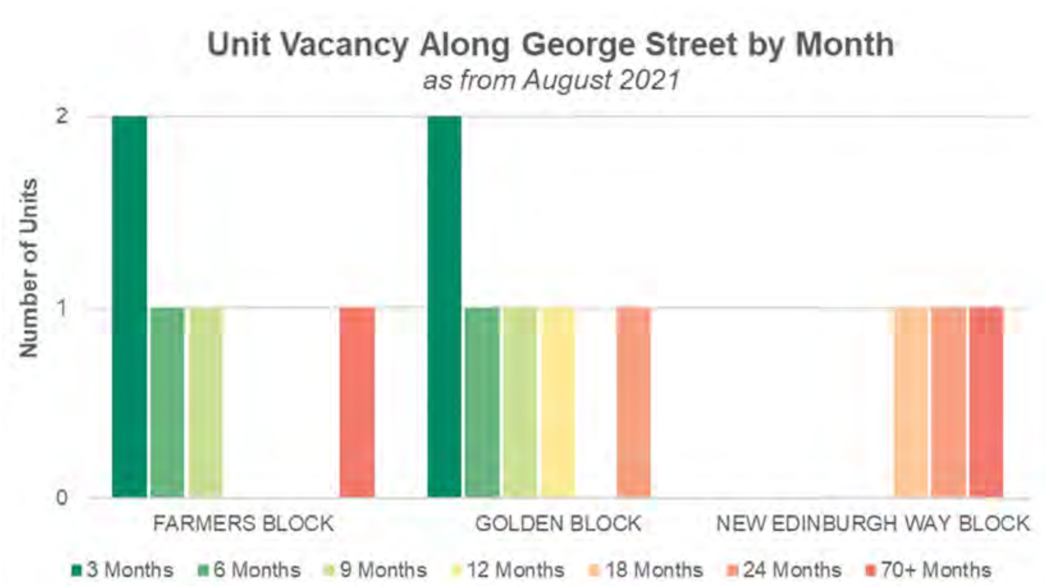


Figure 25: Unit Vacancy along George Street as from August 2021

Accessibility and Amenity

Poor space allocation along George Street not only has detrimental consequences for the local economy, but also on accessibility, general amenity, and perception of safety in the Retail Quarter, all with negative impacts on footfall numbers. The Retail Quarter – Economic Resilience report noted 70% of respondents sought improvements to the Retail Quarter to enhance visitor experience and reflect values of the wider community and cultural heritage (cultural values outlined in Section 4.2.1). The DCC's annual Resident's Opinion survey also shows declining satisfaction with the look and feel of the city centre, demonstrating the potential importance of these issues alongside other concerns such as access to car parking.

A decline in appeal was reinforced by stakeholders during engagement with the CCAG in June 2020. Several groups (including elderly, accessibility, and youth groups) expressed that they did not view the Retail Quarter as accessible given the lack of public amenities (such as seats and toilets) and inadequate crossing facilities, resulting in these groups feeling excluded from visiting and using the space. The Accessibility Review undertaken in 2020[19] noted that the tactile ground surface indicators (TGSI) at many of the Barnes Dance intersection crossings were incorrectly configured and consequently will not safely or correctly direct visually impaired and blind people across the road

[19] Retail Quarter, George Street Accessibility Review – Strawbridge Accessibility, 2020

(Figure 26). The condition of the existing pavers and pavement surfaces have been of on-going concern. The 2011 Dunedin Central City Strategic Directions document listed uneven pavement as a headline challenge and weakness facing the central city, noting the risk to elderly and less able users.

Figure 26: Barnes Dance Crossing St Andrews Street – Incorrect TGSI configuration and uneven surface[20]

Existing formal crossing facilities on George Street are limited to intersections and there is currently no provision of safe mid-block crossings, apart from several courtesy crossings (see example in Figure 27). However, it appears that despite the improved sight lines that kerb buildouts offered at courtesy crossings, they do not seem to significantly improve accessibility. The Accessibility Review also noted that there was no provision of TGSI at any of these locations to warn visually impaired and blind people of the road crossing. However, it is doubtful that the provision of such will help, as there is no requirement for cars to give way at these locations. In addition, the surface material is often uneven, creating slips and trip hazards, posing a challenge for those with mobility issues.

Further to this, it appears that both the signalised and courtesy crossings don't necessarily align with desire lines. During the evening peak, several people were observed crossing at points where formal or courtesy crossing infrastructure was absent, creating the potential for conflict with private motor vehicles and buses. Figure 27 shows several unsafe crossing movements observed within a short space of time, which highlights the existing poor pedestrian connectivity on George Street.

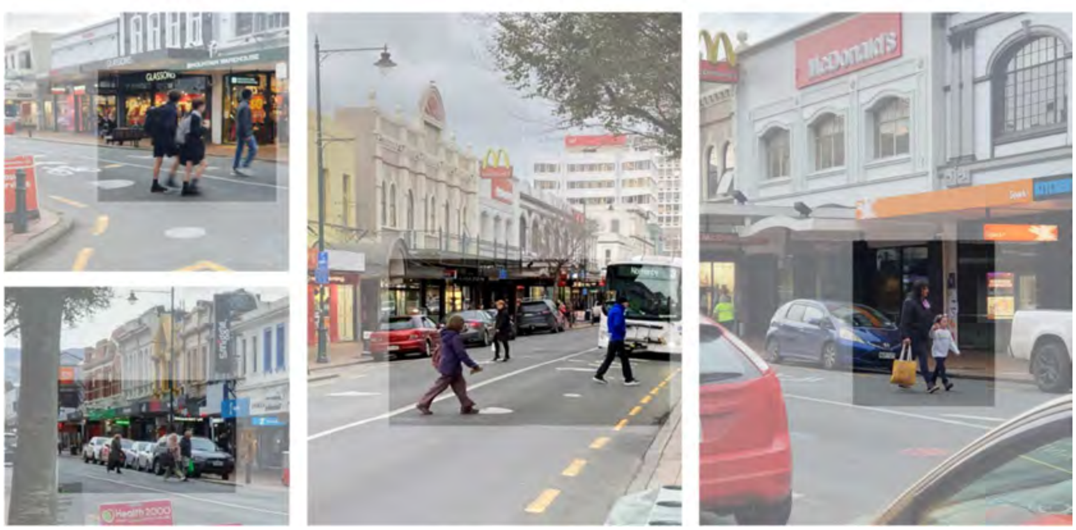


Figure 27: Informal crossing movement

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[20] Retail Quarter, George Street Accessibility Review – Strawbridge Accessibility, 2020

Additionally, a Pedestrian Environment Review System (PERS) assessment undertaken in June 2021 identified that sections of the footpaths were inadequate to cater to high pedestrian volumes; had uneven surfacing in sections with gradients that would impact wheelchair access and street furniture such as bins or advertising boards obstructing pedestrian movement zones. At present, the limited footpath space is insufficient in catering for high pedestrian volumes which can be present during lunch rushes, Christmas Shopping periods, or during Graduations. Realistically, the space is only wide enough to allow for two people to walk abreast, with overtaking proving to be difficult. These factors result in constrained movement as well as an unattractive environment. Examples of such poor pedestrian provision are shown in Figure 28.

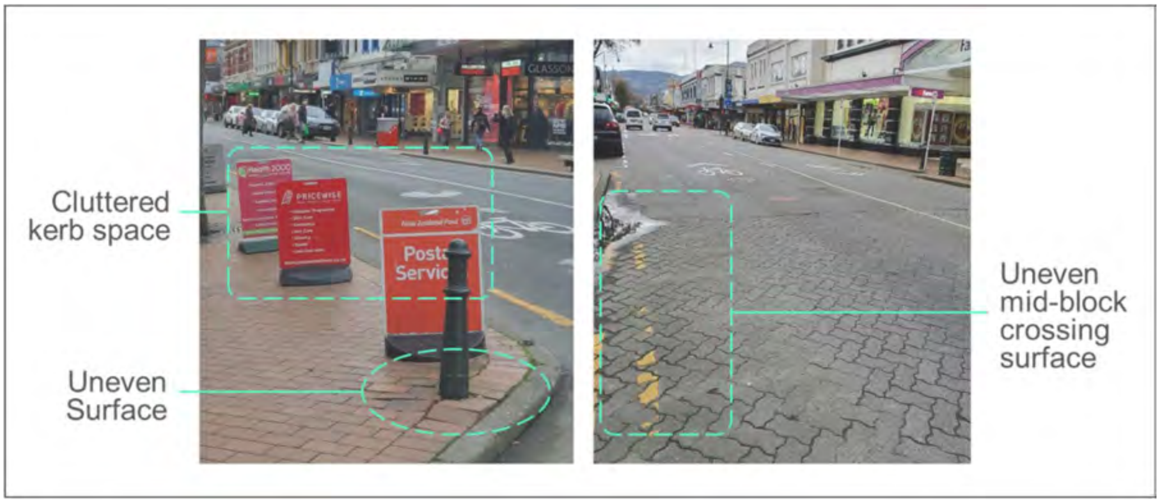


Figure 28: Cluttered footpaths and uneven surfaces alogn George Street

This unwelcoming environment does have direct impacts for the Retail Quarter, reducing visitation and potential customers and retail spend. Anecdotal evidence in Table 10 suggests youth, disabled and elderly groups feel the existing layout and design of George Street is not conducive to social cohesion. and interaction. Elderly and Disabled groups feel isolated from the area as a result of the unwelcoming environment with poor amenity provision (e.g. seating and toilet facilities), resulting in concerns for safety and unwillingness to visit. Similarly, youth groups feel there is nothing to attract them to the area.

Public space plays a key role in facilitating social interaction, or conversely, when poorly designed, it limits social cohesion opportunities. In an article examining how urban design contributes to loneliness published by Stuff[21], architect David Gibbs notes that, “we need people bumping into the same people regularly to get a connected society,” and wanting to go to and spend time in a public environment is a key contributor to this. A research paper examining loneliness post lockdowns in 2020[22] noted that, “when streets are safe, open, and friendly to pedestrians and bicycles, people are much more likely to stop and chat, spend more time outside, and feel a sense of wellbeing and belonging”.

Perception of safety

During a site visit in June 2021, the perceived pedestrian safety risk around the five-arm intersection was highly evident. Pedestrian crossing times and traffic signal phases were observed to be a key safety issue at the intersection. The phasing only allows for a five second pedestrian green time before the flashing red light appears. At this point, the red-light phase ends for turning traffic, resulting in vehicles attempting to turn, while pedestrians remain in the carriageway. This phasing issue is demonstrated in Figure 29.

21 https://www.stuff.co.nz/national/122579037/how-urban-design-can-transform-lonely-cities-into-social-societies
22 https://helenclark.foundation/wp-content/uploads/2020/06/alone-together-report-min.pdf

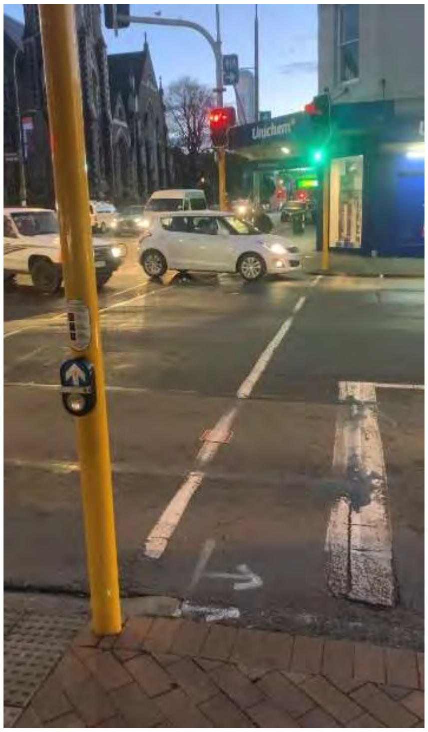


Figure 29: Vehicle movement during pedestrian crossing phase at five-arm intersection

This issue was observed on numerous occasions over every approach at this intersection, including witnessing a near miss incident. Pedestrians are forced to cross more rapidly or give way to turning vehicles. During the observations, it was noted that able-bodied people who walk at a rapid pace were covering approximately half the distance before the signals changed. It was further observed that people with mobility issues were not able to clear the lane markings, leaving them exposed to turning vehicles. This issue was also noted in the 2020 George Street Accessibility review that stated the set crossing time of 19 seconds was insufficient for the 16m crossing based on the slowest movement rate of the Pedestrian Planning and Design Guide.

The poor perception of safety at this intersection is therefore an evident barrier for easy and safe access to the Retail Quarter. During engagement meetings in June 2021, it was noted that due to the layout of the junction and the potential safety impacts, students tend to use the new Barnes Dance junctions along Great King Street as opposed to navigating George Street.

Shifting away from safety complications created by modal conflict along George Street, a sense of personal security is strongly linked to the perception of safety in the Retail Quarter. A key indicator of the likely perception of safety can be inferred from local crime statistics. New Zealand Police Crime Snapshot data indicates the area between Stuart Street and Frederick Street, which encompasses the majority of the project scope, has the most reported instances of crime in Dunedin (Figure 30). In total, 3,214 victimisations of crimes such as assault, sexual assault, robbery, and burglary were reported for the year between May 2020 and April 2021. 405 of these occurred in the Stuart Street to Frederick Street area unit, the highest in the city by a significant margin. The second and third highest zones for reported crime victimisation occurred immediately to the north and south of the central city, with 201 and 198 instances respectively. The data suggests the central city and specifically the area surrounding the Retail Quarter is a Dunedin crime hotspot, which is likely eroding the public perception of safety.

There is also anecdotal evidence of an increase in sexual harassment in the last few months. Women describe 'cat calling' coming from passing cars at all times of the day, with George Street, Octagon, Great King Street, Albany Street and Clyde Streets being the most common places to experience this behaviour. Representatives from the Police during engagement commented that juvenile behaviour and assault were the main issues for them on George Street, primarily after dark. They also noted that provision of lighting and reduction of obstacles to hide behind (e.g. large trees) are key contributors to behavioural issues. Retention of the liquor-ban along George Street along with clear demarcation of the ban (e.g. through bigger signage) will also be important to managing safety and minimising behavioural concerns.

This anecdotal data creates a case for the incorporation of Crime Prevention Through Environmental Design (CPTED) principles into streetscape upgrades and therefore presents an opportunity to reduce instances of crime within the Retail Quarter and ultimately enhance the perception of safety in the area.

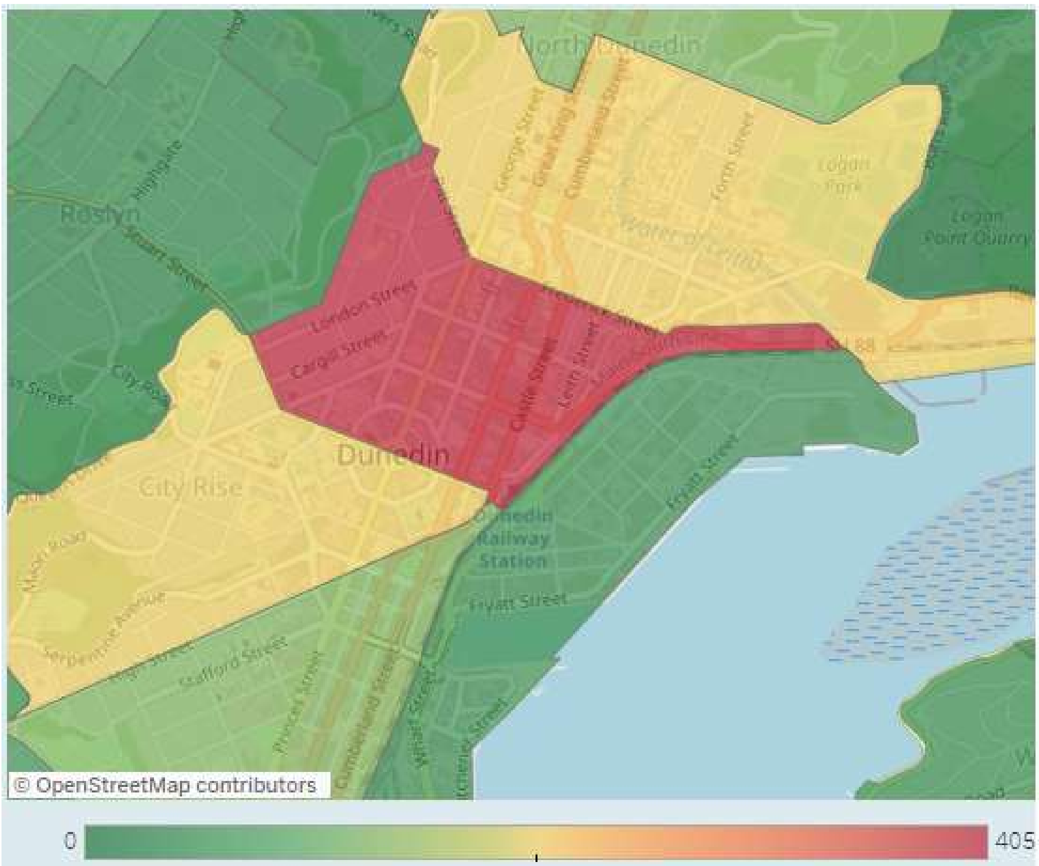


Figure 30: Dunedin central city crime victimisations (Source: New Zealand Police Crime Snapshot)

Limited opportunities for the expression of culture

As mentioned in section 4.2 above, Ōtepoti Dunedin has a rich cultural history. Mana whenua have, however, identified that the existing street design does not reflect their whakapapa or history, noting they are not represented in the typically Eurocentric appearance of the street and surrounding buildings. Through engagement with Kāi Tahu, the Preliminary Design Report from 2020 notes that, '*George Street does not reflect the diversity, culture and sense of place of Ōtepoti.'*

Accordingly, this is evidenced in Figure 31 which shows several images that highlight the Eurocentric Architecture present along the street and the complete absence of features that pay tribute to Dunedin's cultural heritage.

Other groups within Dunedin have also expressed similar concerns. Anecdotal feedback during the workshops expressed that the LGBTQIA+, Pasifika, youth and other communities did not see their cultures or identity expressed in the area, meaning they were less likely to come here as visitors and customers. Sadly, some expressed that they simply did not feel welcome in the area, so chose to avoid it completely.

As outlined in DCC's Spatial plan and Arts and Culture strategy, there is significant opportunity to recognise and embed Dunedin's rich art and culture into any future design of George Street to make it memorable and distinctive.

This aligns with the strategic theme of 'Identity Pride', which is one of the four themes Ara Toi Ōtepoti – Dunedin's Arts and Culture strategy, which outlines the vision for arts and culture in the city. This theme seeks to utilise urban design and planning to enhance and revitalise public spaces through the use of festivals, events, and public art. This strategy notes that there is currently an opportunity to improve the approach to arts and culture in the city, especially noting that[23], "*arts and culture drive economic success and contribute to better social outcomes for Dunedin residents, support improved community participation in decision-making, and help transform the public realm.*"

Therefore, this is goes beyond simply having arts and culture displayed and consumed in the area, but also expanding opportunities for production and practice throughout the Retail Quarter. While these issues cannot all be resolved by this project, there are opportunities for improvements through the associated Retail Quarter Revitalisation Plan.

Figure 31: Eurocentric Architecture (dating from approximately 1900's) present along George Street

Summary Problem statement 3 – Place

Poor space allocation and supporting infrastructure along George Street is adversely impacting modal choice, access and the overall attractiveness of the area. Despite a significant proportion of Retail Quarter users visiting the area via alternate modes, the majority of the public realm is dedicated to motor vehicles. What space is offered to pedestrians is cluttered, in poor condition and does not support key desire lines for crossing or opportunities for placemaking and expanded economic, social or cultural activity. Ultimately the area is perceived as unattractive and inaccessible, most clearly evidenced through stakeholder reports and recent economic stagnation. In addition, poor space allocation leads to the Retail Quarter being perceived as unsafe, with a high potential for modal conflict and high instances of crime. There is also limited opportunity for design features that recognise Dunedin's cultural diversity and heritage, all of which contribute to a reduction in visitor appeal and potential customers for local businesses.

[23] https://www.dunedin.govt.nz/__data/assets/pdf_file/0015/522060/Ara-Toi-Viewable.pdf

4.6 Benefits and measures

Figure 32 below links the benefits and measures to the investment objectives. This extends from Figure 31, showing a line of sight from the overarching DCC strategic guidance. The key problem themes identified in section 4.5 have been included throughout the figure, to highlight how the common themes are represented at each level.

Discussion on how each of the measures are achieved is included as part of the economic case in section 8.0 below.

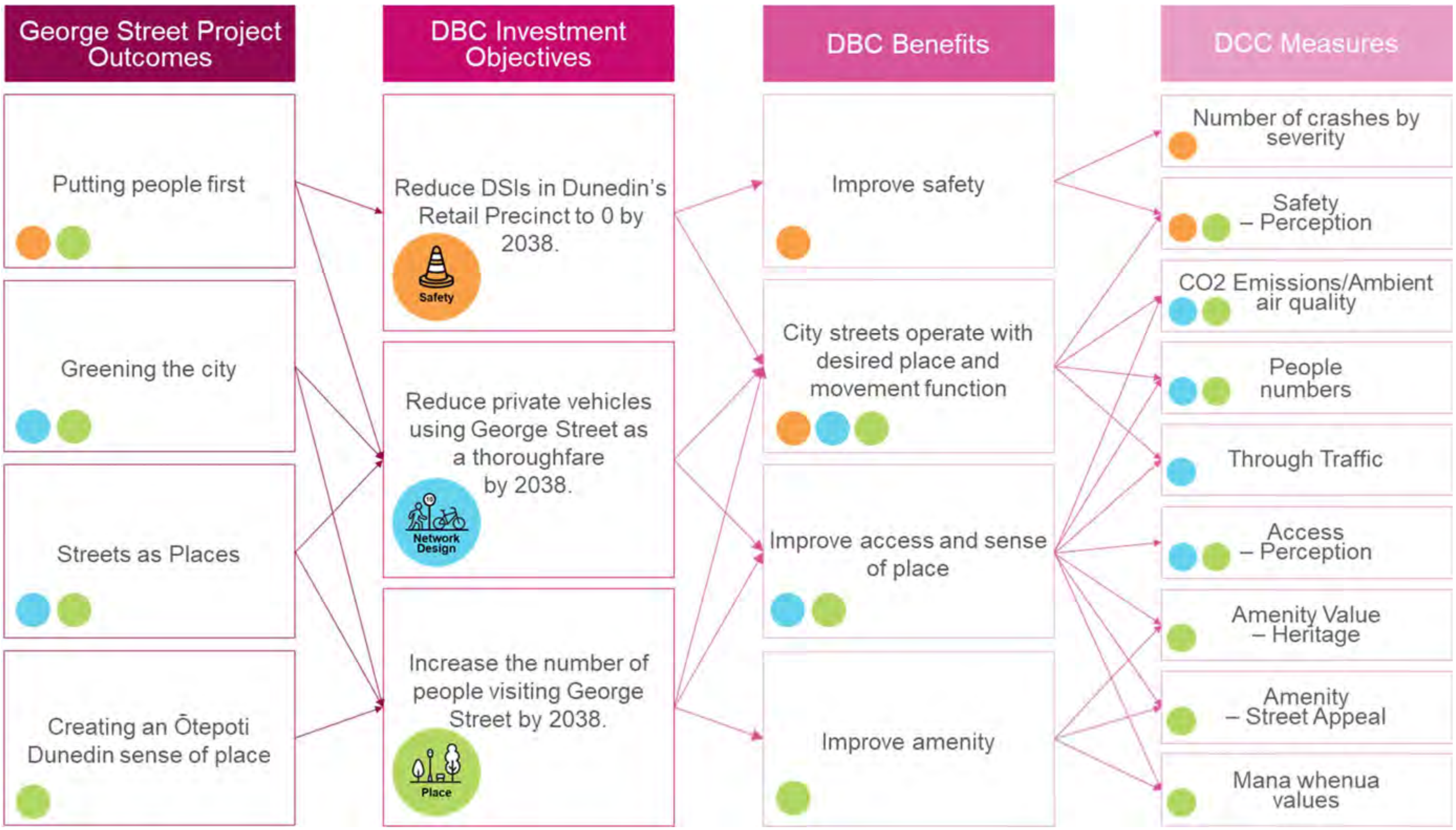


Figure 32: Project specific benefits and measures

Part B

5.0 Economic Case - Identifying the preferred option

This section briefly describes the development of the short-listed options and the assessment process undertaken to identify a preferred option.

The IBC and the IQA feedback of the IBC sought for the DBC to test and provide a comprehensive analysis of how the options seek to address the problems identified and demonstrate the value for money provided by the project, including the wider network impacts.

Figure 33 summarises the option assessment process undertaken for this DBC.

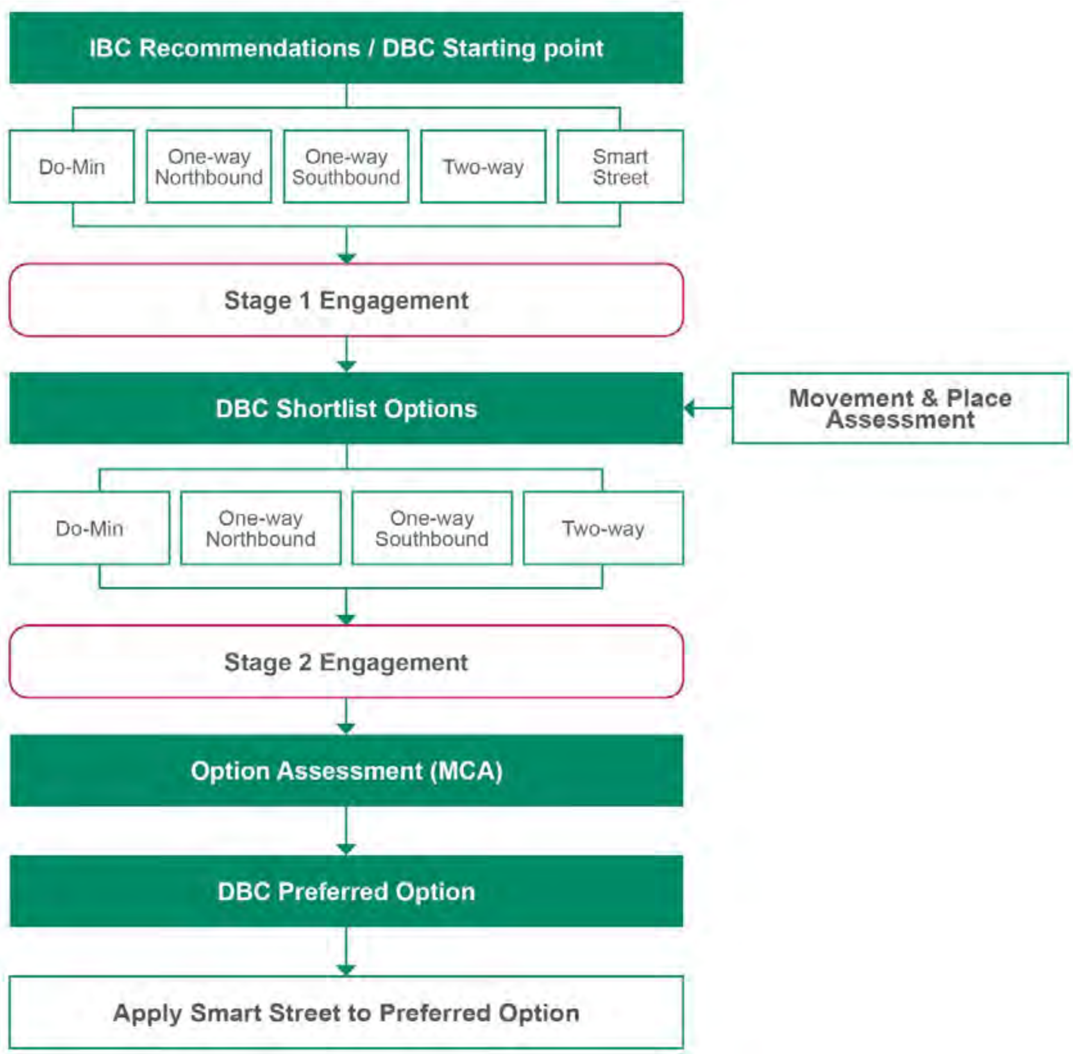


Figure 33: Option Assessment Process

Additionally, this figure exemplifies that at the commencement of this DBC the Smart Street was a distinct option. However, following feedback from stakeholders and discussion with DCC, it was determined that the Smart Street technology could be implemented with any of the short-listed options. Details on what this includes is discussed in 5.2.5.

5.1 Option development

5.1.1 Option development history

This project has a rich option development history. The emerging preferred option from the IBC underwent an independent review by Urbanism+, as well as council staff and planning and environment committee reviews. Each of these processes resulted in a different recommended option emerging. A summary of various entities and preferred options at the inception of the DBC, are summarised in Figure 34. Further details are documented in Appendix A – Optioneering History. A summary of all options assessed to date and rationale for discarding of any options is shown in Figure 35.

Figure 34: Progression of the DBC Optioneering

Notably, Figure 35 focusses on the optioneering history that occurred prior to the commencement of this DBC. As such, this figure shows five options as the starting point for DBC option development, which includes a Two-Way Smart Street option. However, as the process diagram shows in Figure 33 above, as optioneering progressed for this DBC, this was removed as a distinct option, as it was instead determined that the Smart Street approach could be applied to any of the short-listed options. Details on what this includes is discussed in 5.2.5.

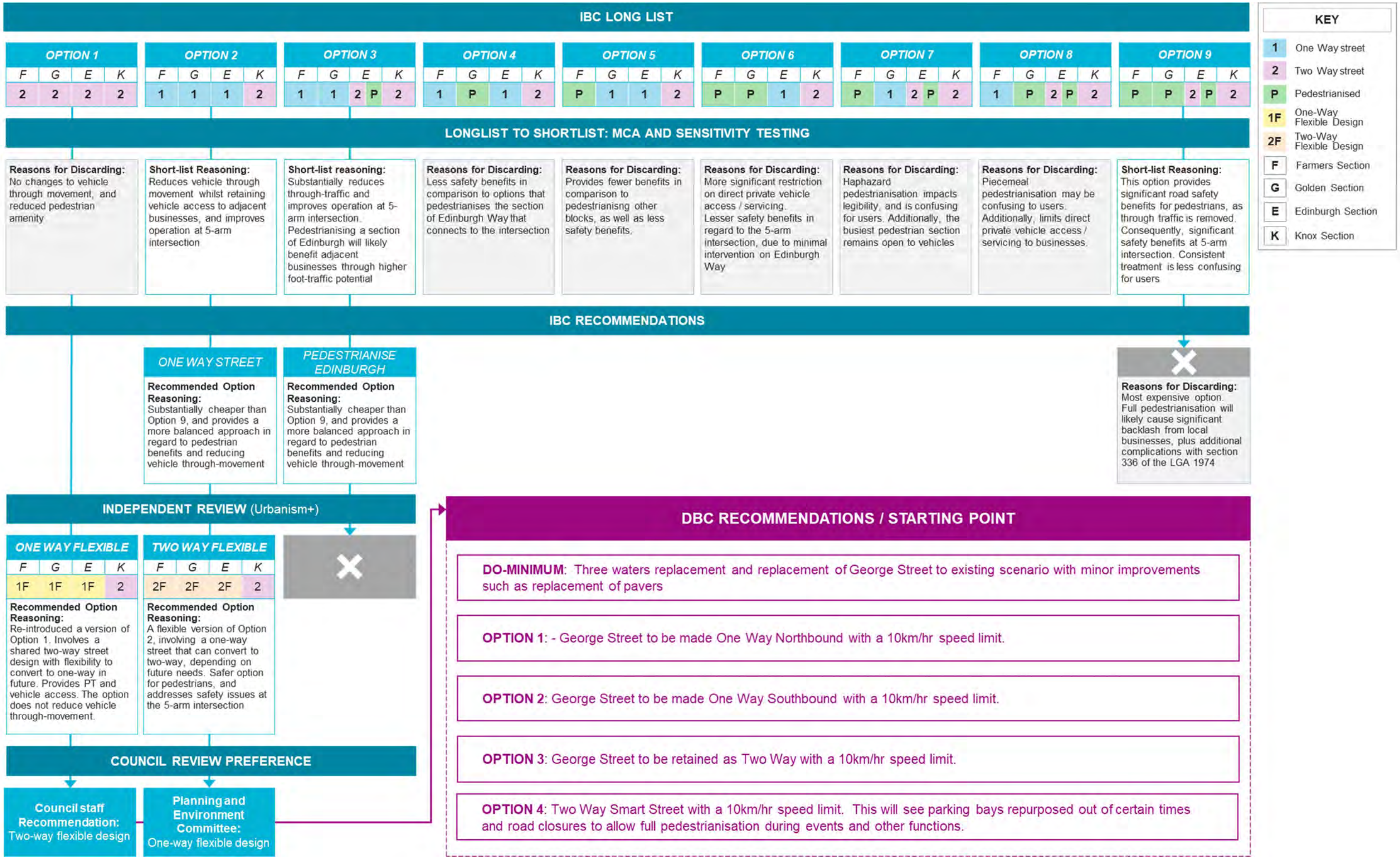


Figure 35: Summary of optioneering to date

5.1.2 Design response assumptions

While each of the options to be tested as part of this economic case are slightly different in their spatial arrangement and overall outcomes for the Retail Quarter, there are several assumptions which underpin the design across all options. These assumptions are based on the current understanding of the Retail Quarter and specific ideas and requirements that have evolved through the initial design phases. These will form part of the Design Philosophy Statement and will be applied regardless of the final selected option.

5.1.2.1 Kāi Tahu values and aspirations are reflected in the design response

As discussed above in Section 4.2.1, Dunedin has a rich cultural history and as a Treaty partner, DCC are working collaboratively with Kāi Tahu to ensure cultural values, aspirations and narratives are reflected in the final design outcome.

To ensure these aspirations are met, a design response has been developed, distilling the George Street project outcomes and Kāi Tahu values into three key 'big moves'. Aligning with the big moves is a spatial framework by which design energy will be focussed to give effect to the big moves and ultimately the project outcomes and cultural values. A summary of this design response is displayed in Figure 36.

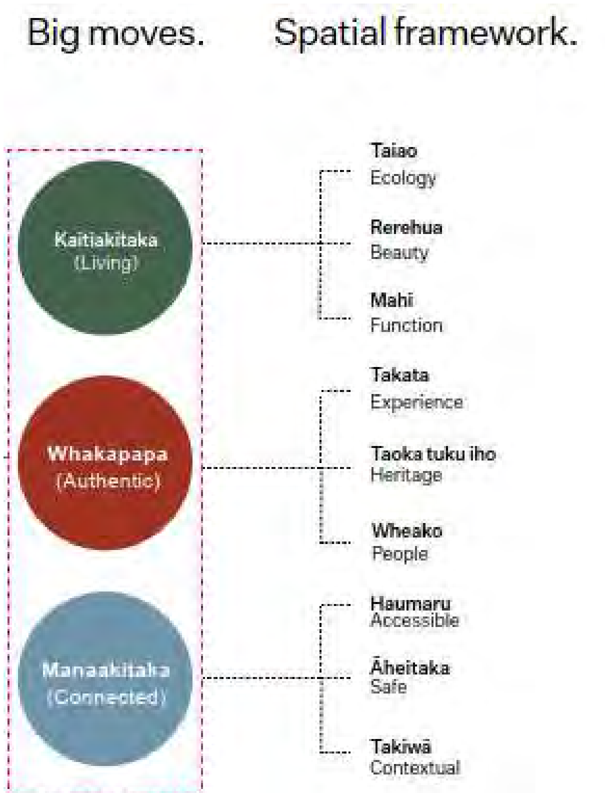


Figure 36: George Street design response

The key components of the spatial framework include the following:

- **Taiao (ecology)** – Connecting the street with surrounding green pathway. Realising the interdependence of the natural environment. Integrating nature into the street network.
- **Rerehua (beauty)** – Ensuring plantings are universally appreciated. Providing a diverse and verdant mix of vegetation that is resilient, engaging and reflects Dunedin's natural and cultural heritage.

- **Mahi (function)** – Urban comfort balances access to shade, shelter and sun. Plantings are robust, resilient and easy to maintain. Water quality and quantity is passively treated, acknowledging the mauri of water as the essence of life and health.
- **Takata (experience) –** Providing a diverse collection of urban settings and scales to promote shared experiences and a sense of belonging. Provide a sequence of compression and release throughout the street through grain, density and scale.
- **Taoka tuku ihu (heritage) –** Scale of the public realm responds to the built form. Public realm respects selected heritage and character buildings. Embedding of authentic cultural narratives.
- **Wheako (people) –** Enable civic events through the provision of space and infrastructure. Use of Ōtepoti plants, materials and narratives to reinforce sense of place.
- **Haumaru (safe)** – Lower crossings and permeable streets. Lower speeds and less vehicle movement. Safer streets that are active, well-lit and have clear lines of site.
- **Āheitaka (accessible) –** Universal design enables access for all ages and abilities, servicing businesses and providing accessible parking.
- **Takiwā (contextual) –** Express offsite views within each block. Acknowledging the wider context and connection to place.

Each aspect of the design response described above will assist in giving effect to Kāi Tahu aspirations and values.

5.1.2.2 Built heritage along George Street is supported by the design

The Retail Quarter and George Street in particular, is home to some classic built features with distinctive heritage value. These heritage buildings are significant attractors to the area and integral to the character of the central city. It is an assumption that design features of the preferred option will be implemented in a way that supports and does not obstruct the visual amenity of these heritage buildings, which will vary from block to block. For example, the Farmers Block has a comparatively low number of listed heritage and character contributing buildings and therefore there is greater opportunity for tree planning close to the building facades. In contrast, the New Edinburgh Way has a far greater abundance of heritage and character contributing buildings and these facades should be framed and celebrated, rather than obstructed.

There is also a significant amount of heritage below the ground in George Street that can be better celebrated as part of this project. From the known engineering elements such as the brick lined drains still in operation, to the yet undiscovered archaeological remains, these artefacts tell the story of Dunedin and its early inhabitants. The project team will work closely with heritage experts to find the best ways to incorporate archaeological finds and features into the design and story-telling of the project.

5.1.2.3 Cycling provision

The aspirations for the George Street upgrades are to provide a safer and more balanced environment to allow access for all transport modes. For this reason, despite being a designated primary cycle route a separated dedicated cycle lane is not considered appropriate for George Street. The key rationale behind this decision is:

- Dedicated cycle lanes would tend to encourage cycle users to travel at speed through the area, creating safety risks for other vulnerable users. This is also inconsistent with the approach taken for other vehicles, where the intent is to slow vehicle speeds and see the area as more of a destination to enjoy rather than a thoroughfare.
- A 10km/h speed limit on George Street will naturally support greater cycle priority. Regardless if the street becomes a shared space, or a traditional carriageway is retained, this very low speed environment will significantly benefit cyclists from a safety perspective.
- Under the one-way option, cyclists will be provided for through a “movement zone”, which will encompass vehicle movement as well as cyclists, e-scooters and pedestrians. This will generally be centrally located along the corridor. Contra-flow cycle provision is enabled through a buffer area between the activity zone and movement zone.

- For pedestrians that do not feel comfortable walking among cyclists and other vehicles, there will be 3-4m wide pedestrian paths on either side of the street. This is best practice for one-way slow street environments.

For this reason, despite being defined as a primary cycle route, a dedicated cycle lane is not deemed appropriate.

5.1.2.4 Public transport

Under all options it is proposed to move bus services from George Street (between the bus hub and Frederick Street) to Great King Street. Buses would re-join George Street via Frederick Street into the Knox Block. Otago Regional Council (ORC) is supportive of and planning for the implementation of these changes.

The project acknowledges the importance public transport has on both accessibility for all to the Retail Quarter, and on mode-shift away from private motor vehicle reliance. However, the continued provision of bus services (with more frequent services) down George Street would create challenges and conflicts for other project goals. These include the following:

- Retaining the existing size/style of the buses and services means traffic lanes along George Street would need to be maintained at their current width, significantly limiting opportunities for increased space for pedestrians and other modes, amenity and placemaking.
- Investment objective two sets out to reduce all vehicle through movement to maximise the place-value of the area. Allowing frequent bus movements significantly compromises this objective.
- The10km/h speed limit along George Street would significantly compromise the reliability of bus services. Routing buses along Great King Street provides the opportunity for buses to maintain an efficient, frequent, and reliable service, while continuing to provide access to the CBD and Retail Quarter. There is also opportunity to refine stop locations along Great King Street, to maximise access to each block
- Buses are some of the largest vehicles using George Street, therefore combining bus movements with growing numbers of more vulnerable road users, such as cyclists, pedestrians, and scooter users, may increase safety risks and undermine the safety improvements this project seeks to achieve.
- As large, heavy vehicles, buses are more likely to damage or break new surfacing and public spaces along George Street following construction, thereby hindering the quality of the project in the long term. While material and construction choices can mitigate some of these impacts, these choices would also reduce the degree of amenity improvement in the area.
- Under the one-way options, bus routing would need to change in one direction, given the one-way restriction would also be applicable to buses. A contra-flow bus service (where public transport could continue to travel in both directions) is not feasible and would have negative safety outcomes. Splitting the outbound and inbound routes would make the system less legible from a user perspective and would see the negative impacts spread across two streets.
- Removing bus stops from George Street (alongside rationalising the number of dedicated turning lanes) provides an opportunity to expand space for pedestrians and placemaking, without requiring the loss of as many carparks.

It is acknowledged that moving buses will create an inconvenience for some users, particularly those with limited mobility. Recognising this, whilst the enabling works and George Street upgrades mainly centre on the north south roads, the scope of the detail design phase will include coordinating the improvement and upgrading of pedestrian facilities and connections of the key east west streets and laneways. This will include improving cross fall grades and accessibility for pedestrians walking from the bus hub to George Street. Bus infrastructure and wayfinding signage will also be improved along Great King Street.

Additionally, to assess the impact of relocating the bus stops, a multi-modal accessibility software tool was used to analyse the walk travel times from the public transit stops, comparing existing with proposed. This is further detailed in Appendix B.

In summary, for both able bodied people (walk speed of 1.5m/s) and people with limited mobility (walk speed of 1.2m/s), the entirety of George Street and the Octagon is accessible within a five-minute walk from the bus hub. For those who have further reduced mobility issues (walk speed of 0.8m/s), whilst only George Street is just accessible, the Octagon is not. This, however, is not due to the relocated bus routes, but instead a result of the location of the bus hub, which is where other bus routes, i.e. routes that do not currently use George Street, would terminate.

5.1.3 Knox Block

Knox block will be retained as two-way under all options.

Land-use in the Knox Block is largely comprised of comparatively higher density residential, hospitality and accommodation services. Several vehicle crossings and alleyways exist providing access to back of house service areas, which will need to be retained. The higher vehicle access requirements for land use activities along the Knox Block will mean one-way traffic flows are not practical.

Additionally, in order to ensure the continued efficient operation of the bus network, buses need to be able to be retained on this section which Continuing buses along Great King Street through to Albany Street isn’t possible, given that the SH 1 Northbound pair merges to use the Great King Street corridor from the Albany Street intersection, and to accommodate this merge, this previous section turns into a dead-end. Consequently, Knox Block provides the most logical routing of bus services, to then join up with Great King Street from Frederick Street. Therefore, a one-way option would not be possible for this block, as bus movements in both directions need to be accommodated for along this section.

5.2 Short list options

Given the evolution and uncertainty surrounding the options since the submission of the IBC, along with Waka Kotahi’s IQA recommendations for additional option testing, the DBC project team re-formulated a short-list of options for re-testing. A workshop was undertaken with DCC and Waka Kotahi in April 2021 and the following options were confirmed for further assessment in this DBC:

- Do Minimum – Three waters replacement and replacement of George Street to existing road layout with minor improvements such as replacement of pavers, retaining the 30km/hr speed limit (see section 5.2.1)
- Option 1 - George Street to be made One-way Northbound with a 10km/hr speed limit (see section 5.2.2)
- Option 2 – George Street to be made One-way Southbound with a 10km/hr speed limit (see section 5.2.3)
- Option 3 – George Street to be retained as Two-way with a 10km/hr speed limit (see section 5.2.4)

As mentioned above, a ‘smart street’ concept was also raised as a potential option, but then removed as a separate option as it was considered to be able to be applied to any of the emerging preferred options (see section 5.2.5)

These options are discussed and assessed in this section.

Figure 37 and Figure 38 below illustrate how the one-way and two-way options are applied for the whole corridor. The sections that follow break down each of the four options by block with further detail including key stakeholder sentiments toward each option.

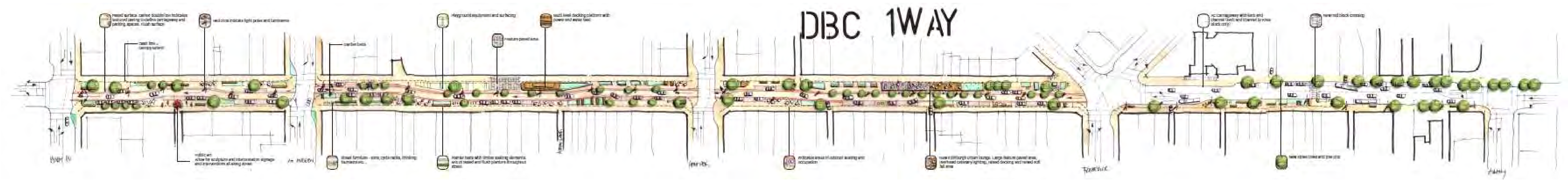


Figure 37: Schematic drawing of a one-way George Street

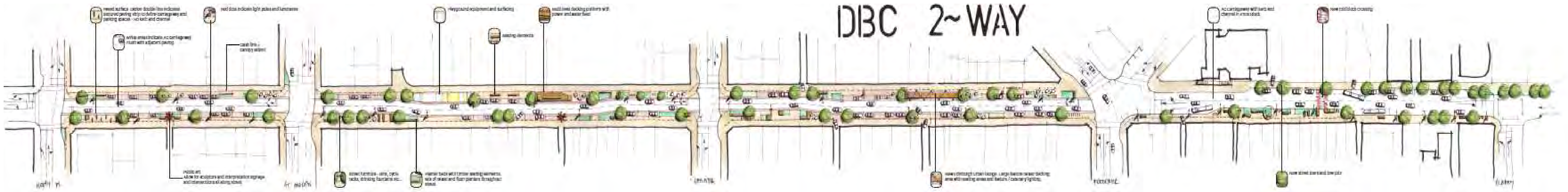


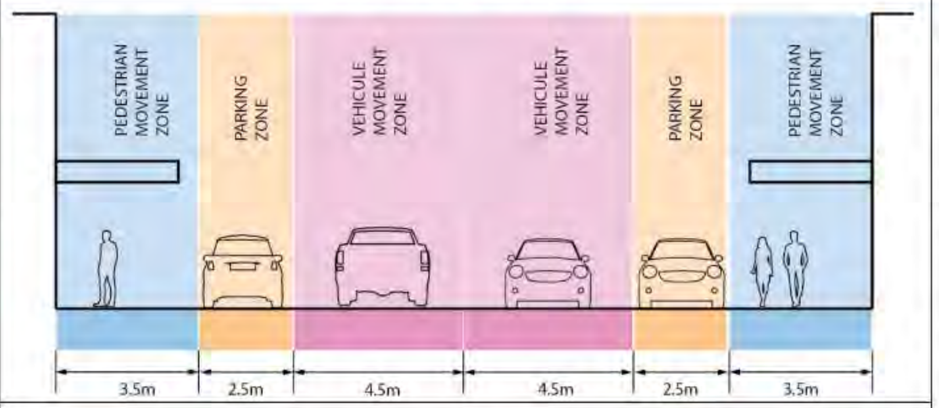
Figure 38: Schematic drawing of a two-way George Street

5.2.1 Do-Minimum

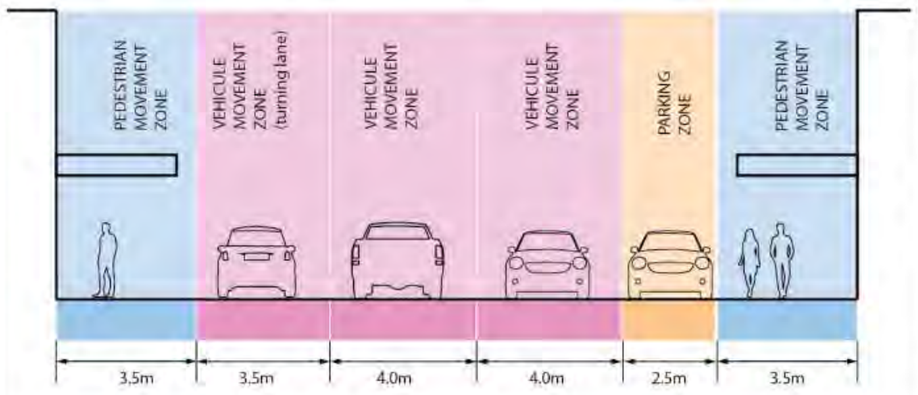
DO-MINIMUM OPTION

Option Description

Typical Mid-block Cross-section



Typical Turning Lane Cross-section



The Do-minimum option assumes that following the Three Waters replacement, the layout of George Street will be put back as its existing layout. Some minor improvements will be made such as the replacement of pavers, and the posted speed limit will be retained at 30km/hr.

How will it address the problem?

PS1 - Safety: Retaining at 30km/hr maintains the lower level inter-modal conflict (i.e. this slower vehicle speed reduces the severity of a crash), however the design of the speed environment doesn't encourage vehicles to travel at this speed (wide lanes and straight carriageway).

PS2 - Network Design: Whilst there is minimal change to the design of the corridor, the addition of a right-turn lane into the Meridian car-park on Filleul Street (added as part of the enabling works) reduces the number of cars circulating to get into the car park.

PS3 - Place and Amenity: This option does not really address this problem, as the space provided for pedestrians is retained as is, with the exception of new pavers. It is doubtful that this will encourage people to spend more time within the Retail Quarter.

Stakeholder Thoughts

Age Concern: Perceives option to be inadequate, believing George Street needs a 'shot in the arm'.

OUSA: This option 'isn't forward thinking'.

Disabled Persons Assembly: Not viable or feasible, only partially pedestrian friendly

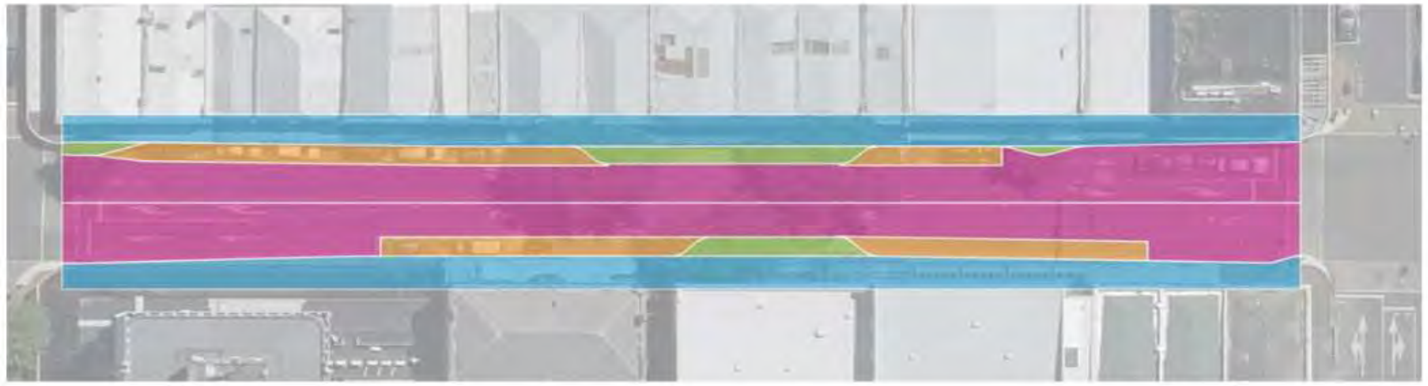
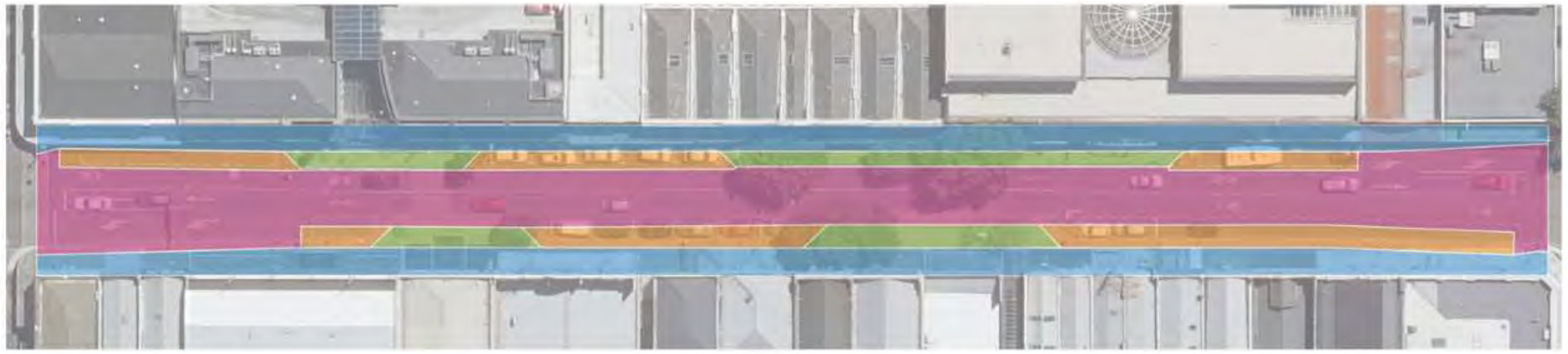
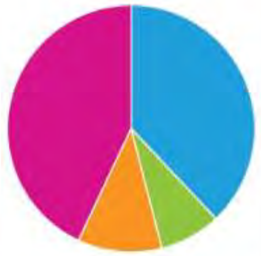
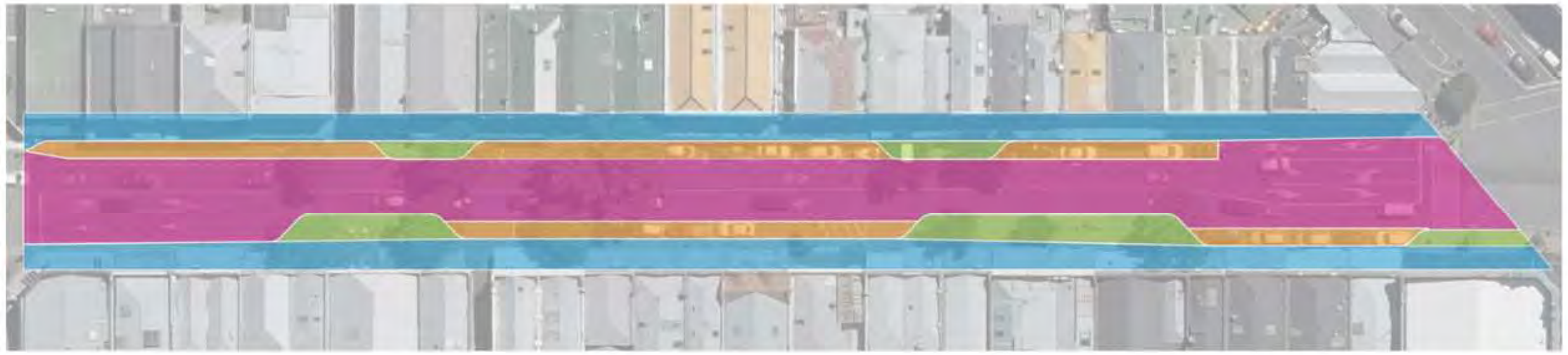
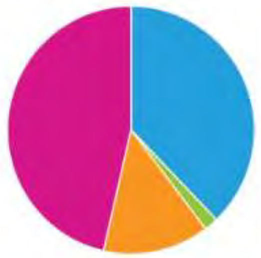
AA: Currently works for traffic flow.

NZ Police: Status quo will remain status quo - will not further enhance CBD.

Building Owner: Not viable - Upgrade is long overdue, and this is the front door.

Chamber of Commerce: Least ambitious option. Yesterday's thinking.

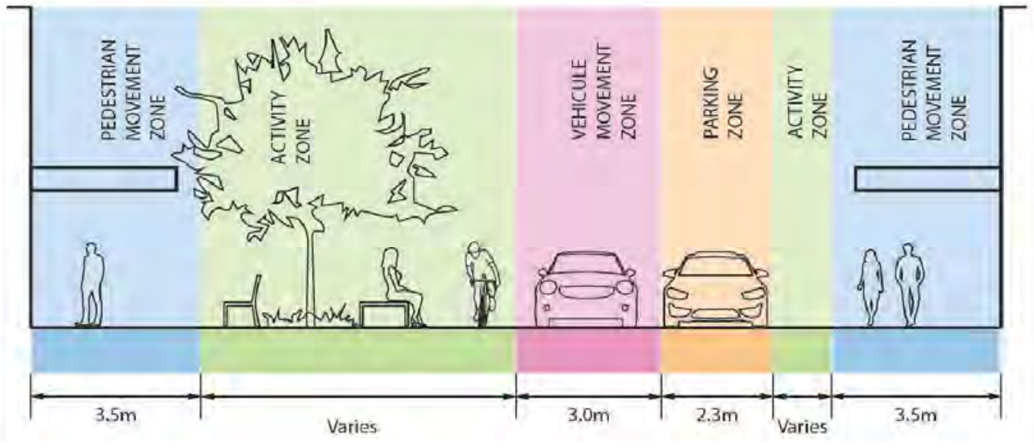
Generation Zero: Misses a great opportunity to transform Dunedin.

	Space Allocation Drawings	Preliminary Area Calculations
Farmers Block		Pedestrian Movement: 35% Activity Zone: 4% Parking / Servicing Zone: 11% Vehicle Movement Zone: 50% 
Golden Block		Pedestrian Movement: 38% Activity Zone: 8% Parking / Servicing Zone: 11% Vehicle Movement Zone: 43% 
Farmers Block		Pedestrian Movement: 36% Activity Zone: 7% Parking / Servicing Zone: 13% Vehicle Movement Zone: 44% 
Knox Block		Pedestrian Movement: 38% Activity Zone: 2% Parking / Servicing Zone: 14% Vehicle Movement Zone: 46% 

5.2.2 Option 1 – One-way Northbound

OPTION 1: ONE-WAY NORTHBOUND

Option Description



Option 1 includes a single lane of traffic routing in a northbound direction. The speed limit will be reduced to 10km/hr, with the street layout designed to manage the speed environment. This will be done by making the corridor a shared space, with no kerbs and at one level, deflecting the alignment of the carriageway, narrowing the lane width, and locating planting / street furniture adjacent to vehicle lane to reduce the perception of space, thus slowing traffic.

The design includes four key space elements: pedestrian movement, activity zone, vehicle movement, and parking. The activity zone contributes to enhancing the public realm, as it allows space for street furniture, planting, performance spaces, and play equipment, but will be detailed in next stage of design. The number of parking spaces is relatively similar to existing, with the provision of more mobility spaces.

How will it address the problem?

PS1 - Safety: Reduces inter-modal conflicts as vehicles are slowed significantly, which in conjunction with the one-way movement, reduces the attractiveness of the corridor as a thoroughfare for vehicles. As a consequence, vehicle volumes are decreased significantly.

PS2 - Network Design: Car movement is no longer the primary function, with significant space reallocated to pedestrian movement and activity, increasing accessibility for all modes. This is more in line with the desired place function. The street design will encourage through movement to move to the more suitable parallel corridors.

PS3 - Place and Amenity: This option will be designed as a 'shared space' eliminating the segregation of road users. The removal of typical street elements, including line-markings, signage and kerbs, is replaced with street furniture such as seats, cycle parking, play equipment, performance space and landscaping to form more of an 'activity space'. This results in an intentional level of ambiguity so that drivers proceed with caution and at slow speeds. These elements also contribute to the street being more of a 'destination' This ideally encourages people to come and spend more time within the Retail Quarter.

Stakeholder Thoughts

Pacific Trust Otago: Most of the Pacific community is congregated in South Dunedin, so they see an advantage in traveling Northbound along George Street.

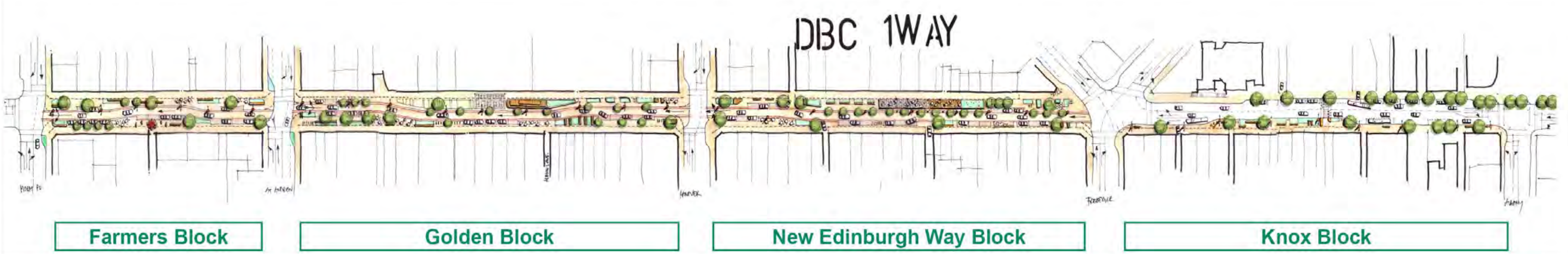
OUSA: Believes One-Way to be much better for access, reducing vehicles, and making it more of a destination. Northbound less attractive in the sense that it feels like you are driving out of George Street, rather than into it.

NZ Police: Favours reduction in speed and traffic volumes – reduces cost associated to injury. However, difficult to enforce 10km/hr.

Plunket: One-way options discourage through traffic, and provides more space for a more family friendly spaces and 'rest-spaces' for families with children.

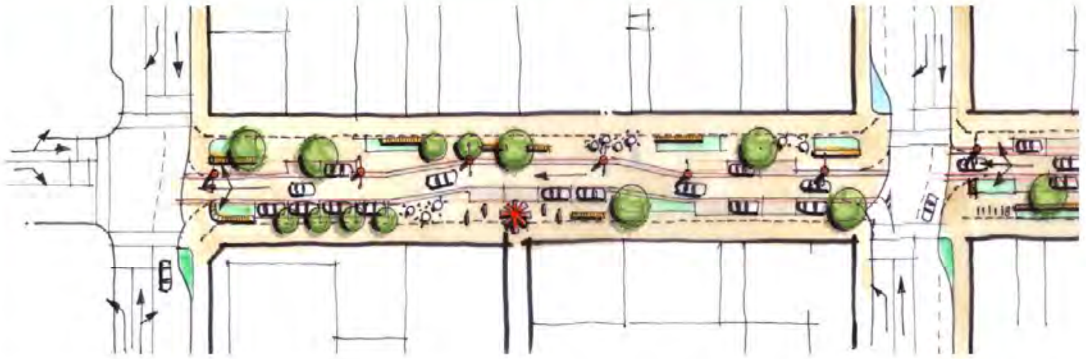
Chamber of Commerce: Better customer experience.

Otago Polytechnic Students Association: A better option for both students and people visiting the city.



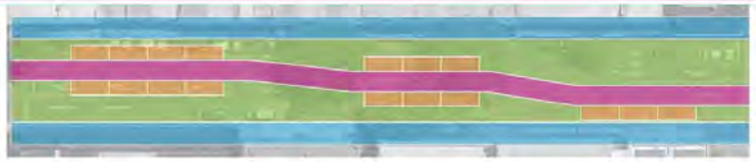
Preliminary Design Sketches	Preliminary Area Calculations

Farmers Block



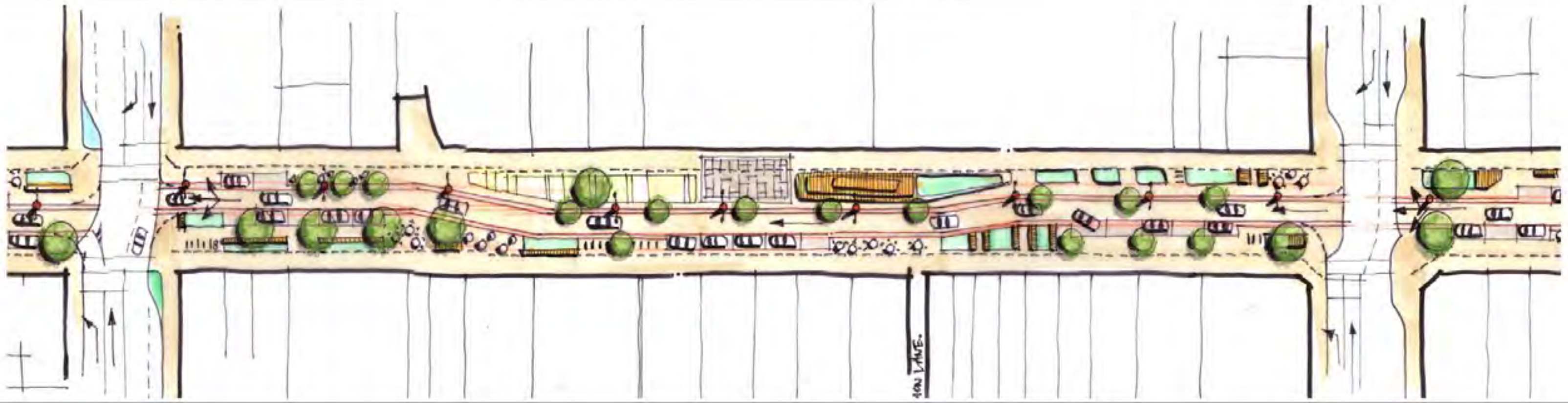
The drawings show arrows / cars traveling south-bound.

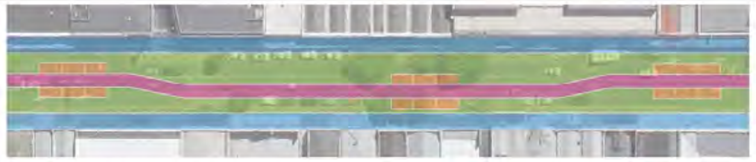
These are indicative only, and the layout at this stage is the same for the Northbound Option



Pedestrian Movement: 35%
Activity Zone: 26%
Parking / Servicing Zone: 9%
Vehicle Movement Zone: 30%

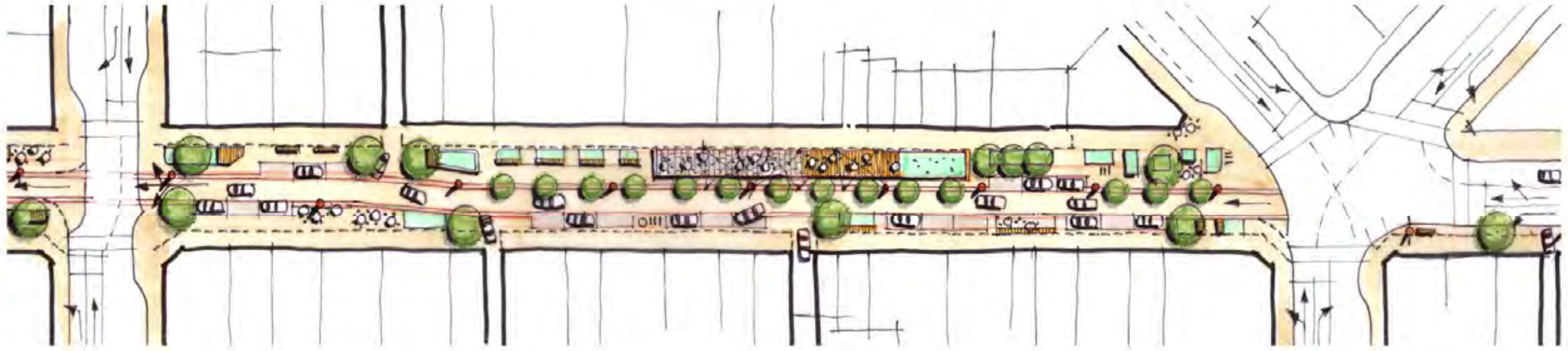
Golden Block





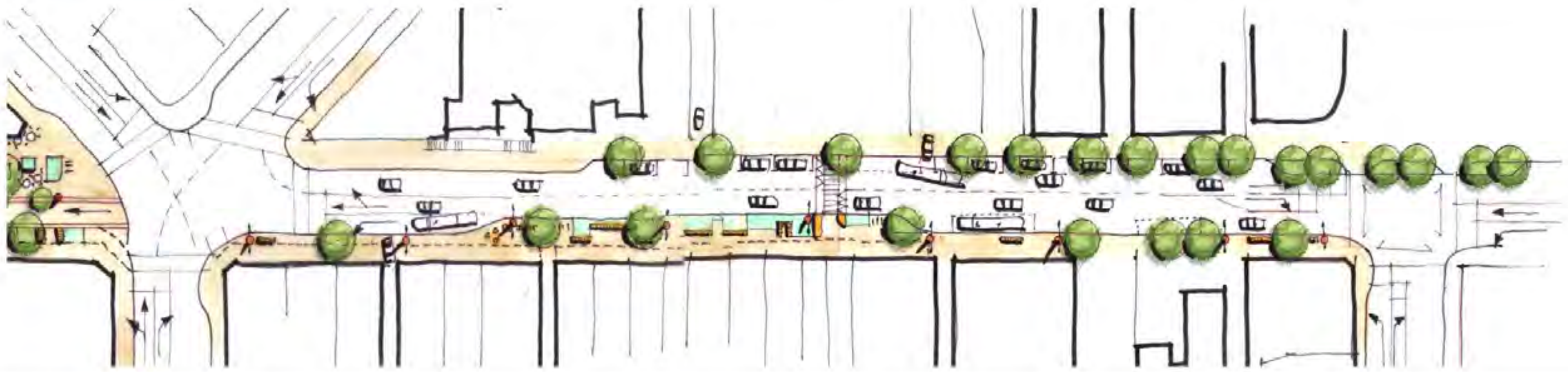
Pedestrian Movement: 35%
Activity Zone: 43%
Parking / Servicing Zone: 6%
Vehicle Movement Zone: 16%

Farmers Block



Pedestrian Movement: 35%
Activity Zone: 41%
Parking / Servicing Zone: 8%
Vehicle Movement Zone: 16%

Knox Block

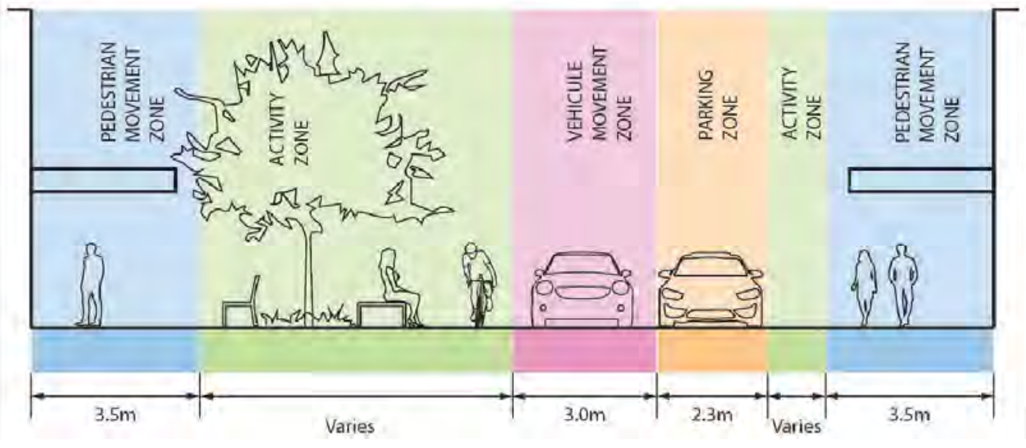


Knox Block has the same layout for all One-way and Two-way Options. Two lanes are retained to allow buses to continue to use this section of George Street. However, some car-parks are removed in this section to allow for kerb-build outs to make more space for Activity Zones that hospitality can use for outdoor seating.

5.2.3 Option 2 – One-way Southbound

OPTION 2: ONE-WAY SOUTHBOUND

Option Description



Option 2 includes a single lane of traffic routing in a southbound direction. The speed limit will be reduced to 10km/hr, with the street layout designed to manage the speed environment. This will be done by making the corridor a shared space, with no kerbs and at one level, deflecting the alignment of the carriageway, narrowing the lane width, and locating planting / street furniture adjacent to vehicle lane to reduce the perception of space, thus slowing traffic.

The design includes four key space elements: pedestrian movement, activity zone, vehicle movement, and parking. The activity zone contributes to enhancing the public realm, as it allows space for street furniture, planting, performance spaces, and play equipment, but will be detailed in next stage of design. The number of parking spaces is relatively similar to existing, with the provision of more mobility spaces.

How will it address the problem?

PS1 - Safety: Reduces inter-modal conflicts as vehicles are slowed significantly, which in conjunction with the one-way movement, reduces the attractiveness of the corridor as a thoroughfare for vehicles. As a consequence, vehicle volumes are decreased significantly.

PS2 - Network Design: Car movement is no longer the primary function, with significant space reallocated to pedestrian movement and activity, increasing accessibility for all modes. This is more in line with the desired place function. The street design will encourage through movement to move to the more suitable parallel corridors.

PS3 - Place and Amenity: This option will be designed as a 'shared space' eliminating the segregation of road users. The removal of typical street elements, including line-markings, signage and kerbs, is replaced with street furniture such as seats, cycle parking, play equipment, performance space and landscaping to form more of an 'activity space'. This results in an intentional level of ambiguity so that drivers proceed with caution and at slow speeds. These elements also contribute to the street being more of a 'destination' This ideally encourages people to come and spend more time within the Retail Quarter.

Stakeholder Thoughts

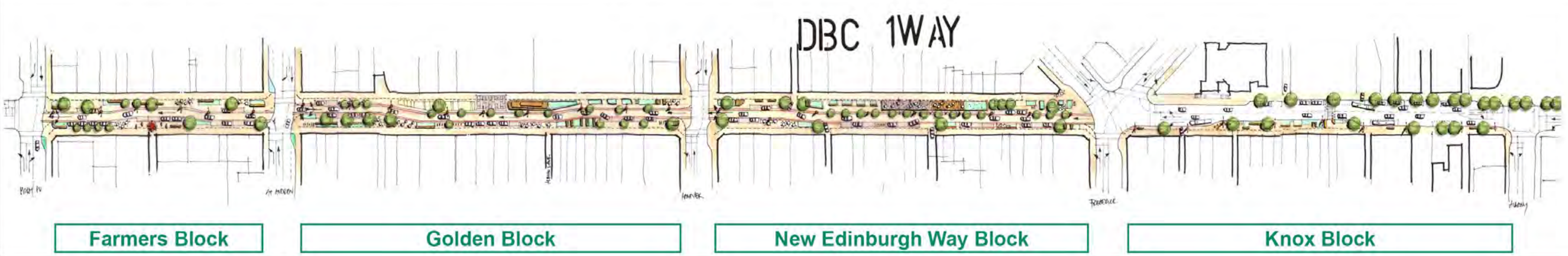
Fire and Emergency: Preference for Southbound option, due to the ability to remove a movement from the five arm - freeing up access to Hill Suburbs (off London and Pitt Street).

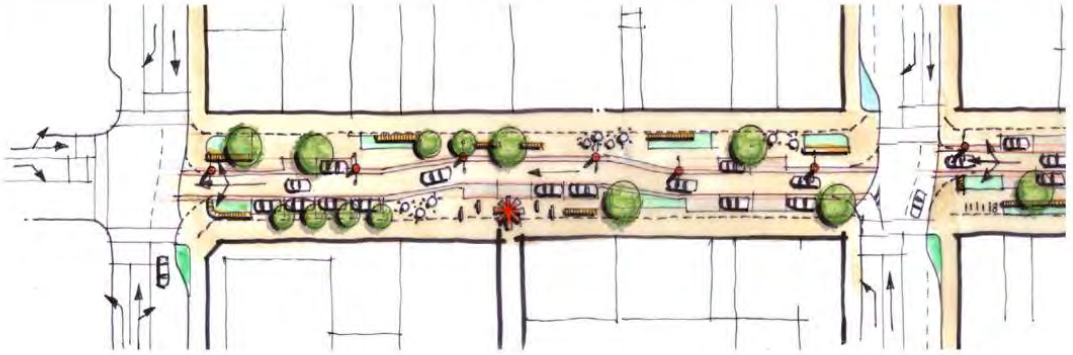
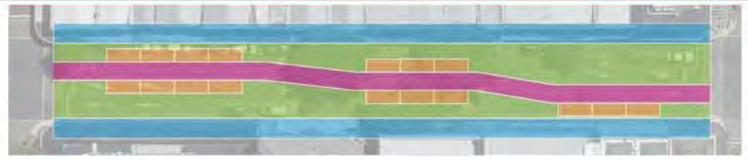
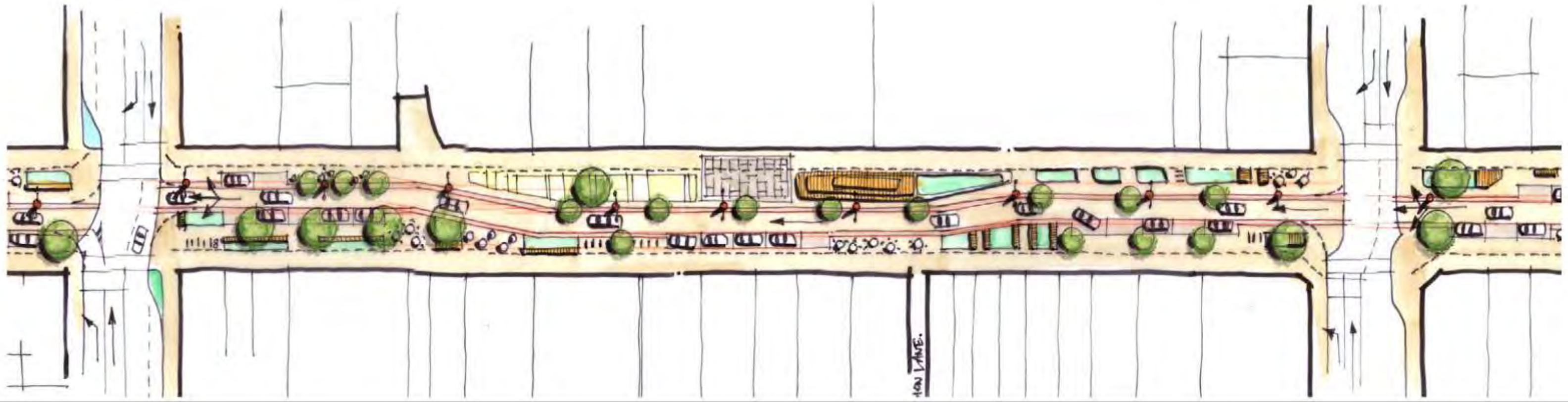
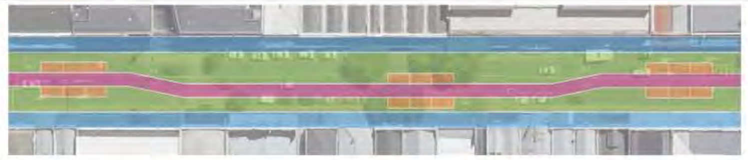
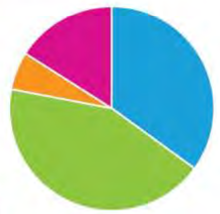
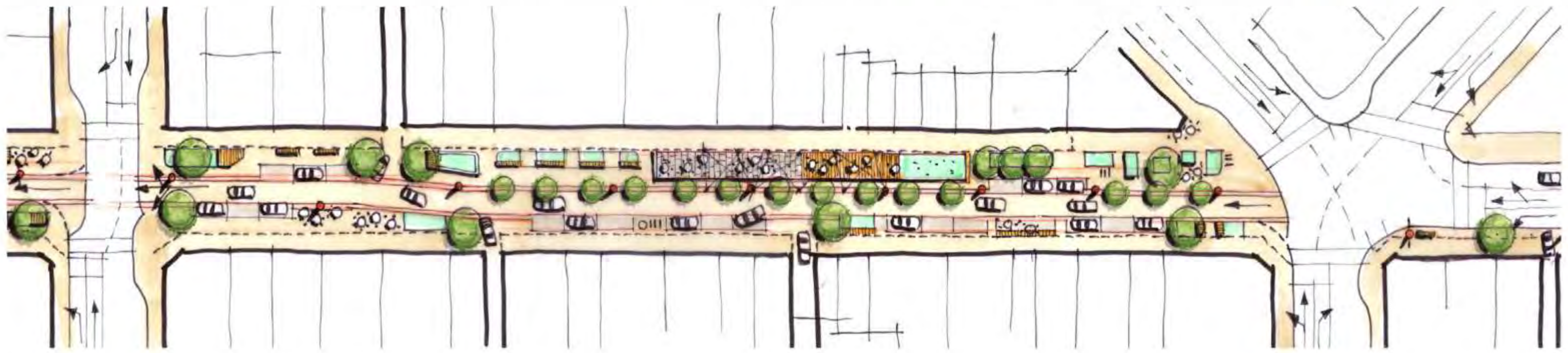
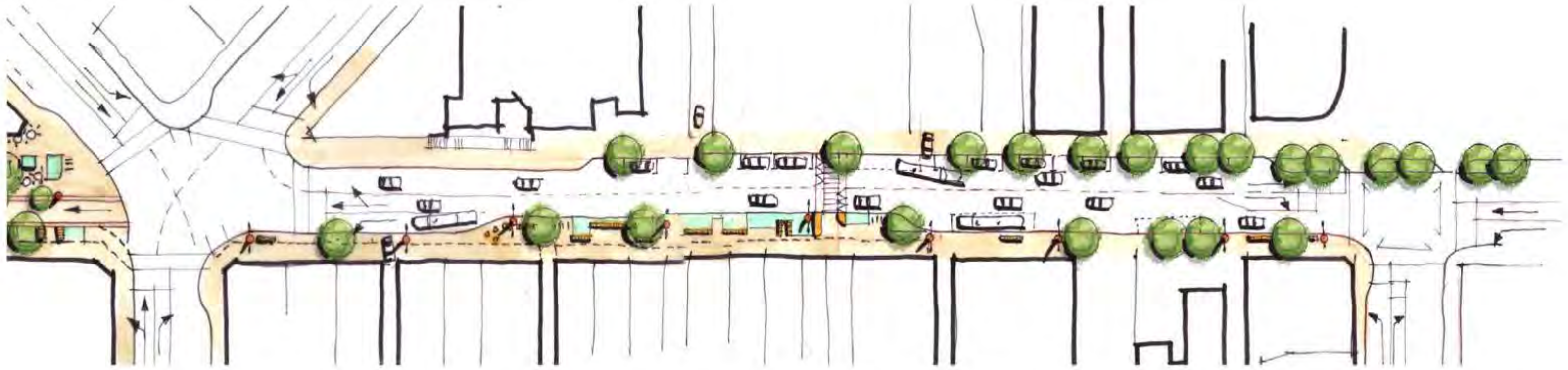
Plunket: One-way options discourage through traffic, and provides more space for a more family friendly spaces and 'rest-spaces' for families with children.

OUSA: Believes One-Way to be much better for access, reducing vehicles, and making it more of a destination. Southbound is better for students accessing by car / bike.

NZ Police: Favours reduction in speed and traffic volumes – reduces cost associated to injury. However, difficult to enforce 10km/hr.

Otago Polytechnic Students Association: A better option for both students and people visiting the city.

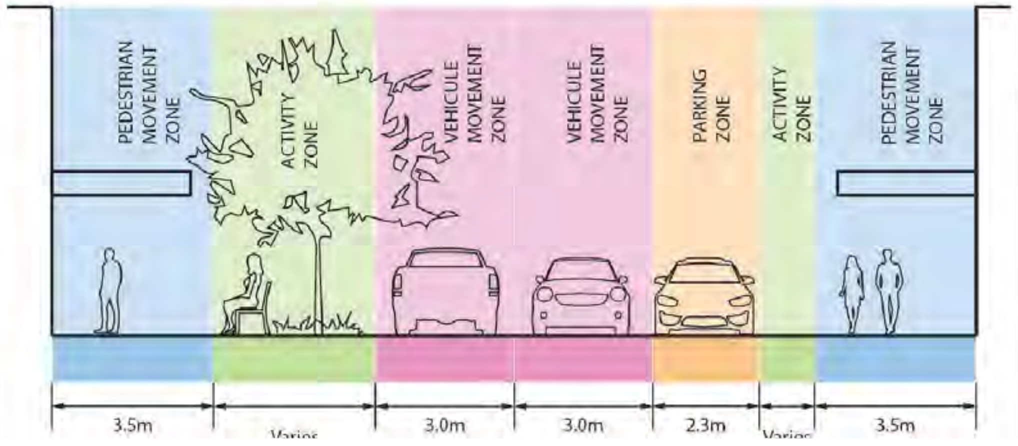


	Preliminary Design Sketches	Preliminary Area Calculations
Farmers Block	 *The drawings show arrows / cars traveling south-bound.* *These are indicative only, and the layout at this stage is the same for the Northbound Option*	 Pedestrian Movement: **35%** Activity Zone: **39%** Parking / Servicing Zone: **10%** Vehicle Movement Zone: **16%** 
Golden Block		 Pedestrian Movement: **35%** Activity Zone: **43%** Parking / Servicing Zone: **6%** Vehicle Movement Zone: **16%** 
Farmers Block		 Pedestrian Movement: **35%** Activity Zone: **41%** Parking / Servicing Zone: **8%** Vehicle Movement Zone: **16%** 
Knox Block		Knox Block has the same layout for all One-way and Two-way Options. Two lanes are retained to allow buses to continue to use this section of George Street. However, some car-parks are removed in this section to allow for kerb-build outs to make more space for Activity Zones that hospitality can use for outdoor seating.

5.2.4 Option 3 – Two-way

OPTION 3: TWO-WAY

Option Description



Option 3 assumes that traffic will be maintained as a bi-directional, two-lane corridor. The speed will be reduced to 10km/hr, and the street layout will be designed to manage the speed environment, primarily through narrowing lane widths, deflecting the alignment of the carriageway, and locating planting / street furniture adjacent to the lanes to reduce the perception of space. Additionally, whilst the corridor will be all one level, unlike the one-way options, the carriageway will use tarmac and include lane markings.

Compared to one-way options, there is more space catered toward vehicle movement, however the design still includes the four key space elements, improving upon the existing space allocation. Notably, at intersections all turning movement lanes are removed, and combined in one lane to maximise the space allocated to pedestrians / activity. Additionally, because of this space saving, the number of parking spaces is similar to existing, with more mobility spaces provided.

How will it address the problem?

PS1 - Safety: Reduces inter-modal conflicts as vehicles are slowed significantly, which reduces the attractiveness of the corridor as a thoroughfare for vehicles. As a consequence, vehicle volumes are decreased significantly.

PS2 - Network Design: Car movement is no longer the primary function, with more space reallocated to pedestrian movement and activity, increasing accessibility for all modes. This is more in line with the desired place function. The street design will encourage through movement to move to the more suitable parallel corridors.

PS3 - Place and Amenity: This option will be designed to be more of a shared environment, with increased public realm. The removal of typical street elements such as signage and kerbs, is replaced with street furniture such as seats, cycle parking, play equipment, performance space and landscaping to form more of an ‘activity space’. This results in an intentional level of ambiguity so that drivers proceed with caution and at slow speeds. These elements also contribute to the street being more of a ‘destination’ This ideally encourages people to come and spend more time within the Retail Quarter.

Stakeholder Thoughts

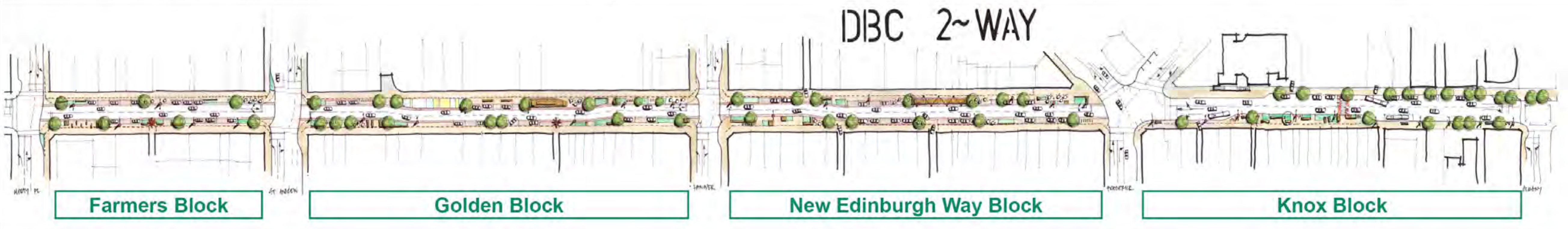
Age Concern: Does not think there is enough activity space provided - too crammed and busy.

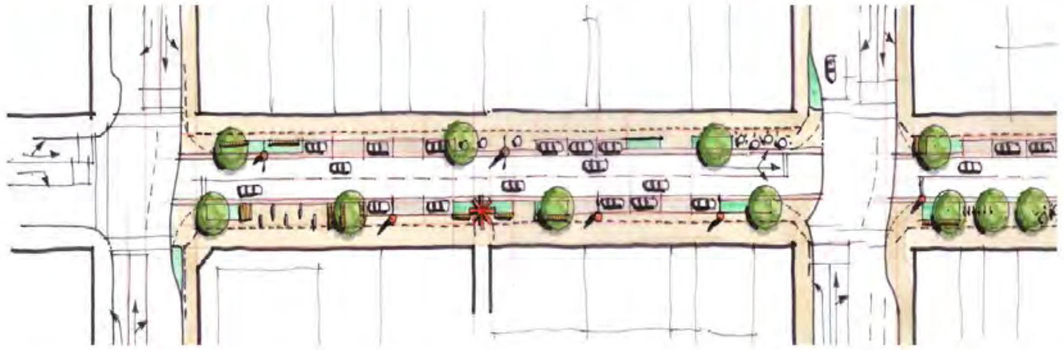
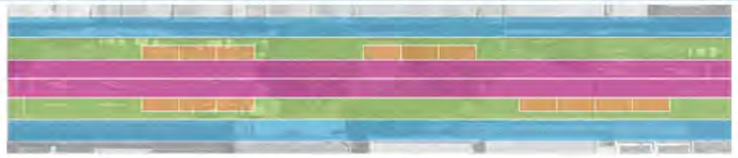
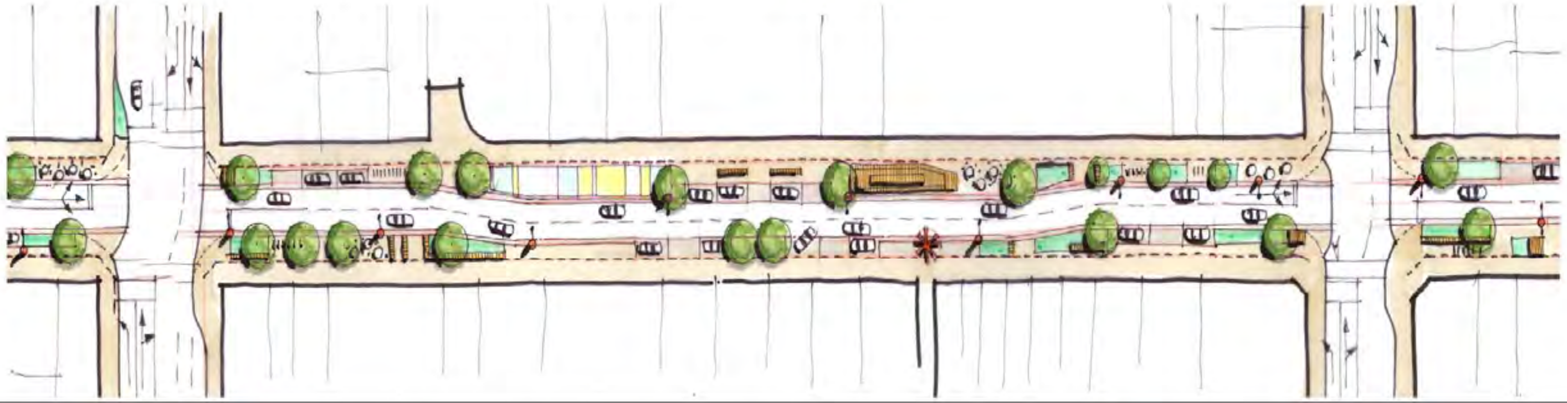
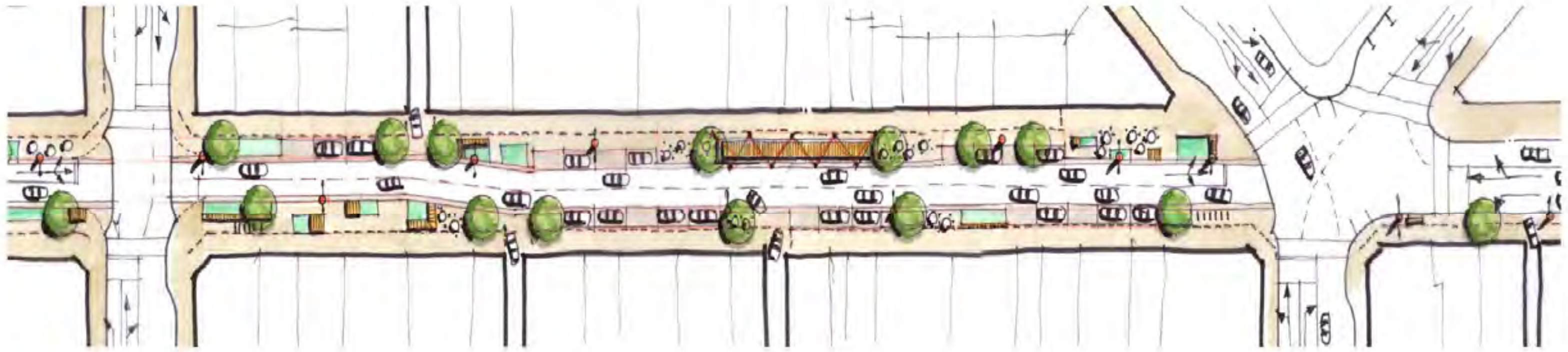
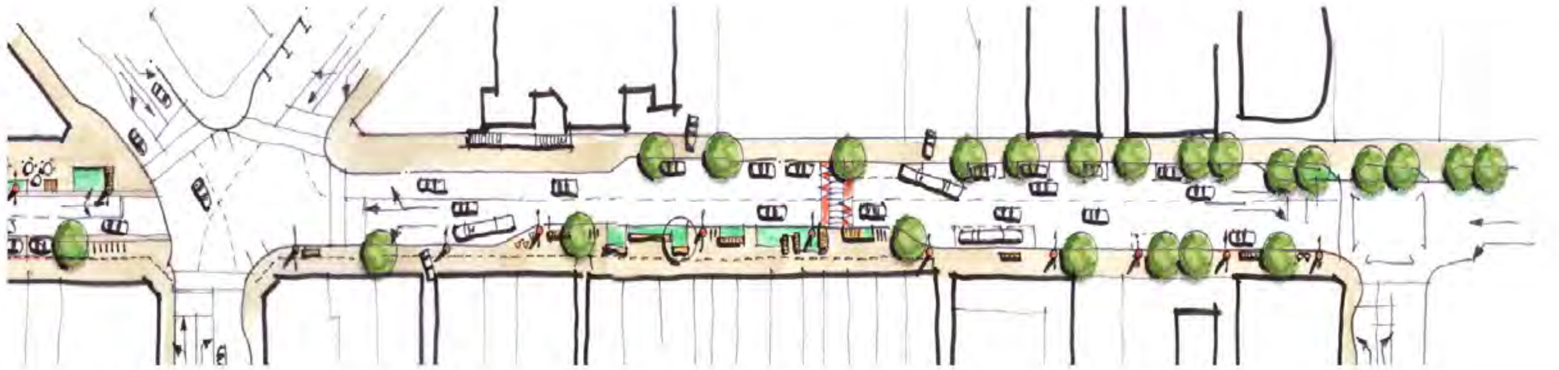
Pacific Trust Otago: Does not think there is enough activity space provided in this option - not adequate for larger groups / families.

AA: Two-way seen to provide easy access and friendly environment.

NZ Police: Two-way more difficult to navigate traffic compared to one-way for emergency response.

Generation Zero: too busy for a small space, only benefit is reduction in speed.



	Preliminary Design Sketches	Preliminary Area Calculations
Farmers Block		 Pedestrian Movement: 35% Activity Zone: 26% Parking / Servicing Zone: 9% Vehicle Movement Zone: 30% 
Golden Block		 Pedestrian Movement: 35% Activity Zone: 30% Parking / Servicing Zone: 5% Vehicle Movement Zone: 30% 
Farmers Block		 Pedestrian Movement: 35% Activity Zone: 27% Parking / Servicing Zone: 8% Vehicle Movement Zone: 30% 
Knox Block		Knox Block has the same layout for all One-way and Two-way Options. Two lanes are retained to allow buses to continue to use this section of George Street. However, some car-parks are removed in this section to allow for kerb-build outs to make more space for Activity Zones that hospitality can use for outdoor seating.

5.2.5 Smart Street

There is a strong desire for George Street to have a high level of flexibility and ability to change over time to allow George Street to evolve from a main street, to a distinctive, attractive space for all. To facilitate this, a 'Smart Street' approach has been developed.

The Smart Street approach centres on using two key smart provisions within the street design:

- Retractable (electronically operated) bollards at the beginning and end of each block to control access with a more flexible approach
- LED (or similar) lighting sensors in parking spaces and/or e-signs to communicate more flexible parking space utilisation

Smart Street technology will be linked to DCC's existing central traffic and parking management system, allowing the use of the space to be actively managed by DCC. This will also allow integration and dissemination of information to the wider transport network via variable message signs (VMS).

These elements provide the capability and capacity to deliver a different future space. This could include pedestrianisation or closure of one or more blocks along George Street at certain times of the day or week. The closures could for example be for late night or Sunday shopping, street events, or seasonally determined times. Whilst these closures may not be enacted initially, there is significant value in knowing the potential is there for the future.

The parking sensor technology provides the opportunity to have flexibility with the space that has been allocated to parking. Initially, this may be used to tell whether a parking space is available, but over time could allow for parking spaces to be booked for events or be available for certain uses at certain times of the day and change across the day. For example, before 9am there may be more spaces available for delivery and servicing vehicles, during the daytime designated for outdoor seating and in the evenings used for takeaway or Uber eats pick-ups.

The Smart Street technology could be implemented with any of the short listed options, and provides a simple base to begin with, allowing time for management and policy changes to follow.

Following the identification of a preferred option, the 'smart-street' concept and features will be considered as part of the developed and detailed design stages.

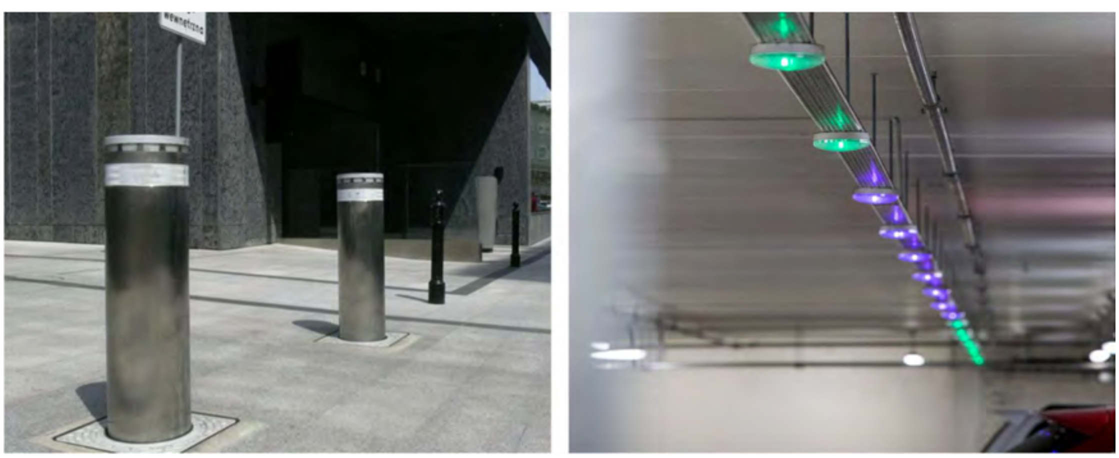


Figure 39: Automatic Bollards[24] and Electronic Parking indicators[25]

24 https://www.hampden.co.nz/automatic-bollards?gclid=Cj0KCQjwpf2IBhDkARIsAGVo0D3SEP7mgLq9PZD7UZPOU9mXzn90r_37HJbzA6sJUwl3aJmzk3q1k8MaAu-kEALw_wcB

25 https://www.smartparking.com/smartpark-system/smart-sensors

5.2.6 Design examples

Several case studies exist that exemplify how attractive public spaces can utilise the streetscape more efficiently and create new destinations that support pedestrian volumes and improve the economic performance of adjacent businesses. Two such examples from around central Auckland are Fort Street and Elliot Street, both of which have been the subject of recent upgrades that enhance the public realm, with significant positive impacts to footfall and economic turnover. The Dunedin Warehouse Precinct provides a local example of a revitalisation plan which involved a complementary package of measures through a collaboration between DCC and Waka Kotahi, that sought to improve amenity, transportation and open space. A preliminary study of the impacts of the project suggests positive effects so far.

Fort Street

Fort Street is one of several streetscape transformations that have been implemented in Auckland's CBD and has been internationally regarded as an exemplar for successful shared spaces. The term 'shared space' refers to the design approach of removing clear demarcations between vehicles and pedestrians, while prioritising pedestrians and enabling them to share the street in an equitable and efficient manner. Consequently, development of Fort Street saw the removal of conventional kerbs and the installation of a single level paved surface across the width of the corridor.

The area around Fort Street was initially identified as having strong potential for transformation in 2008.Consequently, the project was initiated with some clear goals – to better integrate the area with the surrounding network, provide greater pedestrian priority, create a distinctive public space, create a space that supports businesses and residents and provide an attractive high quality street that contributes to a sustainable city centre.

Prior to redevelopment, space allocation along Fort Street was similar to what exists on George Street, with wide traffic lanes, narrow footpaths and ample on-street parking on either side of the carriageway. Figure 40 displays an example of the post-development design of Fort Street.

Figure 40: New shared space on Fort Street

As shown, the new Fort Street streetscape offers a much more balanced environment for all transport modes. While there are many benefits to this shared space street design, the following represent a summary of five key positive impacts, as exemplified in Figure 40:

1. The shared space has resulted in a significant increase in pedestrian visitation – up 47% at peak hour
2. The shared spaces are recognised as destinations in their own right – 49% indicated they would visit the area more often
3. More spaces are provided for pedestrians to move around, sit or relax
4. There is more space for outdoor activities, outdoor dining, events and gatherings
5. The upgrade has increased vibrancy, boosted local businesses and led to significant investment in the area[26]

Elliot Street

Elliot Street in Auckland is another example of where the successful use of a shared space design has transformed a central city location. The Elliot Street design also has no traditional kerb, but instead a level surface shared by pedestrians, cyclists and motor vehicles. Pedestrians have absolute priority in the space but are not to unduly obstruct the movement of motor vehicles. Figure 41 depicts how space allocation has changed along Elliott Street before and after development.

Figure 41: Changes to space allocation, Elliott Street, Auckland

Elliott Street was part of the Auckland Council City Centre Masterplan (2012)[27] Shared Space Programme that focused on creating quality open spaces in the city centre. The scheme had several objectives, based around the themes of increasing the perception of safety and creating public spaces for passive and active movements. Post-evaluation work saw a number of successes with the scheme, with 75% of property owners indicating it is valuable to be on or near a shared space; foot traffic increased by 50%; and all users and stakeholders agreed that delays to traffic did not affect their business.

The idea of a street with level surface shared by all modes, that increases the availability of public realm space has underpinned the design of all options, with the exception of the do-minimum option. This is discussed in sections 5.2.2 to 5.2.4.

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[26] Auckland Design Manual. Share the Wealth -Shared Spaces Make Great Business Places. http://content.aucklanddesignmanual.co.nz/resources/case-studies/street_fort_street_precinct/Documents/ADM%20Case%20Study%20Fort%20Street%20Precinct%20Auckland.pdf

[27] https://www.aucklandcouncil.govt.nz/plans-projects-policies-reports-bylaws/our-plans-strategies/place-based-plans/Documents/city-centre-masterplan-2012-print-version.pdf

Dunedin Warehouse Precinct

The Dunedin Warehouse Precinct revitalisation plan provides a local example that sought to improve amenity, transport, and open space within the Warehouse Precinct. The project involved a collaboration between Waka Kotahi and DCC to regenerate and revitalise the precinct. Transportation initiatives for this project included:

- Coordinated changes to local precinct roads and state highways
- Traffic calming buildouts into the road space (see figure)
- Drop down kerbing to assist street crossing (see figure)
- Changes to parking durations and configurations
- Improvement to cyclist conditions (see figure)

These initiatives coincided with urban realm and amenity improvements to enhance the heritage character of the area. Ultimately this combination of amenity and transport improvements is a key takeaway for the Retail Quarter, seeing as a small study undertaken post implementation of stage one suggests there have been positive impacts. There are a few signs of revitalisation of the area evident, based on the quantitative data analysed for this study. This has included an increase in property values, which appears to be increasing faster for the Warehouse Precinct than for the city in the five years from 2011 to 2016.

The upgrades along George Street intend to adopt a similar approach, by improving both street amenity and transport (safety, accessibility, and space allocation). Thus, seeing signs of revitalisation for another precinct within Dunedin via a similar approach is a positive indication for this project.

Figure 42: Warehouse Precinct Transportation Initiatives

6.0 Option Assessment

The assessment of each option draws on the transport assessment, economic analysis and multi criteria analysis (MCA) to demonstrate the likely outcomes and relative value for money of each option

The multiple engagement stages with CCAG group has also been a key element in the optioneering process, with the feedback received from this group feeding into both the development of the option short-list (stage 1), and the scoring of the 'public acceptability' criteria as part of the MCA (stage 2). The MCA is discussed in more detail in Section 6.2.

6.1 Transport assessment

This section summarises the key findings from the transport modelling and transport assessment. The full Transport Modelling and Engineering report can be found in Appendix B.

The transport modelling has demonstrated that the road network within the base has a network peak of approximately 15 minutes in both the AM and PM Peak. The main failure is located at the five-arm intersection with the remainder of the network appearing to operate well with limited congestion.

With the enabling works and committed highway improvements for Shaping Future Dunedin projects added, in 2028 we observe a reduction of traffic on George Street and an increase of traffic on Filleul Street. This is primarily due to the new right turn into the Median Mall car park and therefore the traffic that had been forced to use George Street to circulate, is now using Filleul Street instead.

The option testing demonstrated that overall, there is little difference between the options in terms of change in travel times or congestion across the wider network. A review of the network shows the options have limited impacts on the wider network with some intersections operating with a slightly higher delay than in the base and do minimum. It is considered that this delay is minimal, and this is demonstrated in the network statistics. At a local level, all options see a large reduction in through traffic This is primarily due to the new right turn into the Median Mall car park and therefore the circulating traffic, which used to use George Street, is now using Filleul instead.

Modelling has also indicated that low numbers of through-traffic are likely due to the 10kph speed limit, in which the inconvenience that this speed creates deters people from using the corridor for that purpose. However, there have been questions raised regarding the reality of vehicles travelling through adhering to this posted speed limit, seeing as it is hard to enforce. Whilst a valid concern, the posted speed limit will happen in conjunction with design elements that will create side friction inducing the need to travel slowly. Additionally, the shared space environment will encourage less linear movement by people and whilst this will take time to embed, vehicles will need to adjust their speed to traverse the environment.

The main failure point on the network is the five-arm intersection of Filleul / London / George / Frederick Street. Whilst just improving the signal timing would improve the intersection from a capacity perspective, there is a need to balance this against pedestrian safety. An all red pedestrian phase is an option but, the management of this to prevent a Barnes Dance (crossing diagonally) scenario would be difficult. The requirement of the Barnes Dance is to provide sufficient pedestrian crossing time to cross diagonally. The trade-off to this is a longer red time for vehicles which will cause extensive delay to vehicles.

The southbound one-way option would provide a safer intersection, as it removes an entry arm. But this does not impact significantly on the function of the intersection. It is recommended that this intersection be retested when the SFDT works and the hospital works, are included within the Paramics model to determine the total impacts on the intersection. and a provide a design which is suitable to all projects.

Overall, the transport report has demonstrated that all options work well from a traffic perspective, they all provide more space for pedestrians and cyclists and other micro mobility users and they will provide a safer environment for users.

6.2 Multi Criteria Analysis (MCA)

The MCA is a key part of the option assessment process and is used to evaluate the options against key criteria or success factors (both qualitative and quantitative) to help determine an emerging preferred option. A MCA does not provide definitive answers about which is the best option, but does provide an assessment and opportunity to critically think about how each option is likely to deliver on the investment objectives, how feasible is it, and what effect it will have on environmental and strategic factors.

The MCA has been undertaken collaboratively with a range of technical specialists contributing to the evaluation, scoring and discussions. A workshop was held on Wednesday 28 July to discuss and confirm criteria and scoring. Participants provided feedback post workshop to refine and complete the MCA assessment.

6.3 Criteria

Significant thought and discussion with partners have underpinned selecting the appropriate criteria for this MCA. Care has been taken to ensure the criteria adequately reflect the risk, opportunity, and complexity of the project. This enables a robust assessment against key strategic and delivery considerations, whilst avoiding double counting.

The selection of the criteria full into three broad categories:

- Investment
- Ability to implement
- Assessment of effects

Each category has several criteria within it and where possible a range of qualitative and quantitative measures. Each criterion has been scored for each option using a seven-point scale ranging from +3 (very high positive impact) to -3 (very high adverse impact). This scale has been adopted from the Waka Kotahi Business Case guidance as the Treasury Better Business case have no prescribed scale. Consistency with the Waka Kotahi guidance is critical if this business case is going to pursue funding with Waka Kotahi. The category, measures and scoring definitions are shown below in Figure 43, Figure 44 and Figure 45.

Investment

How well does the option achieve the investment objective? This section assesses each option against the three investment objectives.

Ability to implement

This section assesses how feasible, affordable, and acceptable the options are. The feasibility considers the technical risk in delivering the options. How will each option be implemented and what is the level of complexity and disruption that needs to be considered? Can it be delivered safely? Can any risks be addressed in the design process? Will there be any feasibility issues based on the possible impact on the wider transport network? The assessment of this section draws on the work that has been done in the transport assessment (Appendix D) as well as input from the design and delivery team.

Consent risk is low with this project as work is wholly within the road space.

The affordability each of the option is considered by balancing the costs and benefits and drawing on the economic assessment completed (Appendix D).

Stakeholder acceptability is a significant element of this project. At the conclusion of the IBC, many stakeholders felt their perspectives had not been sufficiently considered or heard. The outcome of the George Street upgrade will directly impact a number of people's livelihoods, and for this reason the project is highly emotive. It is important that stakeholders' perspectives have been considered, and as much as possible is done to ensure confidence in the decision-making process about Council's investment in the Retail Quarter and the criteria and evidence decisions are based on. The stakeholder acceptability scoring comes directly from questionnaires completed by stakeholders who took part in the CCAG workshops.

Assessment of effects

This section has the largest number of criteria reflecting the importance of testing the options against DCC's key strategic directions and pillars. It considers both the impact as well as the opportunity for economic development, Mana Whenua, art, culture, and heritage as well as the environmental impact and impact on access, amenity, and personal security.

Investment Objective	KPI	Measure/Description	-3 Significant Adverse - Impact or Risk	-2 Moderate Adverse - Impact or Risk	-1 Minor Adverse - Impact or Risk	0 Neutral	+1 Minor Positive	+2 Moderate Positive	+3 Significant Positive
Reduce DSIs in Dunedin's Retail Quarter to 0 by 2038.	Reduced frequency of incidents Reduced severity of incidents	Speed reduction, reduced geometry and crossing distances	Worse than 2038 DM			No change over DM	Minor Positive	Moderate Positive	Significant Positive
Reduce private vehicles using George Street as a thoroughfare* by 2038.	Reduction in thoroughfare vehicular traffic	Through vehicular trips from Moray to Frederick St	Worse than 2038 DM			Same as 2038 DM	-0-30% reduction from DM	-31-60% reduction from DM	->60% reduction from DM
Increase the number of people visiting George Street by 2038	Improving perception of safety	Pedestrian LOS at 5 Arm	Worse than 2038 DM			Same as 2038 DM	Minor Positive Improvement	Moderate Positive Improvement	Significant Positive Improvement
	Improved sense of place and quality of experience	Opportunity for retail investment and retain or increased spending by visitors to the space.	Significant Adverse	Moderate Adverse	Minor Adverse	Neutral	Minor Positive	Moderate Positive	Significant Positive

Figure 43: Investment criteria

Criteria	KPI	Measure / Description	-3 Significant Adverse - Impact or Risk	-2 Moderate Adverse - Impact or Risk	-1 Minor Adverse - Impact or Risk	0 Neutral	+1 Minor Positive	+2 Moderate Positive	+3 Significant Positive
Feasibility	Technical Constructability	Technical risk in developing or implementing the option. * Managing underground utilities. * Disruption effects to transport network. * Surface treatment complexity. * Managing access to businesses continuity.	Significant Adverse	Moderate Adverse	Minor Adverse	Neutral			
	Safety in Design zero harm	H&S Risk in construction, operations and maintenance	Significant Adverse	Moderate Adverse	Minor Adverse	Neutral			
	Impact on the wider transport network	Increase in modelled vehicle travel time across the network.	Total VTT >5 min increase (2038 DM PM Peak)	Total VTT 1-5 min increase (2038 DM PM Peak)	Total VTT <1 min increase (2038 DM PM Peak)	No change in total VTT (2038 DM PM Peak)	Total VTT <1 min decrease (2038 DM PM Peak)	Total VTT 1-5 min decrease (2038 DM PM Peak)	Total VTT >5 min decrease (2038 DM PM Peak)
Affordability	Benefit/Cost ratio	NPV benefits / costs	BCR < -1	-1 < BCR < 0		0 < BCR < 1	1 < BCR < 3	3 < BCR < 5	5 < BCR
Stakeholder Acceptability	Stakeholders/ customers	How acceptable is this to stakeholders and customers? (Questionnaire from workshop two used to score)	Significant Adverse	Moderate Adverse	Minor Adverse	Neutral	Minor Positive	Moderate Positive	Significant Positive

Figure 44: Ability to implement criteria

<table>
<tr><th rowspan="2">Community Strategic Outcomes</th><th rowspan="2">KPI</th><th rowspan="2">Measure / Description</th><th>-3</th><th>-2</th><th>-1</th><th>0</th><th>+1</th><th>+2</th><th>+3</th></tr>
<tr><th>Significant Adverse - Impact or Risk</th><th>Moderate Adverse - Impact or Risk</th><th>Minor Adverse - Impact or Risk</th><th>Neutral</th><th>Minor Positive</th><th>Moderate Positive</th><th>Significant Positive</th></tr>
<tr><td rowspan="8">Spatial Plan
Memorable, distinctive, vibrant city
Accessible and connected city
Prosperous and diverse economy
Economic Development
Business vitality
A compelling destination
3 Waters Strategy
Key services are maintained
Integrated Transport Strategy
Safe, efficient, integrated network
Platform for sustainable transport choice
Social Well-being Strategy
Connected people
Vibrant and cohesive communities
Parks and Recreation Strategy
A range of accessible environments that encourage play, activity and informal recreation so communities can thrive
Te Ao Tūroa Strategy
Resilient and carbon zero
Ara Toi Ōtepoti Strategy
Identity pride
Access and inclusion</td><td>Te Ao Maori</td><td>Impact on Te Ao Maori and Mana Whenua principles and values</td><td>Significant Adverse</td><td>Moderate Adverse</td><td>Minor Adverse</td><td>Neutral</td><td>Minor Positive</td><td>Moderate Positive</td><td>Significant Positive</td></tr>
<tr><td>Arts and Culture</td><td>Ability to foster a creative streetscape with opportunities for diverse arts and cultural activities.
Embeds imaginative solutions within the physical environment to allow for ongoing creative use of the streetscape by public and private stakeholders.</td><td>Significant Adverse</td><td>Moderate Adverse</td><td>Minor Adverse</td><td>Neutral</td><td>Minor Positive</td><td>Moderate Positive</td><td>Significant Positive</td></tr>
<tr><td>Heritage</td><td>Impact on heritage and/or archaeological value</td><td>Significant Adverse</td><td>Moderate Adverse</td><td>Minor Adverse</td><td>Neutral</td><td>Minor Positive</td><td>Moderate Positive</td><td>Significant Positive</td></tr>
<tr><td rowspan="2">Environmental</td><td>Impact of design on sustainability (rain gardens, drainage, permeable surfaces)</td><td></td><td></td><td></td><td>No change to existing</td><td colspan="3">Moderate Positive +2
use of rain gardens and/or permeable surfaces</td></tr>
<tr><td>Impact on air quality.</td><td>Total VKT 11-15% increase</td><td>Total VKT 6-10% increase</td><td>Total VKT 0-5% increase</td><td>No change in total VKT from DM</td><td>Total VKT 0-5% decrease</td><td>Total VKT 6-10% decrease</td><td>Total VKT 11-15% decrease</td></tr>
<tr><td>Amenity and urban comfort</td><td>Extent of option to support quality public realm, amenity and urban comfort. Seating, planting, drink fountains etc (Specifics TBC).</td><td colspan="3">Less quality than existing -1</td><td>Neutral</td><td>Minor Positive</td><td>Moderate Positive</td><td>Significant Positive</td></tr>
<tr><td>Accessibility</td><td>How accessible and functional is the option for all? (Considering the needs for groups with varied needs and disabilities)</td><td colspan="3">Less quality than existing -1</td><td>Neutral</td><td>Minor Positive</td><td>Moderate Positive</td><td>Significant Positive</td></tr>
<tr><td>Personal security</td><td>7 Qualities of safer places - access, surveillance and sightlines, layout, activity mix, sense of ownership, quality environments, physical protection.</td><td></td><td></td><td></td><td>No change to existing</td><td>Minor Positive</td><td>Moderate Positive</td><td>Significant Positive</td></tr>
</table>

Figure 45: Assessment of effects criteria

6.4 MCA summary

As mentioned above, each option is scored against each criterion using a seven-point scale. Scores, rationales, and key assumptions have been recorded and help inform the investment decision.

Table 11 to Table 12 show the scoring for each of the criteria detailed in section 6.3 above.

Table 11: MCA Scores for Investment Objectives

Investment Objective	KPI	Do Minimum	One-way Northbound	One-way Southbound	Two-way slow
IO1: Reduce DSIs in Dunedin's Retail Quarter to 0 by 2038.	Reduced frequency of incidents Reduced severity of incidents	0	2	2	1
IO2: Reduce private vehicles using George Street as a thoroughfare* by 50% by 2038.	Reduction in thoroughfare vehicular traffic (through vehicle trips)	0	3	3	3
IO3: Increase the number of people visiting George Street by 2038	Improving perception of safety	0	0	1	0
	Improved sense of place and quality of experience	0	1	1	1

Table 12: MCA Scores for Ability to implement criteria

Criteria	KPI	Do Minimum	One-way Northbound	One-way Southbound	Two-way slow
Feasibility	Technical/ Constructability	0	-2	-2	-2
	Safety in Design/zero harm	0	-2	-2	-2
	Impact on the wider transport network	0	-1	-1	-1
Affordability	Benefit / cost ratio	0	3	2	3
Stakeholder Acceptability	Stakeholders / customers	0	1	1	3

Table 13: MCA Scores for Assessment of Effects criteria

Criteria	KPI	Do Minimum	One-way Northbound	One-way Southbound	Two-way slow
Community strategic outcomes	Te Ao Maori	0	2	2	1
	Arts and culture	0	2	2	1
	Heritage	0	1	1	1
	Impact on sustainability	0	2	2	2
	Air Quality	0	-1	-1	-1
	Accessibility	0	3	3	2
	Amenity and urban comfort	0	2	2	1
	Personal Security		2	2	2

Figure 46 also provides a simplified summary of the MCA scores for each option. This figure clusters the criteria into five distinctive scoring categories: Investment Objectives 1, 2 and 3, Feasibility and Affordability, Stakeholder Acceptability, and Environmental Effects. Notably, the Stakeholder score has been separated from the Feasibility grouping, to highlight the importance of gaining stakeholder acceptability for this project. The figure shows how each group is scored per option, with the thickness of the colour indicating the score it received (e.g. +3 and -3 scores will have the thickest blocks), and is shown as either above or below the line (which is denoted as zero) depending on a positive or negative score. Using these same categories, Table 14 summarises the primary reasons behind the allocated scores. The full MCA spreadsheet with scores and a detailed explanation is provided in Appendix D.

Notably, the Do-Minimum option is not shown or discussed in the following figure or table, as all options are scored against the Do-Minimum, forming the baseline for scoring, hence the overall neutral score.

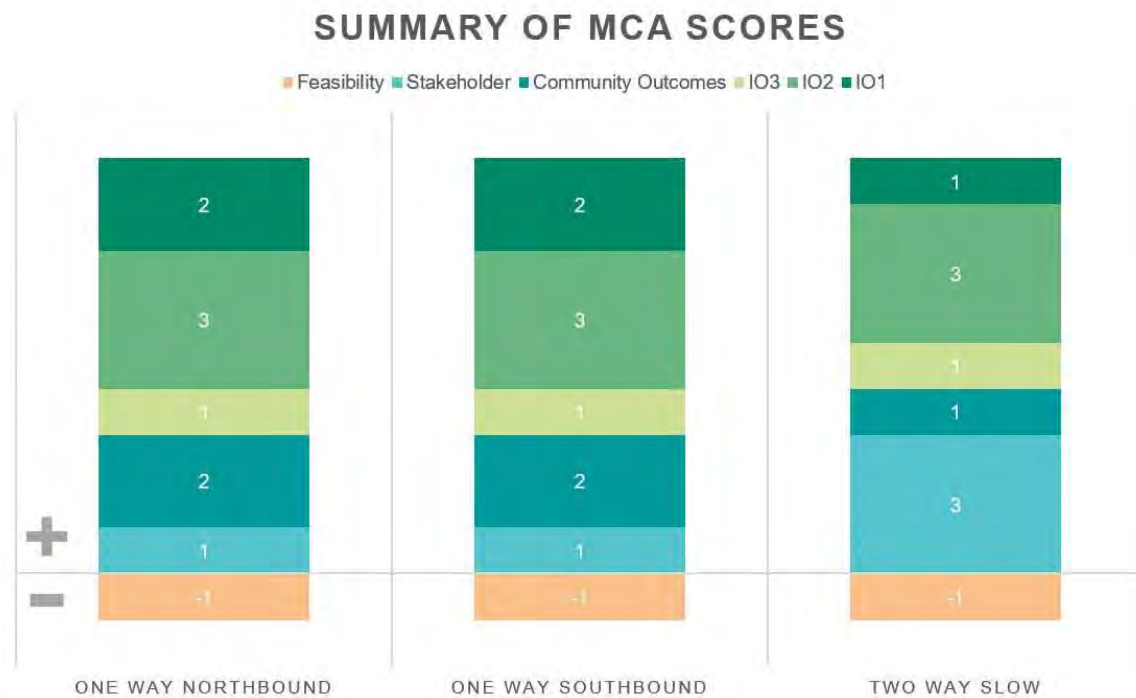


Figure 46: Summary of MCA Scores by option

Table 14: Option assessment summary

Option	Criteria	Commentary
One-way Northbound	IO	• Joint highest score against IO1, as crossing distance is significantly reduced compared to existing. • Score highly against IO2 due to significant reductions in through traffic • All options, apart from the do-minimum option, positively score against IO3 due to increased pedestrian space and place making opportunities.
	Feasibility	• Joint lowest score with high levels of disruption and high level of surface treatments. Highest BCR of the one-way options.
	Stakeholder	• Primarily a positive sentiment towards the one-way option but a notable proportion of stakeholders gave this option a significantly adverse score. Highlights the varying levels of acceptability for this option.
	Community strategic outcomes t	• Joint highest score with southbound option due to greatest opportunity to increase space for amenity, activity, culture, and environmental benefits.
One-way Southbound	IO	• Joint highest score against IO1, as crossing distance is significantly reduced compared to existing. • Scores highly against IO2 due to significant reductions in through traffic • All options, apart from the do-minimum option, positively score against IO3 due to increased pedestrian space and place making opportunities. • Additionally, Southbound option enables the removal of a signal phase at the 5-arm, contributing to decrease in total cycle time.
	Feasibility	• Joint lowest score with high levels of disruption and high level of surface treatments. Lowest BCR of the one-way options.
	Stakeholder	• Primarily a positive sentiment towards the one-way option but a notable proportion of stakeholders gave this option a significantly adverse score. Highlights the varying levels of acceptability for this option.

Option	Criteria	Commentary
	Community strategic outcomes	• Joint highest score with northbound option due to greatest opportunity to increase space for amenity, activity, culture, and environmental benefits.
Two-way	IO	• Low positive score against IO1 due to two-way traffic and minimal reduction in crossing distance. • Scores highly against IO2 due to significant reductions in through traffic • All options, apart from the do-minimum option, positively score against IO3 due to increased pedestrian space and place making opportunities
	Feasibility	• Higher level of surface treatment compared to do-minimum. • The two-way option has the second highest BCR.
	Stakeholder	• Highest scoring option for stakeholder acceptability, with less variability in the scores from stakeholders.
	Community strategic outcomes	• An overall minor positive score against these criteria, due to an increase in space that allows for amenity, activity, culture, and environmental benefits, but to a lesser degree compared to the one-way options.

6.5 MCA outcome

A summary of the MCA category scoring, cost and BCR range are shown below in Figure 47.

All options scored well against the investment objectives except for the do minimum. Managing the disruption, technical feasibility and affordability mean all options score negatively in terms of ability to implement, however the two-way option scores highest as it is generally the most acceptable to stakeholders. In terms of the assessment of effects there is significant opportunity to embed the vision of the Spatial plan and CCP plan objectives in all the options except the do minimum. The one-way options score slightly higher over these variables as the space available for uplift is greater than in the two-way option.

Criteria	Do Minimum	One Way Northbound	One Way Southbound	Two Way slow
Investment	0	6	7	5
Ability to implement	0	-2	-3	-1
Assessement of Effects	0	13	13	9
Capital cost	$9m	$19m	$19m	$18m
BCR range	-1.6	4.0 - 10.3	2.2 - 8.5	3.5 - 10.6

Figure 47: MCA score totals

6.5.1 Balance of variables

As mentioned earlier in this section, getting the quantum and balance of criteria for the MCA is challenging. The strategic direction and intentions for the Retail Quarter, and consequently George Street, has underpinned the criteria used for this assessment. The desired outcomes and directions are shown in Figure 43, Figure 44 and Figure 45 above, which highlight the line of sight between these key DCC documents and the DBC investment objectives. Whilst there is no direct duplication, the criteria chosen for the assessment of effects have quite an emphasis on improving space allocation and place amenity. To some degree, this may have impacted the balance of variables, and favours outcomes that align more with these principles.

Variables could be removed, added, or weighted to alter this outcome, but this could result in an option outcome being engineered, which is not the intention of the MCA. Essentially the MCA shows that there is no one option that is a resoundingly better investment that another and for this reason a preferred option is not able to be identified.

6.5.2 Political decision

Due to the highly political nature of this project and the risks associated with that, it is recommended the DCC consider the information in the option assessment section of this business case along with the stakeholder engagement feedback contained in Section 9.3 to inform their decision making.

6.5.3 The difficulty in linking a specific design option to retail success

The broad community desire to maintain the Retail Quarter's role as Dunedin's preeminent retail area is a strong driver for the project. Engagement feedback discussed later in this business case demonstrates that a 'do nothing' or even 'do minimum' approach has little support from stakeholders, who acknowledge that some type of amenity upgrade to the public realm is well overdue.

The question of which of the options beyond the do minimum will have the greatest positive impact on maintaining or enhancing the retail and other commercial activity in the Retail Quarter is a more difficult question to answer definitively.

Across Australasia and across the world, there are countless examples of how major amenity upgrades have revitalised retail and other commercial areas. Locally, although not a retail-focused area, the Warehouse Precinct is an example of how even targeted amenity upgrades can provide expanded opportunities for adjacent businesses and incentives for the private sector to invest.

Within these examples of successful investment in the public realm to support and revitalise adjoining business activities, no one amenity or transport solution guarantees success. Depending on the local context, solutions from full pedestrianisation to two-way streets have resulted in retained and expanded retail vibrancy.

Looking at recent successful amenity upgrades, some common trends have emerged:

- Creating a high-quality pedestrian environment
- Reducing vehicle speeds
- Providing high levels of accessibility for a range of users and transport modes
- Expanding opportunities for social interaction
- Encouraging a range of compatible uses to encourage longer hours of activity

Both the one-way and two-way options assessed in the DBC try to address these factors. In the refined options, the options balance the different trade-offs between vehicle access, the amount of space allocated to different modes of transport, and opportunities for place-making differently. Which one of these options will work best is relatively subjective, depending on personal circumstances, business types/models and ideological perspectives?

Two other points are worthy of consideration. Anecdotally, a key factor in the most successful examples appears to be good cooperation between the public and private sector and broader community, both in terms of working together to come up with a design that encourages people to visit, but also in terms of working together to leverage the maximum benefits from any changes. An attractive amenity upgrade will not succeed in turning retail fortunes around if there are not good shops, products and other attractions to keep people wanting to return to and spend money in the area. Locations where the amenity upgrades have been accompanied by strong private sector investment and collaborative efforts to manage the area differently appear more likely to succeed than those that rely solely on public realm improvements alone.

It also appears that in the absence of any definitive evidence to support which of the options will deliver the best potential economic success through retail revitalisation, that perception will be just as important as any data, information or similar examples from elsewhere that can be provided. A more positive perception about the process and plans from the business community is more likely to encourage them to invest, where more negative perceptions may see them take a more neutral stance or decide to relocate and invest elsewhere.

For this reason, the DBC supports the idea of a proposed Retail Quarter Revitalisation Plan to sit alongside the amenity and infrastructure works. Such a plan could help to leverage opportunities that cannot be addressed solely through the physical infrastructure and amenity works. It could also encourage better partnership between the private and public sector, more community input and ownership of the area, and the development of on-going programmes such as a retail association, events and marketing to assist in stabilising or even reversing the declining share of Dunedin's retail spend.

7.0 Economic assessment of the short list options

This section summarises the economic analysis economic evaluation of the project options using the Waka Kotahi Monetised Benefits and Costs Manual (MBCM).

The Economic evaluation report provides further details and sets out the full methodology, assumptions, scenario testing, incremental analysis, and sensitivity analysis undertaken and can be found in Appendix E.

7.1 Assumptions

The following assumptions have been made in completing the economic assessment of the options.

- The base date for the evaluation is 1 July 2021
- Time zero is 1 July 2021
- The evaluation period is 40 years
- The base assumption for the discount rate is 4%
- Construction for the enabling works is assumed to commence on 1 January 2022 and be completed by 31 December 2022
- Construction of the Do Minimum and the options is assumed to commence on 1 January 2023 and be completed by 31 December 2023
- Benefits have been straight line extrapolated between the model years 2019, 2028 and 2038. The benefits were capped at 2038 levels for the later years
- All update factors, base value travel times, vehicle operating costs etc. are based on update factors from the MBCM (August 2021 Update).

7.2 Costs

7.2.1 Capital cost

The ‘expected’ estimates for the scheme, both undiscounted and discounted net present value (NPV) costs, are summarised in Table 15 below.

Table 15: Undiscounted and NPV costs ($m)

Description	Expected Estimate ($m)	NPV Costs ($m)
Enabling works	5.4	5.2
Do Minimum	9.0	8.3
Option 1: Two-way	18.0	16.6
Option 2/3: One-way	19.0	17.6

7.2.2 Maintenance costs

Routine maintenance

It was estimated the that annual routine maintenance cost:

- For Do Minimum is approximately $6,000 per year; and
- For all the other options are approximately $7,000

Resurfacing and pavement rehabilitation

It was estimated that the cost:

- Of resurfacing is around $237,000; and

- Of rehabilitation is around $1,024,000.

A summary of the maintenance costs is shown in Table 16.

Table 16: Maintenance cost summary

Description	Do Minimum ($)	Option 1 ($)	Option 2 ($)	Option 3 ($)
Annual Routine Maintenance	6,000	7,000	7,000	7,000
Resurfacing	236,800	236,800	236,800	236,800
Rehabilitation	1,024,000	N/A	N/A	N/A

All maintenance costs shown in Table 16 are present value costs. It was further assumed that the maintenance cost will increase by an additional 3% cost-escalation over 40-years, for material and resource costs.

Total maintenance costs

Table 17 shows the undiscounted and NPV of total maintenance costs over the 40 year analysis period.

Table 17: Undiscounted and NPV of Maintenance Costs ($m)

Description	Do Minimum ($m)	Option 1 ($m)	Option 2 ($m)	Option 3 ($m)
Total maintenance costs (undiscounted)	3.8	0.9	0.9	0.9
NPV maintenance costs	1.6	0.4	0.4	0.4

Table 17 shows that the NPV maintenance costs for:

- Do Minimum is $1.6 million over 40 years; and
- All the other options are $0.4 million over 40 years.

The Do-minimum assume at least two renewals over this 40-year period, in account of the existing road configuration and traffic volumes, which are set to increase over time due to growth. This will require a higher level of pavement renewal and rehabilitation. Renewal of footpaths is also assumed.

For the other options, reduced traffic volumes and a higher standard of pavement (interlocking blocks), will mean there is no requirement for a renewal within the 40 year period.

7.3 Benefits

This section outlines the tangible benefits of the option, based on the Waka Kotahi's MBCM August 2021. The benefits summarised in this section are stated as a comparison of the options and the Do Minimum using a fixed trip matrix methodology.

Benefit sources that have been included in the economics are travel time costs, vehicle operating costs, carbon emissions costs, crash cost savings, and walking and cycling health benefits. The primary monetised benefit is the health benefits because of the facility attracting new pedestrians and cyclists.

The calculation of the health benefits is sensitive to the estimated new pedestrian uplift assumptions; therefore, a range of pedestrian uplift scenarios (low, base, and high) have been tested to estimate the number of new pedestrians likely in the future. The assumptions behind each of the scenarios is further explained in Appendix E.

7.3.1 Crash cost savings

Given the lack of crash history/evidence in the project study area, and recent changes to crash hotspot intersections having eliminated the pedestrian and cycling crashes previously observed, quantifying monetised crash cost savings using the existing MBCM and Waka Kotahi's Crash Estimation Compendium did not prove effective.

While the project can be expected to improve the overall safety, especially for vulnerable road users, with reduced flows, shorter crossing distances and lower speeds, the monetised crash cost savings for all options have been conservatively assumed to be zero.

7.3.2 Source of benefits

The NPV benefits of the Do-Minimum and all options are summarised from Table 18 to Table 20.

Table 18: Summary of High Case NPV benefits

	Travel Time ($m)	Vehicle Operation ($m)	Carbon Emission ($m)	Crash Cost ($m)	Health ($m)
10km/h NB Only	6.4	-0.8	-0.1	0.0	77.3
10km/h SB Only	-8.2	-0.6	0.0	0.0	77.3
10km/h Two Way	-0.7	-0.9	-0.1	0.0	77.3

Table 19: Summary of Base Case NPV benefits

	Travel Time ($m)	Vehicle Operation ($m)	Carbon Emission ($m)	Crash Cost ($m)	Health ($m)
10km/h NB Only	6.4	-0.8	-0.1	0.0	38.0
10km/h SB Only	-8.2	-0.6	0.0	0.0	38.0
10km/h Two Way	-0.7	-0.9	-0.1	0.0	38.0

Table 20: Summary of Low Case NPV benefits

	Travel Time ($m)	Vehicle Operation ($m)	Carbon Emission ($m)	Crash Cost ($m)	Health ($m)
10km/h NB Only	6.4	-0.8	-0.1	0.0	26.7
10km/h SB Only	-8.2	-0.6	0.0	0.0	26.7
10km/h Two Way	-0.7	-0.9	-0.1	0.0	26.7

7.4 Benefit cost ratios (BCRs)

The Do Minimum has assumed that funding has been committed for the three waters projects and the enabling works and the subsequent renewal of George Street to its current state. The BCR has however been estimated the Do Minimum (which includes the costs of the enabling works and the renewal). The Do Minimum has assumed that funding has been committed for the Three Waters projects and the Enabling Works and the subsequent renewal of George Street to its current state.

The BCRs when using the Do Minimum as the comparator and for all cases tested are shown in Table 21.

Table 21: Benefit cost ratio summary

	High Case			Base Case			Low Case		
	NPV Benefit ($)	NPV Cost ($)	BCR	NPV Benefit ($)	NPV Cost ($)	BCR	NPV Benefit ($)	NPV Cost ($)	BCR
Do Minimum		15.1			15.1			15.1	
10km/h NB Only	82.8	23.2	**10.3**	43.5	23.2	**5.4**	32.2	23.2	**4**
10km/h SB Only	68.6	23.2	**8.5**	29.2	23.2	**3.6**	17.9	23.2	**2.2**
10km/h Two Way	75.7	22.3	**10.6**	36.3	22.3	**5.1**	25.1	22.3	**3.5**

7.5 Economic evaluation summary of options

It can be concluded that:

- The proposed upgrade options are likely to attract new pedestrians and cyclists, and therefore health benefits are a primary monetised benefit
- The BCR is sensitive to the assumptions on pedestrian and cycling uplift due to the project so a range of pedestrian uplift scenarios were tested (high, base and low case) to estimate a range of BCRs in response to the uncertainty of pedestrian numbers in the future resulting from the project.
- The two-way option is forecast to result in the best BCR (10.6 for high case, 5.1 for base case and 3.5 for low case)
- The one-way northbound option is forecast to result in the second best BCR (10.3 for high case, 5.4 for base case and 4 for low case)
- The one-way southbound option is forecast to result in the third best BCR (8.5 for high case, 3.6 for base case and 2.2 for low case)

Following the identification of the preferred option the Value of Urban Realm Toolkit (VURT) will be used to undertake an analysis of the amenity benefits for the town centre associated with improving the place function of the Retail Quarter. Based on this analysis, VURT will produce User Benefits (the values people say they give) to changes in urban realm quality that will be monetised. User benefits are calculated according how many people experience the change in urban realm quality and for how long they experience this change. VURT uses the counts of pedestrians walking or staying in a street for a particular period and then calculates the user benefit for that time period.

8.0 Assessment of non-monetised benefits

Some benefits are not able to be reliably quantified into monetary terms. Non-monetised benefit measures focus on quantitative or qualitative measurement to help understand the impact of an investment.

An assessment of the non-monetised benefits is presented in Table 22. This groups the measures derived for this DBC into four categories. These categories broadly align with the Waka Kotahi Land Transport benefits framework and management approach and have been used as a basis for this assessment. However, these have been amended in places to more accurately measure the benefits from this project, which is a combination of transport benefits (safety and improved access), as well as urban realm and place based benefits (improving the amenity and sense of place within the Retail Quarter).

Table 22: Assessment of non-monetised benefits

Category	Non-monetary benefit - Measure	Description – Business advantage gained by solving the problem
Health	Impact safety perception	• Reduced crossing distances, slower vehicle speeds through narrow and deflected traffic lanes and greater space dedicated to pedestrians (footpath and activity zones) will improve the safety and ease of walking, cycling and perception of moving through the George Street space. • Greater activity space and amenity that attracts more people will improve the perception of personal safety.
	CO_2 emissions / Ambient Air Quality	• Reduction of through traffic volumes and planting will have a positive impact on the ambient air quality along the street. Better air quality will contribute to both a healthier street environment for pedestrians and improved amenity.
Job / Earnings	People counts	• Greater space allocation for pedestrian movement and activity zones will be an attractor to George Street. Anecdotal evidence from stakeholders shows support for this, with many suggesting the upgrades would encourage them to come the area (and potentially spend money). • Whilst not explicitly measuring retail spend, attracting a greater number of people to the area is likely to correlate with increased retail spending, and investor confidence contributing to revitalising the Retail Quarter
	Amenity Value – Street Appeal	• The existing George Street environment is unattractive, some people avoid the area and many chose not to linger in the area. Provision of urban comfort elements, e.g. seats, planting, and even play equipment (pending design), will greatly improve the appeal and level of amenity of George Street. • Combined with smart street initiatives, such as temporarily closing blocks for street events, the street is likely to become a key destination in both the Retail Quarter, and for the wider city. • Significant improvements to amenity and streetscape to create a compelling destination will impact positively on business vitality
Access	Through traffic	• A significant reduction in through traffic through traffic calming design will deter unnecessary car trips and provide a more equitable use of the space for walking and cycling.
	Impact on mode choice Access – Perception	• A key concern for many of the stakeholders was the retention of on-street parking, as parking was considered critical for access. Whilst this will be finalised in the next stage of design, parking numbers are likely to be comparative with existing, with some repurposed to increase mobility parks. • The level road surface will improve access along George Street for people with mobility concerns. • A shared and attractive space with high levels of amenity, safety, and comfort with increase the perception of the space being welcoming and accessible to all.

Category	Non-monetary benefit - Measure	Description – Business advantage gained by solving the problem
Cultural	Impact on Te Ao Maori and Mana Whenua values	• Significant opportunity and benefit to Dunedin city to be able to closely work with Mana Whenua (during the next stage of design), to embed manaakitangi in the street design and improve cultural value.
	Impact on amenity value – Heritage	• All options will be able to integrate and showcase Dunedin's rich cultural heritage not currently represented along the street generating significant benefit to making Dunedin memorable and distinctive. No changes to the built heritage along the street.

9.0 Partners and stakeholders

This section summarises engagement undertaken with partners, key stakeholders, and the community by DCC and the project team for this DBC. Engagement has centred around providing information to stakeholders, understanding their issues and constraints, and providing them with an opportunity to feed their thoughts and ideas into the options, design and investment decision making process.

9.1 Partners

The partners for this project are DCC, Aukaha and Waka Kotahi and Otago Regional Council.

9.1.1 Dunedin City Council

The DCC provide strategic transport planning for the city and provide and operate the local road network.

DCC are the key decision makers for this project and are seeking a transformational change for the George Street retail precinct. This project falls under the CCP of which the council are currently implementing.

9.1.2 Aukaha

Within the Otago Region, Kāi Tahu recognises the whakapapa of the three-constituent iwi. Encompassed within this, there are five papitipu rūnaka that have special interests in the region. The collective aspirations of these rūnaka are facilitated, advocated and championed by Aukaha, an entity established to represent and deliver the kaupapa set by mana whenua.

Aukaha works on behalf of Kāi Tahu as the Treaty Partner when engaging with local government, on projects such as this.

9.1.3 Waka Kotahi

Waka Kotahi's core function is to invest in land transport activities, manage the state highway network and provide access to and regulation for land transport.

Waka Kotahi are a potential co-funder for this project, to support the transport investment objectives and benefits of the George Street upgrade. Investment decisions are guided by the GPS which gives effect to the NLTP.

9.1.4 Otago Regional Council

ORC is responsible for environmental management, land management, public transport planning and funding, and the Regional Land Transport Plan. ORC's main interest in this project will be to ensure any changes to the network does not negatively impact on the city's bus operations.

9.2 Stakeholders

This is an important project for the city, as well as those who live, work, and invest in this area. There are livelihoods at stake, therefore it is important to ensure there is confidence in the decision making surrounding how George Street will be upgraded. For this reason, engagement with stakeholders has been an integral part of this project.

An open and collaborative engagement approach has been taken throughout the business case. DCC and the project team have liaised with and sought feedback from stakeholders via targeted engagement. This has primarily been achieved through the CCAG, a collection of key stakeholders from a range of demographics with special interests in the Retail Quarter.

These groups have had tangible impact on how the options have evolved. For example:

- Student groups have demonstrated their innovative potential with the suggestion to employ a 'smart-street' approach across all design options.
- Retail and business groups have influenced the retention of on-street car parking.

- Disability and elderly advocacy groups have strongly influenced the design of George Street to be all one level, meaning there is no differentiation between the road and footpath

Table 23 summarises the relationships each group has with this project.

Table 23: Stakeholder relationships to the project

Stakeholder	Inter-relationship
Emergency Services	Responsible for emergency response. Have a strong interest in any changes to the road network and the impacts this can have on emergency response times. Police are also responsible for ensuring safe use of roads and vehicles through enforcing speed limits, checking vehicle compliance, managing traffic/congestion associated with crashes and other unplanned stoppages.
Chamber of Commerce	Advocate for business concerns and submit on behalf of members on local and national government policy. Has an interest in economic opportunities/regeneration that can be enabled by the project.
CCS Disability Action CCS	Disability Action’s vision is to see every disabled person included in the life of their family and community. Focused on ensuring improvements to access by all modes for all ability types.
Disabled Person Assembly (DPA)	Works to affect positive change for all disabled people in New Zealand and around the world.
Urban Access Dunedin Inc	Urban Access Dunedin is an incorporated Society established in 2020 to engage with local authorities to ensure access within Dunedin City works for all users.
Pacific Trust Otago	Pacific Trust Otago is an independent community provider of health, education, and social services to Pacific peoples. They work within a holistic framework to improve the health and wellbeing of our community.
Automobile Association	Promotes interests of motor vehicle owners. Focus on road safety.
Araiteuru Marae Council	Works to support and connect the multi-ethnic communities in Dunedin, and work with local government for the benefit of the multi-ethnic communities.
Youth Council	Focused on ensuring the needs and perspectives of young people in Dunedin are understood.
Heart of Dunedin	Group with a vision to reinvigorate Dunedin’s central city area. Focused on bringing people back to the heart of the city.
Generation Zero	Non-partisan, youth-led organisation that champions solutions towards a carbon neutral Aotearoa. Focused on smarter transport, liveable cities and independence from fossil fuels.
Age Concern Otago	Promotes healthy, active, and positive ageing for people over 65.
Grey Power Otago Inc.	Advocates to advance, support and protect the welfare and well-being of older people.
Bus Go Dunedin (Bus Users Support Group)	Advocacy for bus users and supporting and promoting fast, clean, efficient, low-cost transport in Ōtepoti Dunedin.
Otago University Students Association (OUSA)	Represents Otago University students. Independent from the university and focused on student interests.
Otago Polytechnic Students Association (OPSA)	Represents Otago Polytechnic students. It is an independent organisation within the Polytechnic representing student views and concerns.
Central Dunedin Business Group	Advocate for businesses in Central Dunedin. Will have an interest in economic opportunities/regeneration that can be enabled by the project.
Hospitality Association Dunedin Branch	Work on behalf of members to promote the industry, partner with government to prevent restrictive legislation, protect commercial interests and to spearhead innovation for a sustainable future.

Stakeholder	Inter-relationship
Property Developers	Interested in the project impacts in relation to their properties or future investment.
Plunket	Advocates for achieving health equity and well-being for tamariki in Aotearoa.

9.3 Stakeholder consultation and communication approach

This section summarises engagement undertaken with key stakeholders, with the full Engagement report contained in Appendix G. The information gathered through engagement has been used to collate key themes, inputs, inform optioneering and design refinement.

Engagement for the DBC has been influenced by and built upon previous engagement work undertaken by DCC.

9.3.1 Engagement History

DCC have engaged on multiple occasions with the community and stakeholders regarding George Street improvements. As outlined in the IBC, engagement formed part of the approvals process of DCC's Integrated Transport Strategy (2013), the Dunedin CCP (2011) and the 2018-2028 Long Term Plan. This was followed in the IBC with additional community engagement in 2019, including stakeholder workshops, a public roadshow, ballot boxes, online survey, and an interactive mapping tool.

9.3.2 DBC Engagement

For this business case, engagement was undertaken in two stages:

- Stage One – Understanding stakeholders
- Stage Two – Optioneering

9.3.3 Stage One Engagement – Understanding stakeholders

The purpose of this engagement was to meet individually with each stakeholder group; introduce the project team, give a project update and listen to the issues each representative group faced on George Street, as well as hear their vision for the area. This work built on feedback from the IBC and ensured that all key stakeholders were given a forum in which to discuss matters.

Key messages from each stakeholder group are summarised in Table 23.A summary of themes and words that emerged most among stakeholders is shown in Figure 48.

Figure 48: Key themes from stakeholder engagement

Table 24: Stakeholder Engagement Feedback Summary

Group	Stakeholder	Main Points
Mana Whenua	Aukaha	• Values and vision statement done for the preliminary report to be included in the options, important that the design will reflect history and cultural values • Access and safety for kaumatua – the elderly – to be considered within all options. • Keen to be involved and input into design process to ensure Mana Whenua have an opportunity to provide input • Meet monthly with Mana Whenua – can take agenda items to these meetings
	Araiteuru Marae Council	• Po near key areas such as the railway station and within the town needed to celebrate cultural narrative and history • Main priority is making it convenient to get into town – in and out • Kaumatua access and safety important • The area needs to have a community space feel for those who are isolated in the community
Pasifika	Pacific Trust Otago	• Happy with the existing layout and do not feel a need to limit access • Convenience is the key driver for getting into town, parking can often act as a barrier
	Pasifika Community	• Maintain as much parking as possible (and improve mobility parking) as this is a key barrier to accessing town • Church is important to community
Retailers	Independent retailer	• Customers to have convenient and accessible ways to get to the area • Buses are not viable in the area given the population density • Opposed to green zones and benches as this will create problems such as loitering, detracting customers – had an issue outside his shop until seats were removed • Whatever you do – make it memorable and work! • Convenient parking important for customers to get in and out
	Central Dunedin Business Group	• Parking required as this is an issue – visitors to Dunedin travel by car; no parking provided for new hospital • Opposes one-way option as it alienates people • Prefers option as flexibility to customise – there should be options for couriers and service vehicles – increased courier demand due to online shopping
	Chamber of Commerce Retail Sub-Committee (CEO) (Chair)	• Minimise retail disruption; do not want to disrupt Christmas trading • Accessibility for vulnerable and elderly community • Supports two-way flexible options

Group	Stakeholder	Main Points
		• Provided Christchurch Riverside Market as an example • Safety at night • Create new option: one-way with flexibility for more space • Pedestrianisation • Interactive, playful lighting (Queen Street provided as example) • Parking in the vicinity is still required • More attractive area
	Heart of Dunedin (Golden Centre Manager)	• One-way options 1 and 2 are not favoured • With a one-way, speeds will not be observed, and George Street will be used to get from A to B • Limiting vehicle movements (through one-way) is not favoured for businesses as this will decrease exposure to retailers • Having initiatives to encourage people into the city viewed positively • Buses can be useful for the elderly and connecting to the bus hub
	Independent retailer	• Parking noted as major issue, with leased parking noted in reports as being available - parking stock is largely utilised by hospital staff and crucial for shift workers • People drive up George Street because there is no alternative option • There are no park and ride/biking facilities available on the fringes of town • Reducing parking will reduce accessibility for a number of customers • By trying to implement modal change, this will deter more people from using retail and will consequently shop online
Youth/Student Organisations	Dunedin Youth Council Generation Zero Otago Polytechnic Students Association	• The idea of shutting the area off for certain time periods gained a positive reaction • Mobility parking and short stay parking for those that require it • The maximum amount of pedestrian space is preferred and helps address wider issues around climate change by detracting car movements • The 5-arm intersection is noted as being hard to navigate, especially for cyclists • Need to slowly increase change in the environment over time • Uni students surveyed walk mostly to get to places • Create places for students to want to come – not much to attract them to city centre currently • Consider smart option for Option 1 and Option 2. Option 4 works, but think seasonal and events all year round to attract students • Polytech students are older with children and tend to drive – so convenience is key, and buses don't necessarily suit them

Group	Stakeholder	Main Points
	Otago University Students Association (Student President)	• Allowing more room for pedestrians whilst also allowing for two-way traffic movements meets the needs of the majority • Students primarily reach and move around George Street as pedestrians, with many using it as a source for employment à personal safety is a major concern, especially in the existing environment in the evening • Accessibility can be an issue for those with mobility limitations, given the existing road design and gradient, creating a barrier to access George Street • Other active mode movements are used through the space, including e-scooters and skateboards • The space needs to be more inclusive and open, including beautification, green spaces, and outdoor seating • IBC – preference for pedestrian only and one-way. Option 4 looks like a good balance and will work for everyone
Hospitality/Private Entities	Hospitality Association NZ Regional Manager	• One-way would be difficult for delivery trucks and concern from members about accessibility for stock • People driving past and seeing shops and restaurants encourages more customers
	New Zealand Automobile Association Incorporated (AA)	• Primary focus is ensuring that people can still get around the city and the impacts to congestion given changes in the network • Want to see changes that will make it more 'family friendly', with concerns that minimal traffic could cause negative behaviour late at night • Short term street parking still required
	Property Developers/Landlords	• Investment in city is required for long term change • Need to make retail convenient to protect trade and henceforth the wider economy • Having parking nearby provides more convenience for customers • Passing car traffic increase the likelihood of passing trade • Cycling is idealistic given the climate and e-scooters 'litter' the streets
	Urban Access Dunedin	• Access/wide space for Fire and Emergency important • Consider wider network and transport projects • 10km/h is very hard to police • Needs to link to good parking availability and attractions to come to town
Public Sector	BusGoDunedin (Bus Users Support Group Ōtepoti Dunedin)	• Overall desire to have buses routing along George Street, either as part of a circular local route from the bus hub or routing a number of services along George Street

Group	Stakeholder	Main Points
		• Buses along George Street will provide modal choice and reduce the reliance on cars • Consider gradients – issue for accessibility e.g. to the library • Bus stops – consider senior and people with limited accessibility – smaller, circular buses along George Street would be ideal • Stacking for buses and travel time reliability would be an issue
	Fire and Emergency New Zealand (FENZ)	• Preference for two-way to provide adequate spacing for appliance (Type 6 Aerial Appliance footprint for the new appliance could be up to 6.5metres wide and around a similar length to the existing appliance of 9.5metres for fire engines) • Primary concern is ensuring positioning is possible • Need to be mindful of water run-off • Hydrant spacing needs to be considered in the design – would like further involvement with this.
Disability Groups	CCS Disability Action	• No kerbs are desirable given the existing accessibility issues for those with limited mobility • Many disabled and elderly people do not visit George Street as they do not feel safe, expense of buses, conflict with other modes (such as e-scooters), not mentally feeling welcome in the space or the lack of amenities (such as public restrooms) • Maximising space for pedestrians is preferred to minimise crossing time of vehicle lanes
	Disabled Persons Assembly (DPA)	• Need adequate mobility parking space provision and drop-off space for those that are mobility restricted • Support of wider pedestrianisation of the area and creating a design that accommodates all users • Want the retail to be more 'bespoke', with greater amenities and overall act as a more attractive area
65+ Groups	Age Concern Otago	• Need to accommodate the street for those most vulnerable, and then it will accommodate everyone • Get the basics right • Conflict noted between e-scooter movements and vulnerable users • Need to take focus away from car movements and focus on providing for pedestrian amenities, such as seating and public restroom • Advocates for a circular bus route along George Street

9.3.4 Stage Two Engagement – Optioneering

This stage followed the development of the short-list of options and was used to gather information on stakeholder option preferences and sentiments towards the initial option layouts. This was used to inform the scoring of the stakeholder acceptability criteria as part of the MCA.

The shortlist and option development process involved consolidating previous work, stakeholder feedback and discussions with DCC. In summary, the feedback received as part of Stage One (see Figure 48 above) helped inform how the options were further developed. This was an important step to ensure that those impacted by the options are able to have a say in the final outcome, thus helping to achieve stakeholder buy-in. Figure 49 summarises how key themes identified in Stage One informed design decisions.

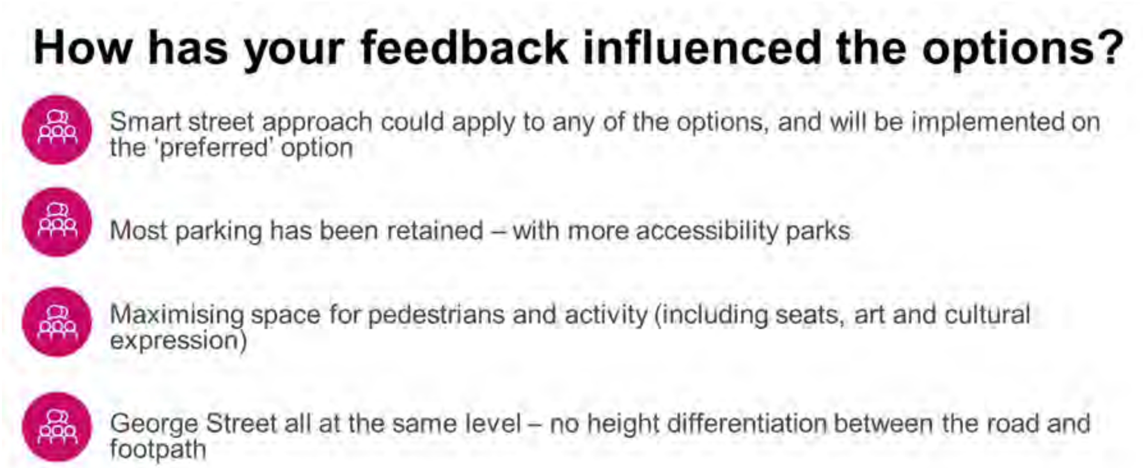


Figure 49: How stakeholder feedback influenced the design

Subsequently, the options developed for George Street were then consulted on further with stakeholders as part of this engagement stage. This occurred over two days, where stakeholders were invited to participate in workshops with the project team.

An overview of the technical assessment work was presented, and each option was discussed in detail, with opportunities provided for stakeholders have their questions answered by the project team. At the conclusion of the workshop, each stakeholder was asked to complete a questionnaire, which asked for both their opinion on each option, as well as rate each option on seven-point scale in terms of how acceptable the option was to those they represent.

Table 25 summarises the feedback received from stakeholders, which includes a combination of questionnaire feedback, and commentary recorded during the workshops.

Table 25: Stage Two Stakeholder Feedback

Group	Stakeholder	Main Points	Sentiment
Mana Whenua	Aukaha	• One-way allows greater opportunity to enhance the look and feel as a destination, and most in line with mana whenua values – creating a space embedded with manaakitanga, an opportunity for mātauraka, community events, it becomes a destination rather than a pathway • Two-way has similar benefits, however, still makes the space a vehicle domain, which may create issues for it being a 'people' space.	One-Way preference – but no specific preference between one-way options
Pasifika	Pacific Trust Otago	• Support for performance spaces for cultural exhibitions/shows. • Preference for the one-way option allows for both performance spaces, as well as space for families/groups to gather • Support for artwork with pacific themes – helps pacific people feel part of the city • Preference for one-way southbound, due to access advantages for the Pacific Community predominantly located in South Dunedin	Very pleased to be invited to consultation sessions Preference for one-way Southbound
Retailers	Independent retailer	• Considers one-way option to worsen accessibility in and out of the CBD. Two-way perceived to be better. • Pedestrians should not be encouraged to interact with traffic. Considers the level surface to be dangerous • Doesn't want to encourage loitering through provision of seating	Happy with the engagement / progress to date. Preference for two-way
	Chamber of Commerce - (CEO)	• Prefers two-way as it creates space for pedestrians and activity. An attractive space can be created whilst enabling two-way traffic. • Need to make sure there is room for short term parking	Preference for two-way
	Chamber of Commerce Retail and Tourism Sub-Committee (Chair)	• One-way offers better customer experience • Doesn't like 10km/hr speed limit • Northbound option doesn't improve flow at 5-arm intersection. Preference for Southbound option in this regard. • Considers the two-way option to preserve status quo. Still prioritises traffic.	Happy with the engagement / progress to date. Preference for One-Way Southbound
	Heart of Dunedin (Golden Centre Manager)	• Shoppers look for maximum ease of access, convenience, and direct route – one-way would be detrimental to this. • As a consumer, would visit CBD provided easy access by car • Two-way option retains access, addresses safety concerns, enhances streetscape • Concerns around enforceability of 10km/hr, and public understanding of who gives way to who	Preference for two-way
	Independent retailer	• Prefers retaining two-way flows • Considers 10km/hr to be very slow	Preference for two-way
	South Dunedin Business Association	• One-way too restrictive, less mobility/accessibility • Two-way easier accessibility for mobility and sight impaired. Easier access for all and parking more accessible for visit without having to cross the street	Preference for two-way

Group	Stakeholder	Main Points	Sentiment
Youth/ Student Organisations	Generation Zero	• One-way has the best level of safety, diversity of access, and placemaking opportunity • Dislikes retention of carparks and 5-arm intersection • Use tactile pavers to guide rather than delineate where to go, and more thought for east-west crossing of carriageway for one-way • Wants busses to be designed for, even if not provided – future proofing of design • Only likes the reduction of speed for two-way option	Preference for One-Way Southbound – may offer better access to parking / traffic flow
	Otago Polytechnic Students Association (Student President)	• One-way is a better option for both students and people visiting the city • Lights to be included on crossings built into road • Dislikes two-way option – desire for the road environment to change	Preference for One-Way Northbound
	Otago University Students Association (Student President)	• Southbound is better for students accessing by car / bike. Perceives Northbound as making less sense – feels like you are driving out of George Street, rather than into it. • Two-way not innovative, but appreciates slower speeds and some shared space	Preference for One-Way Southbound – ultimately wants pedestrianisation, but one-way is better than nothing
Hospitality/Private entities	New Zealand Automobile Association Incorporated (AA)	• Do-min perceived to function for existing traffic flows, but distracts people from George street area • One-way perceived as being too restrictive • Preference for the two-way option to be 20km/hr instead of 10km/hr. • Two-way seen to provide easy access and friendly environment	Preference for two-way, with 20km/hr speed limit
	Property Developer	• Upgrade is long overdue, and this is the front door • Dislikes both one-way options due to impediment to convenience of shoppers • Two-way maintains convenience, as most people will access by car. • Wants a result that attracts as many people to the city centre (visual amenity)	Preference for two-way
	Urban Access Dunedin	• Northbound option considered to fail to address the 5-arm intersection. Southbound considered to be the best one-way option • Considers the two-way option to be a good solution – maintains access and increases pedestrian space	Happy with the engagement / progress to date. Preference for two-way
Public Sector	BusGoDunedin (Bus Users Support Group Ōtepoti Dunedin)	• Concerned about the removal of busses • Favours two-way option due to perception that it is most likely to reintroduce busses in future	Concerned about the removal of busses Preference for two-way
	Fire and Emergency New Zealand (FENZ)	• Access to the west is important (the Hill Suburbs), so southbound one-way could be an advantage, as it frees up movement occurring at the 5-arm intersection. • Main concerns are in regard to incorporating with ThreeWaters Upgrades (e.g. fire hydrant placement), and ensuring usable width of the road, safety of traffic management, and allowing access to buildings / aerials	Preference for One-Way Southbound

Group	Stakeholder	Main Points	Sentiment
	New Zealand Police	• Difficulty policing 10km/hr – especially when more urgent response events • Favours reduction in speed and traffic volumes – reduces any cost associated to injury • Sees one-way options providing for potential growth for the retail sector • Further CPTED analysis to come at later design stages – e.g. large trees provide cover for unsociable behaviour • Two-way more difficult to navigate traffic compared to one-way for emergency response	Preference for One-Way Southbound
	Plunket	• Likes how one-way options discourage through traffic, and provides more space for activities and 'rest-spaces' for families with children • Notes a need for physical barrier between play spaces and carriageway (all options) • Two-way is perceived to be too cluttered, trying to fit in too much, resulting in a compromised outcome. Doesn't think two-way is as safe for children	One-Way preference – but no specific preference between one-way options
Disability Groups	CCS Disability Action	• One-way options have room for everyone. • Concern about cyclists/e-scooter conflicts with pedestrians. Not in favour of shared paths. • Ideally would the project to link in with MRCagney and the work has done with mobility parking • Doesn't see advantage of two-way option – prefers more room for people	Happy with the engagement / progress to date. One-Way preference – but no specific preference between one-way options
	Disabled Persons Assembly (DPA)	• Wants a central city we are proud of, could be NZ leading in inclusiveness • Great that mobility parking increased • Still need for more design detail to be worked on in next phase	Happy with the engagement / progress to date. Preference for One-Way Southbound –
65+ Groups	Age Concern Otago	• Believes George Street needs a 'shot in the arm' • No differentiation between one-way options. Appreciates reduction in vehicles, would prefer if vehicles could be removed all together • Loves when people can sit outside. Makes the city come to life. When you see people sitting outside having a good time, you feel like joining in.	Preference for One-Way Northbound
	Grey Power	• One-way options too restrictive – less accessibility • Two-way offers easy access for mobility and sight impaired	Preference for 2-way

9.3.4.1 Stakeholder Acceptability

Each stakeholder was asked to score each option on a scale from -3 (don't like) to +3 (really like). This scoring has been collated to assign one score per option as part of the MCA process.

The scoring of the 22 stakeholder groups consulted is summarised in Figure 50 with key points including:

- A strong indication that the do-minimum option is not favoured, which is reinforced by commentary from the stakeholders that shows a strong desire to upgrade George Street.
- There is no significant difference between the other three options, which is particularly evident for the one-way options (options 1 and 2). This is likely attributed to the almost identical designs for these options at this stage in the design phase, and consequently, most stakeholders were unable to see a difference, or preference, between them.
- From an acceptability point of view, Option 3 (two-way) is generally more acceptable overall. This is due to less variation in the scores, i.e. less significantly adverse scores (three compared to seven for both one-way options), and an overall more neutral-to-positive outlook.

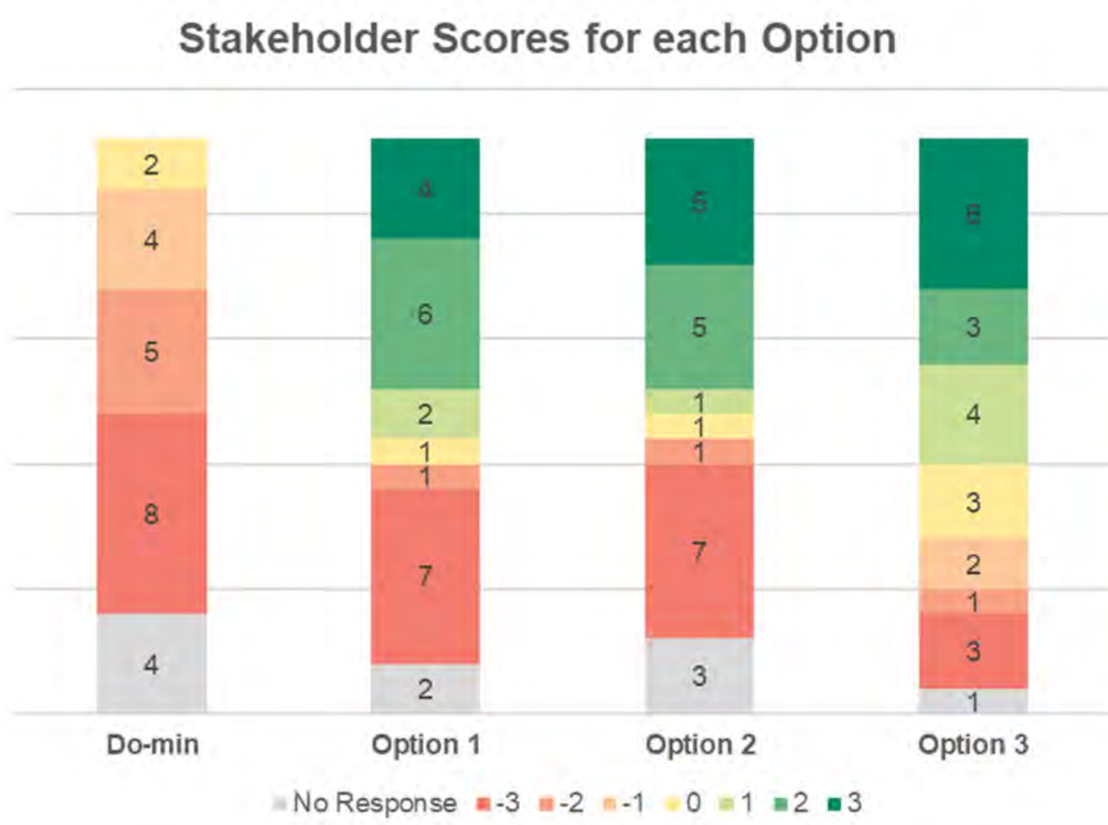


Figure 50: Breakdown of the Stakeholder Acceptability Scores for each option

9.3.5 Summary

Stakeholders have really appreciated the opportunity to be heard and part of the DBC process. The project team have worked hard to communicate transparently with stakeholders, listen to their views and incorporate them where possible.

There was generally a negative sentiment towards the project at the outset of engagement, whereas at the conclusion of the last workshops CCAG members got up and thanked the project team and conveyed genuine appreciation for the involvement they had been given.

In summary there was a strong preference to one-way by some stakeholders, particularly students, young people, Pasifika Trust, Plunket, and disability groups. Whereas the two-way was strongly supported by commercial groups (retailers), landlord/developers, Grey Power, bus user advocacy group and Urban Access Dunedin, but generally most acceptable to all. Care must be given when interpreting these results as some stakeholders are representative of thousands of people (OUSA) and some are representing themselves.

While there still remains divided opinions on whether the one-way or two-way options are best, a greater level of appreciation for all the options has been gained, alongside a greater willingness to accept a compromise as the options have become more similar through design evolution.

Notably, there are still areas where full alignment has not been possible with certain groups. The primary one is the desire to retain buses along George Street. However, as discussed above, this is not possible as it will compromise place outcomes along the street, and it should be reinforced that routing along Great King does not significantly encumber public transport access to George Street (see Appendix B.

10.0 Risk and uncertainty

This section briefly describes key economic, social, environmental, transport, stakeholder and other issues and constraints which could influence the scope of the project outcomes and outputs.

10.1 Uncertainty log

Table 26 below outlines the known issues and constraints identified to date. Issues are the uncertainties / risks that may not be resolved during the development of the business case, whilst constraints are the limiting factors such as time, cost, resources etc. The table below aims to identify and address possible risk and show the need to closely monitor and manage. These will be developed throughout the duration of business case.

Table 26: Issues and Constraints

	Factor	Timing	Probability	Impact	Comments
Issues	Degree of travel demand due to Covid-19 impacts	Ongoing	Likely	Moderate	Impacts trip demand profile for trips to the central city and an increase in working from home flexibility has the potential to alter the number of people in George St.
	Impact of hospital relocation to people visiting the Retail Quarter.	2025 - 2028	Highly likely	Minor	Hospital is planned for, but not consented. It is not included within the Base or Future models. Could have large impacts on travel patterns in 2028 and 2038
	Impact of SFDT PBC	Ongoing	Likely	Moderate	There is alignment between George Street work and the SFDT project outcomes. The SFDT projects are likely to significantly impact how people choose to move in/out and around the Retail Quarter. Notably, the recent Dunedin Transport Model was validated against 2017 volumes. This could mean traffic volumes were underestimated.
	Pushback from local business	Ongoing	Possible	Moderate	The Retail Quarter upgrades is a highly contentious project with many groups sharing polarising views on what is best for the central city. There is ongoing potential for issues to arise with the retail community who are generally averse to any changes that may be perceived to impact business. This issue is being mitigated through ongoing engagement with CCAG to ensure their concerns are being heard and addressed.
Constraints	Policy (or lack of) and management of temporary street closures / flexible street arrangements	Future	Likely	High	The aim and the success of the 'smart street' is to accommodate flexible arrangements for the use of George Street. As this is a relatively new concept, change in policy and mechanisms surrounding the management of the street will need to be addressed by DCC in order to fully operate a 'smart street'.
	Three Waters design restrictions	Impleme ntation	Highly likely	Moderate	Detailed design underway for Three Water upgrades, meaning designs for George Street corridor upgrades are restricted within those parameters to a certain degree. For example, the use of certain adjustable bollards may not be possible where the pipes are shallowly located below the road corridor, requiring innovative approaches if design is to include flexible street arrangements.
	Tight, restrictive timeframes for enabling works, and the consequent timeline of upgrades on George St need to align.	2021-2022	Highly likely	Significant	Timelines are relatively restricted to aligning with the enabling works timeframes, which will be commencing soon and has intentions of being completed by end of December. The desire is to be able to maintain engagement of the Contractors following this work, by seamlessly transitioning into the works along George Street by February. However, this is dependent on timings running according to plan, which includes the development and approval of this DBC.
	Vehicle access along George Street	Impleme ntation	Highly likely	Moderate	There is a need to maintain some vehicle access along George Street to provide access to properties and businesses. The nature of the Retail Quarter also means there is an existing and future need for courier and servicing vehicles supplying stock to businesses. In addition, provision for those with mobility issues, and any residential or motel occupants also require access options.

11.0 Preferred option

There is no one option for this project that has clearly emerged as a better investment than another option.

It is important to acknowledge that the options for this project are very similar. We are not comparing a road widening with a tunnel or a bridge, which clearly would have significant different outcomes, costs, levels of difficulty and risk. The main differences between the project options are the width of the carriageway, the directional flow of the traffic (one-way vs two-way) and the space available to embed culture and art, amenity and street vibrancy to encourage more people to visit George Street.

The keys things that have been taken into consideration in coming to this conclusion are:

- How well will the option meet the investment objectives?
- How easy will it be to implement?
- An assessment of the effects of environmental factors (listed in the MCA)
- An assessment of the benefits and costs
- A technical assessment of the transport impacts
- Preferences of key stakeholders
- An assessment of risk and uncertainty.

Table 27 summarises the option preferences for each area of assessment and highlights the difficulty in reaching a preferred option.

Table 27: MCA Options assessment summary

	Option preference and rationale
Performance against investment objectives	One-way Southbound is the preferred against the IOs as slightly higher safety outcomes because a signal phase at the 5-arm intersection can be removed.
Performance against Ability to Implement	One-way Northbound scores best in terms of the Ability to Implement criteria (very marginally) due to a slightly better BCR.
Performance against Assessment of effects	Both one-way options are equally preferred due their increased ability to accommodate accessibility, mana whenua values, arts, culture, and amenity.
BCR	The cost of the one-way options is identical, and the two-way option is $1 million less. The key monetised benefits come from the health and environmental benefits from more people walking along George Street. The one-way northbound option generates the highest BCR due to the travel time benefits.
Transport assessment	From a transport perspective all options work and there are only very marginal differences between options. The one-way Southbound option is slightly advantageous in terms of being able to improve the 5-arm intersection, the one-way northbound has the least impact on travel time
Preference of stakeholders	There was a strong preference to one-way by some stakeholders, particularly students, young people, Pasifika Trust, Plunket, and disability groups. Whereas the two-way was strongly supported by commercial groups (retailers), landlord/developers, Grey Power, bus user advocacy group and Urban Access Dunedin, but generally most acceptable to all.
Risk and uncertainty	All options have a similar level of risk.

Essentially the assessments undertaken through the business case process reveal that there is no one option that is a resoundingly better investment that another. For this reason, due to the highly political nature of this project and the risks associated with that, the directive to the project team by DCC staff is that for the decision of a preferred option to be made by DCC Councillors.

Once a preferred option has been selected, further assessment using the Valuing Urban Realm Tool may be used to understand the value of the urban realm benefit. Additionally, an assessment against the Waka Kotahi Investment Prioritisation Method (IPM) may be undertaken to progress an application for funding of the transport components of this project with Waka Kotahi.

Part C

12.0 Commercial Case - Preparing for the potential deal

The purpose of the Commercial Case is to describe the planned procurement approach for the delivery of the preferred option. For this project however, (and as outlined below and in the IBC), the procurement for the design and delivery of this project was completed prior to the development of this business case.

12.1 Procurement

Due to the scale of this project (between $20M and $100M), DCC Procurement staff used a selection of matrix tools to determine the preferred delivery model to procure the project design and delivery. This was undertaken in early 2019, and considered 10 project factors including scale, complexity, scope for innovation, market conditions, and risk.

Based on this assessment an Early Contractor Involvement (ECI) contract was recommended as the preferred delivery model for the Retail Quarter (George Street) Upgrade. This model allows the implementation phase to proceed, without the significant investment in DCC's resources required to administer alternative contractual models. The principle objective for selection of this delivery model by the DCC is to have the contractor involved early in the project development, so they can influence and take ownership of the project design, with a view to achieving greater cost effectiveness and cost certainty in construction as well as expediting overall delivery.

The ECI contract will deliver value for DCC by:

- Working in a co-operative environment and embracing a partnering philosophy with the contractor - using shared skills and experience to deliver the optimal solution that meets project objectives including community expectations.
- Continuing to challenge assumptions and constraints and proactively champion innovation through investigations, design, and consultation
- Developing a complete understanding of services/utilities affected by the work in order to develop and implement a strategy for their optimum relocation/protection best suited to the long-term interests of the project.

Procurement for professional services and construction was tendered on the open market through a competitive, single stage process for preliminary design. The procurement method provides the DCC with options to award subsequent detail design and construction phases without re-tendering.

The Ō3 Collective, consisting primarily of Isaac Construction, AECOM and Jasmax was awarded the contract in July 2019. The key roles of the Ō3 Collective are:

- Infrastructure investigation and renewal/upgrade planning for road network, Three-Waters and third-party utility operators
- Investigation, consultation, and design of streetscape upgrade
- Staged design development (concept through to detailed design) for infrastructure renewals/upgrade and streetscape upgrade
- Physical works management and completion.

In addition to the ECI contract, the DCC have awarded several other contracts to support the work being undertaken by Ō3, including:

- Development of the IBC to support DCC to obtain the Waka Kotahi funding for transport related components of the project (completed by Stantec)
- Quantity surveying services to ensure estimated costs are accurate and provide value for money to the DCC (issued to Rawlinson's)
- Representatives of Mana Whenua have been involved in the project process to provide guidance and input into the design (issued to Aukaha)

- Development of a DBC support DCC to obtain the Waka Kotahi funding for transport related components of the project (issued to AECOM)
- Peer review services of the DBCs and Three-Waters design (issued to MRCagney and Jacobs)
- Engineer to Contract and Engineers Representative (issued to OCTA)
- Project Management Services (initially issued to external providers Bonisch and RCP, but now managed internally via dedicated DCC staff resource).

Additional contracts are still planned to be issued for safety audit, activations, and other technical expertise.

12.2 Potential for risk sharing

Key procurement risks have been identified, evaluated, and recorded in the risk register. A copy of the risk register can be found in Appendix F.

At the time of writing this DBC the risk register is in the process of being finalised with DCC and Ō3. Risks will then be priced using a P50/P85 value and assigned to each party. Determining who owns which risks will be part of the price negotiation. This will be completed prior to starting work but not at this stage.

12.3 Contractual and other Issues

Specific reporting requirements for management of the contract during construction will be developed as part of the DCC' requirements for the project.

Payment will be based on the supplier's successful completion of milestones as detailed in the contract.

New intellectual property arising as a result of the contract will belong jointly to the Ō3 and DCC.

12.3.1 Indicative timeframes

The indicative timeframes for delivery are:

- Enabling works Detailed design delivered November 2021
- Enabling works construction to start October 2021 – beginning with service investigations prior to completing the design
- Developed design George St – January 2022
- Detailed design George St – May 2022
- Enabling works construction complete – May 2022
- George St construction works start – May 2022
- George St construction complete – November 2023

Timeframes are discussed further in Section 14.2.

13.0 Financial Case - Affordability and funding requirements

This section outlines the financial case for the Retail Quarter George Street upgrades. This financial case provides oversight on the affordability of the project and possible funding arrangements.

The financial case would usually consider the affordability of the preferred option, however as identified in earlier sections of the business case, a preferred option has yet to be confirmed. To manage the significant political risk associated with this project, selection of the preferred option for delivery will be made by DCC Councillors in September 2021

A key reason a clear preferred option is not emerging is largely due to the very similar costs, benefits, and ability of each option to deliver on the investment objectives. Therefore, whilst the financial case would normally consider the affordability of the preferred option, there is fundamentally very little difference between options and hence when considering the affordability and funding arrangements the same would apply regardless of the option ultimately selected.

A detailed assessment of the Three-Waters portion of the project has been excluded from this financial case. This is due to the replacement of the Three-Waters component of the project being committed in the Long Term Plan (LTP), including the cost of the street reinstatement. Therefore, the purpose of this financial case focuses on the changes to the streetscape and surface infrastructure beyond the do minimum.

13.1 The financial costing model

13.1.1 Project delivery costs

Project delivery costs estimated for this DBC are based on a scheme design which has been informed by an initial geotechnical investigation, topographical survey, and Three-Waters considerations. A summary of the expected costs for project delivery are provided in Table 28 .

Table 28: Project delivery cost estimates – Retail Quarter (including enabling works)

Description		Base estimate One way options	Base estimate Two way options
Design and project documentation costs including consultancy fees		$6.2M	
Three-Waters construction costs	Enabling works	$14.2M	
	George Street	$10.2M	
Transport and amenity construction costs	Enabling works	$5.4M	
	George Street	$19M	$18M
	Total estimated costs	$54 - $55 million	

The base cost estimates are approximately P50 estimates and include some level of contingency.

Contingency is calculated according to the project risks as assessed using the Waka Kotahi minimum z44 standard and chapter 9 of SM014 manual. As discussed in section 14.5 the risk register has yet to be priced and assigned.

In comparison to the project cost estimate of $62.44M[28] (high value) presented in the financial case of the IBC, early indications and understanding of costs through the DBC suggest a savings of approximately $2M from these early estimates.

[28] Table 22-2 from the IBC

13.1.2 Project estimate items

Cost estimates were developed through:

- Costing exercise by each activity identified in the option
- On-site observations
- Pricing schedules from previous projects of a similar type
- Parallel estimates.

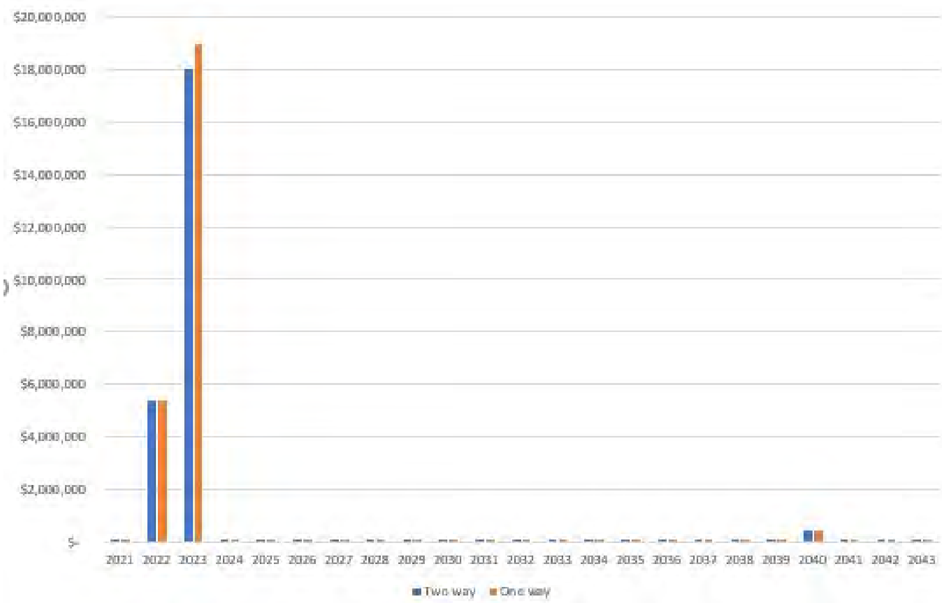
Table 29: Basic outline of cost components

Cost source	Activity description
Project development	• Consultancy fee's • Managed costs
Pre-implementation	• Consultancy fee's – Detailed design • Managed costs
Preliminary and general	• Materials/ formation testing allowance • Temporary works • Services risk • Access during works (public and contractor) • Environmental compliance • Contractors preliminary and general (P&G) • Temporary traffic management
Physical works	• Site clearance • Pavements and surfacing • Traffic signs and road markings • Street furniture • Drainage and service ducts • Lighting • Landscaping • Earthworks
Implementation fees	• Consultant fees – procurement / MSQA

13.1.3 Cashflow

The anticipated cashflow for the Retail Quarter upgrade (excluding Three-Waters) is shown in Figure 51.

Figure 51: Anticipated cashflow for the Retail Quarter upgrade (excluding Three-Waters)



13.1.4 On-going maintenance and operations costs

The proposed works on George Street will result in a change to the use of the road assets and therefore a corresponding change to the operation and ongoing maintenance. George Street will have significantly less traffic after construction, and this will result in less deterioration in the pavement condition. The rebalancing of space allocation to all modes, also means there will be a smaller vehicular area requiring regular maintenance. It is therefore anticipated there will be a reduced need for future pavement renewals or rehabs. This will lead to a significant savings in maintenance cost over the next 40-year period.

The dispersion of traffic to several alternate routes is likely to have a very marginal impact on their respective maintenance and renewal programmes and costs.

There is no material difference in maintenance cost estimates between the one way and two way options.

Table 30 provides a summary of the anticipated maintenance costs for the George Street upgrade.

Table 30: Annual maintenance costs for one or two way options

Item	Annual Cost	Notes
Trafficked Pavement Maintenance	$ 1,672	
Routine Drainage Maintenance	$ 1,230	
Traffic services maintenance	$ 1,094	
Environmental maintenance	$ 1,694	Additional plant care
Footpath Maintenance	$ 1,301	Pressure washing
Total Annual	**$ 6,990**	
1 x Carriageway AC resurfacing in 2040	$ 415,230	
	$ 527,085	
Total (40 years) NPV maintenance costs	**$942,315**	

The Three-Waters component of the project will have ongoing maintenance and operation costs. Comparatively the long-term (40 years) maintenance and operation of the Three-Waters infrastructure to be replaced along George Street will be significantly less than the surface infrastructure. Regular inspections and maintenance under a lump-sum network contract rather than itemised maintenance is anticipated.

It is anticipated that with the renewal of the Three-Waters infrastructure and surface upgrades in the enabling works area there is likely to be some overall reduction in maintenance cost. The difference however is likely to be relatively small so for the purpose of this analysis maintenance cost estimates for the enabling works area has remained the same.

13.1.5 Cost assumptions

The following high-level assumptions relating to the project cost estimates have been made:

- Estimates quoted are in New Zealand Dollars
- Estimates based on Waka Kotahi's SM014 Cost Estimation Manual
- Cost estimate base date is July 2021
- Three-Waters costings based on preliminary design estimates
- Excludes cost to relocate utilities
- Costs based on existing construction programme timings
- Maintenance cost rates were sourced from DCC network contract rates
- Past relevant project cost estimates have been referenced
- Cross checking has been undertaken with the Waka Kotahi Elemental cost database
- Maintenance and operation items have been escalated at 3% per year for 40-years. This is consistent with the approach for the economic analysis, that in addition has been stated as a net present value.
- Three-waters upgrade costs are treated as sunk costs as part of the do minimum, and the costs referenced refer to the recommended George Street transport upgrades.

13.2 Project revenues

No revenue streams have been identified from the operation of the recommended project. Therefore, no detailed analysis for project revenues has been undertaken.

The impact of parking revenue will be analysed during the detailed design phase.

13.3 Funding sources

This project is scheduled to continue to progress through the pre-implementation phase and implementation is due to commence in October. The Three-Waters infrastructure is committed for funding by DCC, including the cost of the street reinstatement as stated earlier.

13.3.1 Waka Kotahi

Whilst DCC has funding approved to progress to the next phase, there is opportunity for co-investment with Waka Kotahi through the National Land Transport Fund (NLTF). As a key potential funding partner DCC and the project team have engaged with Waka Kotahi throughout the life of this project. There has been a high level of collaboration and transparency of information to make sure the project has the best opportunity of meeting Waka Kotahi funding guidance and criteria.

The Waka Kotahi funding assistance rate (FAR) for qualifying activities for DCC is set at 51% for the next 2021/24 NLTP. Waka Kotahi are guided by the GPS for Land Transport and their priorities for investment as informed by the IPM for funding from the 2021/2024 NLTP. Improving safety outcomes across the network, providing better travel options including supporting town centre upgrades to enhance the environment are key priorities that Waka Kotahi invest in[29]. From a transport perspective the primary benefits arising from this project are the health benefits arising from increased pedestrians on George Street.

Following an IQA of the IBC by Waka Kotahi this project was approved to progress to the DBC phase and signalled as a local road improvements activity (due to the endorsed safety opportunity) for future inclusion in the NLTP. As outlined in in Section 3.4.2 the IQA requested further assessment and understanding of several key points, notably better analysis of costs and benefits from a transport perspective, solid justification of the transport/amenity cost split and calculation of a more accurate BCR using transport modelling outputs.

As outlined in Section 4.5.1, whilst safety issues and near misses involving pedestrians have been observed at both the five-arm intersection and mid-block crossings along George Street, analysis of the latest data through this DBC suggests that the evidence of a safety problem (previously identified in the IBC) may no longer exist. However, it is also important to note that this data only covers two years (one of which was impacted by Covid-19 lockdowns), which does not create a statistically robust dataset.

Both the one way and two way options include safety improvements through the reduction of midblock crossing distances, significant speed reduction and the implementation of a shared space environment, however minimal safety improvements are able to be achieved at the five-arm intersection due the unique intersection layout. Basic pedestrian prioritisation initiatives to improve safety in the current vehicle-focused Retail Quarter environment alone are unlikely to deliver comprehensive safety improvements for vulnerable road users in the desired multi-modal future environment of George Street.

Investment in a slow speed shared space with huge amenity uplift generates significant health benefits from new pedestrians walking and moving through an attractive upgraded George Street as well as improved safety outcomes. With the primary benefit identified as health benefits from active modes this activity now this project has a better fit as a walking and cycling improvement activity rather than local roads improvements, and co-investment by Waka Kotahi should continue to be pursued.

A key consideration for this DBC is how to manage the funding contribution between DCC and Waka Kotahi. Whilst Waka Kotahi have a renewed focus on integrating land use and transport decisions to provide high-quality transport choices and liveable cities; their IPM and MBCM frameworks do not lend well to assessing projects with a high amenity element to them such as this project.

Due to the large urban design component of this project Waka Kotahi had requested a ‘transport only’ option be considered. The transport improvements cost component of this project was estimated at $11.5m and alternative BCRs were developed (maintaining the same benefits). It is not appropriate however to claim all the health benefits of the additional place making elements against the reduced cost that eliminated those investment components and would therefore be likely to reduce the number people attracted to walking in the area. The range of BCRs for both full cost and transport only cost have been circulated and discussed with Waka Kotahi. A call was also held with key members of their advisory team to ensure they were happy with the methodology used in our assessments. The methodology and assumptions were confirmed as being acceptable for this project.

Conservatively it is anticipated that a 5% to 10% change in mode shift will occur through new users being attracted to high amenity, and ease of travel given to pedestrians along the upgraded 800m length of George Street. Consequently, based on the GPS alignment and IPM this project would have strategic priority of high to very high as outlined in Table 31.

Table 31: GPS alignment assessment for the IPM

GPS Strategic Priority	Benefit	High	Very High
Better Travel Options and Climate Change (Greenhouse Gas emissions)	Impact on mode choice	The George Street project is forecast to exceed 3% and up to 10% change in share of private passenger vehicle-based trips to other modes from nearby suburbs. The greatest mode shift will be to walking based on the suburb’s proximity to the central city, and likelihood of travelling George Street.	

[29] https://www.nzta.govt.nz/assets/planning-and-investment/docs/waka-kotahi-investment-proposal-2021-31.pdf

13.3.2 Funding risk

There is a risk that this project will not receive funding support from Waka Kotahi.

Once a preferred option is selected by Council, the DBC will outline the case for investment to Waka Kotahi and demonstrate to the degree that this project meets their funding criteria. This project will then need to be assessed in relation to other funding applications and priorities. It is worth noting that the NLTF is a limited resource to fund all transport projects and is already over-subscribed for the next three year period. The exceptional circumstances brought about by COVID 19 have also placed additional pressure on this funding source.

14.0 Management Case: Planning for successful delivery

The Management Case confirms that the proposal is achievable and details the arrangements needed to both ensure successful delivery and to manage project risks, while maintaining a focus on delivery of benefits.

14.1 Project management planning

14.1.1 Programme management arrangements

The proposed investment project is an integral part of the Dunedin Central City Plan. This plan is designed to guide the development of the central city area for the next 10-15 years. It establishes a vision for the central city and an integrated series of initiatives and changes designed to work towards this vision. It comprises a portfolio of projects for the benefit of the city to improve:

- infrastructure and transport efficiencies
- agglomeration benefits related to the concentration of economic activity
- a strengthened sense of community and identity
- creating an environment that can attract visitors, students, new residents, and investment in an increasingly competitive and globalised world.

Revitalising the city centre will in turn have a positive effect for the wider city of Dunedin, with flow-on effects for all of Otago.

The Dunedin City Centre – Access Mobility and Safety programme business case was supported under delegation on the 27 November 2015. The support of this PBC preceded the funding approval for the George Street Retail Quarter IBC. It was noted at the time that the support did not extend to funding approval for the following phases of the business cases which were subsequently assessed separately.

If this investment proposal receives formal approval then this DBC will transition to pre-implementation, and construction.

14.1.2 Project governance

This DBC falls under a wider scope of the CCP scheme, of which is organised through a Programme Governance Framework within DCC.

The project governance structure consists of two key groups, the Programme Change Control Group (PCCG), and the Project Control Group (PCG). The responsibility and membership of each of these groups is described below:

- PCCG – The PCCG consists of senior DCC executive leadership team members, managers and the Senior User Group. The PCCG meets monthly to make strategic decisions on scope, consultation, funding, and programme. The PCCG provides the project team with a conduit for strategic input and guidance from the highest executive level of DCC, reducing the risk of project delay and ensuring alignment of the project scope with the leadership vision of DCC.
- PCG - The purpose of the PCG is to provide leadership and direction to the project team and ensure successful delivery of the project. The PCG also meets monthly and reviews and monitors scope, programme, budget, and risk. The PCG consists of senior staff members from DCC Service Groups including Water and Waste, Transport, Community and Planning and Communications.

The governance arrangements for the CCP have been developed by DCC in accordance with the following design principles:

- A single line of accountability is always maintained (advice can be taken but accountability cannot be delegated/diluted)
- Programme decision making is performed by (and is the responsibility of) named roles not groups
- Programme decision making is separate and distinct from Programme Stakeholder Engagement
- Financial delegations apply as per the DCC's delegation policy.

14.1.3 Project roles and responsibilities

Figure 52 below shows the organisation chart with key responsibilities for the delivery of this project.

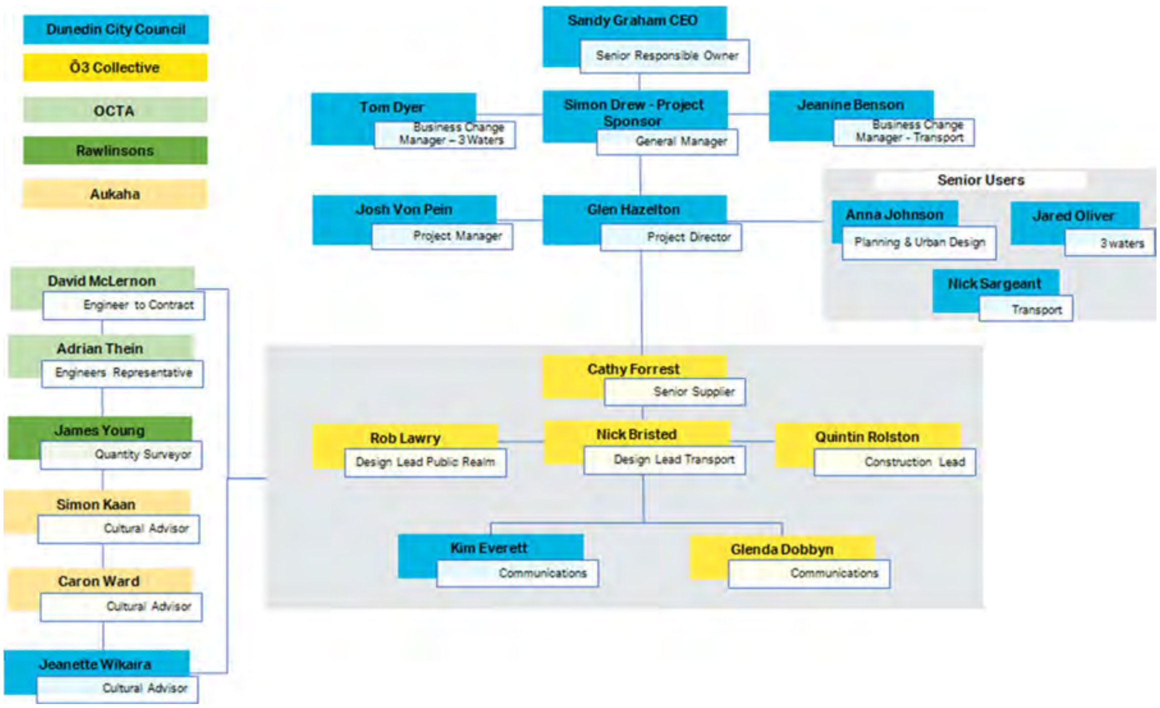


Figure 52: Project organisation chart

The key roles are broadly described below:

- The **Senior Responsible Owner** is the Chief Executive (CEO). The CEO is accountable for the Programme, to ensure it meets its objectives and realises the expected benefits.
- The **Programme Manager** is responsible for leading and managing the Programme from identification through to closure.
- **The General Manager (GM) Infrastructure and Development** is ultimately accountable for the successful delivery of the project and to achieve the project objectives.
- **The Business Change Manager (BCM)** is responsible to manage the operational assets and realising the resultant benefits. As the programme is delivering projects that will generate operational assets across different parts of the organisation, there will be one BCM for each of the three main areas of the project e.g., Transport, 3 Waters, and City Development (Planning and Urban Design).
- **The Programme Management services** provides support and guidance to the projects and internal assurance of the Programme.
- **The Project Director** is responsible for the project's success and is the key decision maker. The Project Director's prime responsibility is to ensure that the project produces the required outputs within the specified tolerances of time, cost, quality, scope, risk, and benefits. The Project Director is also responsible for the project producing a result capable of achieving the benefits identified in the business case.
- **The Senior Suppliers** represents the interests of those designing, developing, facilitating, procuring, and implementing the project's outputs. This role is accountable for the quality of the outputs delivered by the Supplier(s) and is responsible for the technical integrity of the project. If necessary, more than one person may be required to represent the suppliers.

- **The Senior User** is responsible for specifying the needs of those who will use the project's outputs, for user liaison with the project management team, and for monitoring the solution to meet those needs within the constraints of the business case in terms of quality, functionality and ease of use.
- **The Supplier Assurance** role is focused on ensuring key decisions affecting the suppliers are well-informed.
- **The User Assurance** role is focused on ensuring key decisions affecting the Users are well-informed and a particular focus has been placed in this project on ensuring the opportunities for mana whenua participation are considered in the project.
- **A Project Team** has been established to support the design and delivery of this project. The Project Team is made up of the DCC Project Director, Senior Users, User Assurance, and Communications staff. External members of the team include Aukaha, the Quantity Surveyor and Ō3 team members. OCTA are providing the Engineer to Contract and Engineer's Representative functions. The Ō3 Consortium will carry out the scope of work with the DCC representatives providing review and approval of deliverables.

14.1.4 Stakeholder management

Stakeholder management is guided by the Retail Quarter upgrade – Communication and Engagement Strategy, which outlines the engagement's scope, objectives, and frameworks of the Retail Quarter project. The strategy is a living document. It enables a flexible approach and the ability to respond to social changes and new and emerging issues while upholding DCC Significance and Engagement Policy and its overarching values.

A hierarchy of stakeholders for external engagement has been established in the strategy:

- CCAG stakeholders (always first as an external stakeholder)
- Directly affected parties: Business owners, landlords, residents, real estate agents and property managers
- Commuters and travellers/visitors through the area
- Media
- Wider public

14.1.5 Central City Advisory Group

A revised CCAG was established in 2020 to feed into a range of matters related to the Retail Quarter upgrade, including review of the IBC findings, peer review by Urbanism+, preliminary design and the DBC process. The terms of reference for the CCAG is "to provide a forum for inclusive engagement, to advise and feedback on the ongoing detailed design of the George Street part of the CCP."

The group is chaired by the Mayor, with membership of the group consisting of the following representatives:

- Chair or Deputy Chair of the Planning and Environment Committee
- Chair or Deputy Chair of the Infrastructure Services and Networks Committee
- Chair or Deputy Chair of Economic Development Committee
- Aukaha
- Pacific Trust Otago
- Araiteuru arae Council
- Generation Zero
  New Zealand Automobile Association Incorporated
- Urban Access Dunedin
- Otago Polytechnic Students Association

- Otago University Students Association
- Dunedin Youth Council
- Heart of Dunedin
- Central Dunedin Business Group
- Hospitality Association Dunedin Branch
- Chamber of Commerce Retail Subcommittee
- Chamber of Commerce Chair
- Property Developers
- Fire Emergency New Zealand
- NZ Police
- Disabled Persons Assembly
- CCS Disability Action
- Age Concern Otago
- Grey Power Otago Inc
- BusGoDunedin (Bus Users Support Group Ōtepoti Dunedin)

The CCAG group members have been engaged as part of the DBC development processes at two stages. Firstly, members of the group were updated on the options being considered as part of the DBC process and their initial feedback on each was sought in a series of small group meetings in June 2021.

An engagement strategy has been developed to address the two phases of the project being the enabling works, and the full George Street project. The boundaries of the two stages are shown in Figure 53.

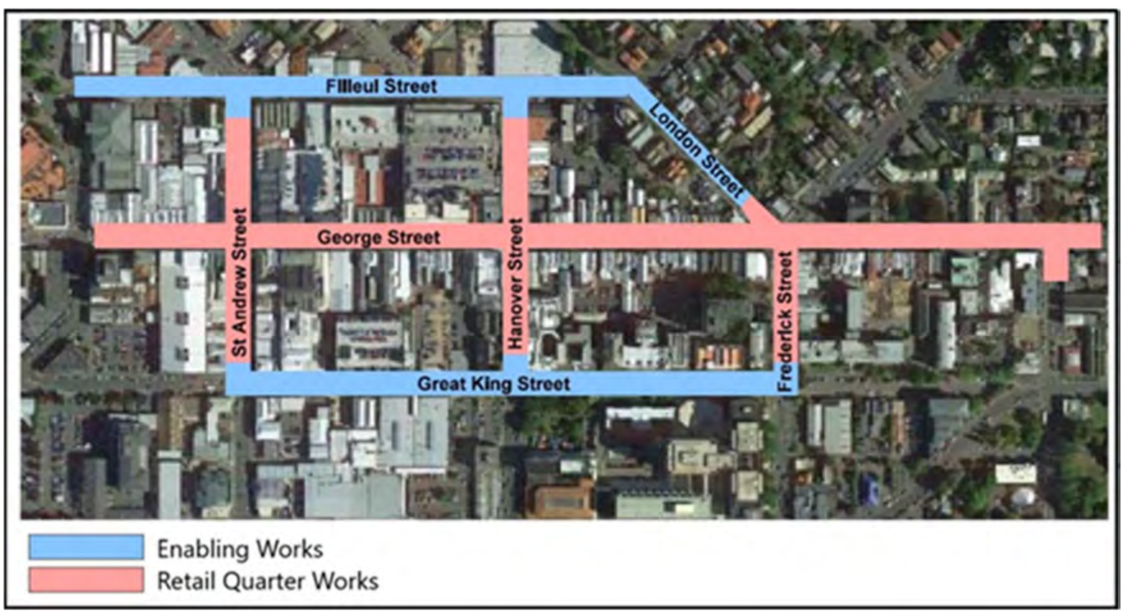


Figure 53: Enabling and Retail Quarter works boundaries

14.2 Project plan and timing

The project is planned to run over three phases and is estimated to take approximately three years. A more detailed summary of the project plan is included as Appendix H.

The project delivery will be phased with the commencement of the enabling works package followed by the intersections and then the mid blocks on George Street. Developed and detailed design for the enabling works and Three-Waters is underway with construction due to start in October 2022. The completion of the George Street upgrade aims to be completed by early 2024.

The indicative timing of each phase is outlined in Table 32.

Table 32: Construction timing of the Retail Quarter upgrade

Construction Phase	Streets	Week Starting	Completion Week
Enabling Works	Developed design and detailed design for enabling works	June, July, August 2021	27 August 2021
	Filleul Street	04 October 2021	21 March 2022
	Great King Street		
Three Waters	Great King St (3 Crews)	04 October 2021	21 March 2022
	Filleul Street (3 Crews)	04 October 2021	21 March 2022
Phase 1 – Main Retail Quarter	Albany Street	07 February 2022	11 April 2022
	Frederick Street	11 April 2022	13 June 2022
	Hanover Street	13 June 2022	08 August 2022
	St Andrews Street	08 August 2022	03 October 2022
	Moray Place	03 October 2022	05 December 2022
Phase 2 – Main Retail Quarter	Knox Block	13 June 2022	24 October 2022
	New Edinburgh Way	24 October 2022	27 March 2023
	Golden Centre	27 March 2023	07 August 2023
	Farmers Block	07 August 2023	Early 2024

14.3 Change management

The strategy, framework, and plan for dealing with change and associated contract management is included in the Ō3 ECI contract, and provides for the following:

- Change of key personnel is to be agreed with the DCC project director
- New project staff, both for the Ō3 consortia and internal DCC staff assigned to be the project will be required to undertake training for onboarding to cover the health and safety plan, document management and record keeping.

14.4 Benefits management planning

In addition to the benefits mapping completed as part of the ILM, mapping back to the strategic and project benefits has also been completed as shown in Figure 54 and Table 33.

This project proposes to manage benefits in accordance with Better Business Case guidance but also draws on the Waka Kotahi Non-Monetised Benefits and Costs Manual which provides guidance in respect to defining and measuring the land transport benefits. These measures can be both quantitative and qualitative in nature. Assessing the delivery of benefits against the project is important for the evidence based decision making to monitor the delivery of the forecasted benefits against the project.

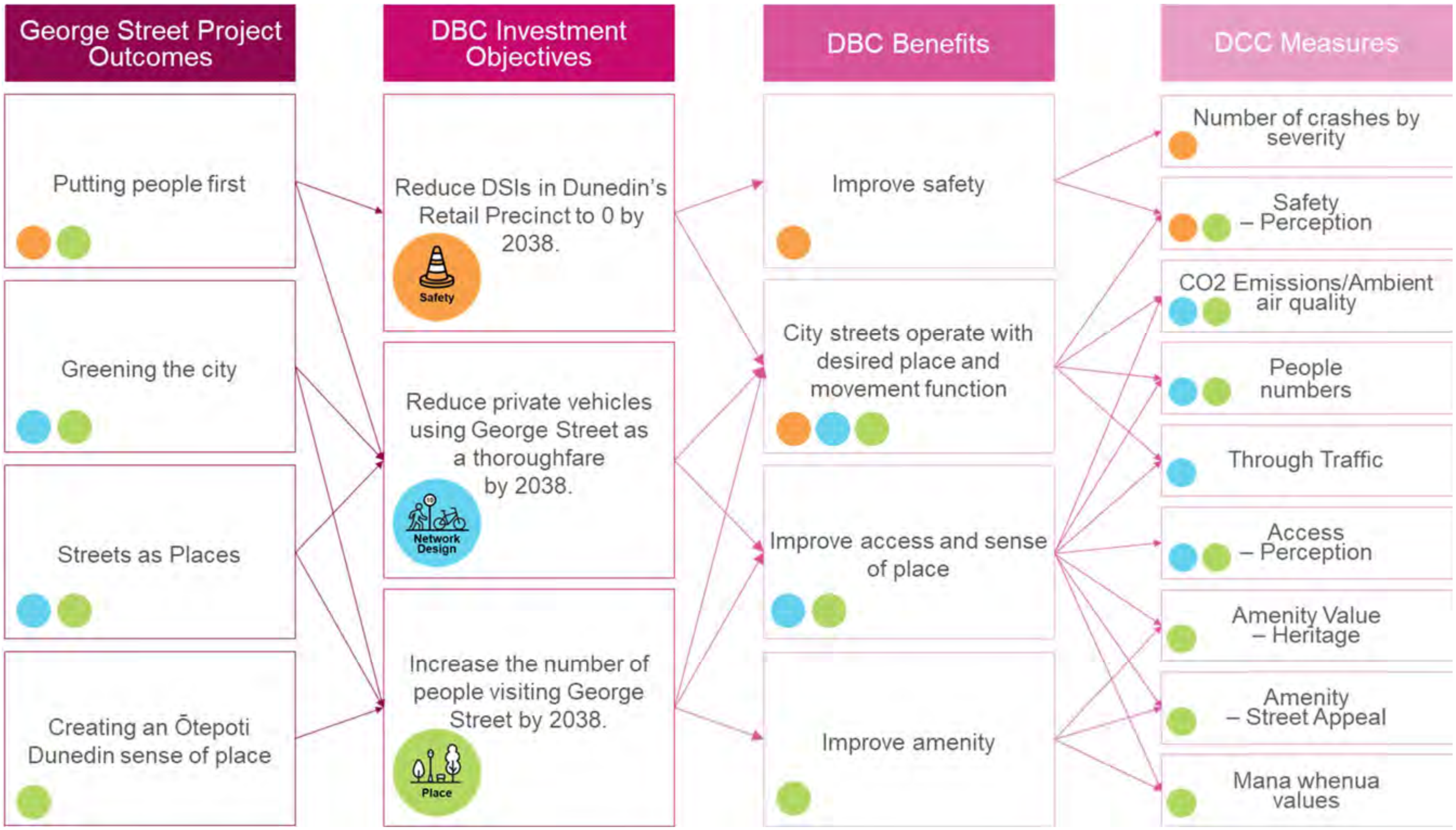


Figure 54: Benefit mapping to project outcomes and investment objectives

Table 33: Benefits realisation monitoring

Project objectives	Benefit	Measure	Monitoring
Creating a healthy central city	Improve safety	Number of crashes by severity	CAS analysis no less than 3-years after project completion. This is important for having a sufficient number of years data to evaluate the changes to safety.
		Number of DSIs	
		Safety - Perception	Survey one year post implementation and on-going feedback from CCAG user groups.
	Air quality	CO2 emissions Ambient air quality	GHG assessment based on changes to AADT at least one year after project completion. Traffic count on George Street one year post implementation.
	Water quality	Water Quality	Water quality assessment and reporting after at least one year after project completion.
Create a vibrant and distinctive city	City streets operate with desired place and movement function	Through traffic	Traffic tube counts on George Street for a minimum of three years after project completion.
	Improve access and sense of place	Access – Perception	Resident survey as part of the update of the transport activity management plan.
Boost Dunedin' s economy by protecting and enhancing the Retail core		People numbers	Installation of Pedestrian (and cyclist) counts on George Street for a minimum of 3-years after project completion.
	Improve amenity	Amenity value - Heritage	Resident and visitor perception survey.
Enhance the visibility of mana whenua		Amenity Value – Street appeal	Resident and visitor perception survey.
		Te Ao Māori/ mana whenua values	Hui with iwi to gather their views on the impact.

14.5 Risk Management Planning

The framework and plan for dealing with the management of risk are as follows:

- Maintenance and updating of an active risk register through the life of the project. This will track the management and avoidance of risk through the project lifecycle to completion
- Update of the risk register will be made through the design phase and based on the outcomes of the Safety in Design workshops. The most recent safety in design workshop was held on the 10th August 2021 and considers the safety risks of the design, and the construction works.

- The risk register will include a separate record for the tracking and realisation of opportunities alongside risks.

The detailed risk register is attached as Appendix F.

14.5.1 Risk register

The register lists all risks identified through this DBC and through the earlier IBC. The risk register includes the results of the risk analysis and evaluation. Information on the status of the risk is also included. The risk register will be regularly and frequently updated and reviewed throughout the course of the project. The top risks and top opportunities are highlighted below in Table 34 and Table 35.

Table 34: Top risks

Risk	Consequence
Unknown ground conditions	Unknown poor ground conditions will require costly remediation for continued construction.
Poor stakeholder engagement and management during construction	Negative public perception and stakeholder expectations not met. Stakeholder complaints leads to time delays additional cost and loss of reputation.
Health, safety, and wellbeing during construction activities	Injury or fatality to staff or the public.
Unknown services are encountered during the construction activities	Design does not tie into the existing infrastructure requiring remediation measures. Service clashes and relocations may cause project delays and incurs additional cost.
Project becomes an election issue, effects project direction, timelines, budget etc	Best outcome for project not achieved. Increase (or decrease) in project costs
Design does not consider future projects / uncertainty around future transport demands etc.	Future growth or changes in use are not allowed for and the CCP projects are unable to cope with additional demand.
Effects of new hospital are not well understood	The Retail Quarter project leads the hospital project so changes in traffic will need to be accommodated as part of the hospital project.
Loss of business, disruption, loss of income claims etc from land/building/business owners	Local businesses fail or take losses due to the interference of the construction.
Heritage and Archaeological investigations and stakeholder engagement processes are prolonged	Delays to construction, prolonged disruption and additional costs.

Table 35: Top opportunities

Opportunity	Consequence
Improved transport choice and uplift in active modes	Decreased traffic congestion and improved public perception and health benefits. Improved perception of safety and improved accessibility.
Improved sustainable management of storm water	Improved integration with urban design and utilisation of low impact design methods to improve water quality.
Opportunity to fast-track delivery of small projects, e.g. parklets initiative giving the public clear examples of what is intended	Increased support and may provide a mechanism for broader engagement
Heritage and endemic plant species retention can be enhanced and celebrated	Early integration of themes to maximise outcomes

Opportunity	Consequence
Consolidation / rationalisation of utility services and service access can be achieved	Improved service layout (in a range of passive provision to active provision guises) and maintenance access
Improvements to the performance of the water management may be possible	Improved street appeal and visual amenity for the public.
Opportunity for community engagement through additional art-work / art installations	Showcase local artist and improved ownership by the community
Incorporate emerging transport tech into the project. e.g. provision for EV charging bays real time transport information (parking/buses etc)	Future proofed infrastructure to cater for future needs and use. No future retrofit required

The full current risk and opportunity register is attached as Appendix F.

14.6 Project and business assurance arrangements

14.6.1 Post-project evaluation planning

A post implementation review is planned the following year post-project completion to assess the lessons learnt through the project development, and to provide a high-level overview of the benefits realisation. The benefits realisation would only be undertaken if sufficient qualitative and quantitative data has been gathered to measure the benefits. If the data is incomplete, then it is recommended that a separate benefits realisation report is prepared approximately three years after project completion. A three year period is typically accepted as being the required amount of time needed after a change to the land transport network to assess the changes for safety.

On-going evaluation reviews are recommended at regular intervals following the project completion.

The post-implementation reporting would be provided to the project steering group members and reported through to Council committee.

15.0 Next Steps

This detailed business case seeks a decision from Council committee of the preferred option and formal approval to proceed to the pre-implementation/detailed design and construction phases for the George Street project.

Appendix A

Optioneering History

Prepared for
Dunedin City Council

Appendix A

Optioneering History

23-Aug-2021
Retail Quarter - George Street DBC

Appendix A

Optioneering History

Client: Dunedin City Council

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23-Aug-2021

Table of Contents

1.0 Background

The purpose of this report is to document the baseline of the recommended option to be used in the Detailed Business Case (DBC). Traditionally, a DBC will refine the recommendation from the Indicative Business Case (IBC) as part of a two-stage business case process. However, since the development of the IBC, the optioneering process has gone through several committees and reviews; all of which having differing opinions on what the recommended option should be for testing at the DBC phase.

A summary of various entities and preferred options at the inception of the DBC are summarised in Figure 1-1.

July 2019:	July 2020:	July 2020:	Oct 2020:	Nov 2020:	Nov 2020:
George Street preliminary design endorsed by Planning and Environment Committee	IBC recommends Option 2 – One-way street and Option 3 – Pedestrianise Edinburgh Way to proceed to DBC	Urbanism+ appointed to carry out independent review	Independent review recommends *Option 1* – two-way flexible design; and *Option 2* – one-way flexible design	Council staff endorse Option 1 – two-way flexible design to proceed to DBC	Planning and Environment committee approve Option 2 – one-way flexible design to proceed to DBC

Figure 1-1 Progression of the DBC Optioneering

2.0 Indicative Business Case

The IBC was completed in July 2020, outlining several long-list, short-list and recommended options. To assess the options, George Street was segmented into four blocks as shown in Figure 2-1.

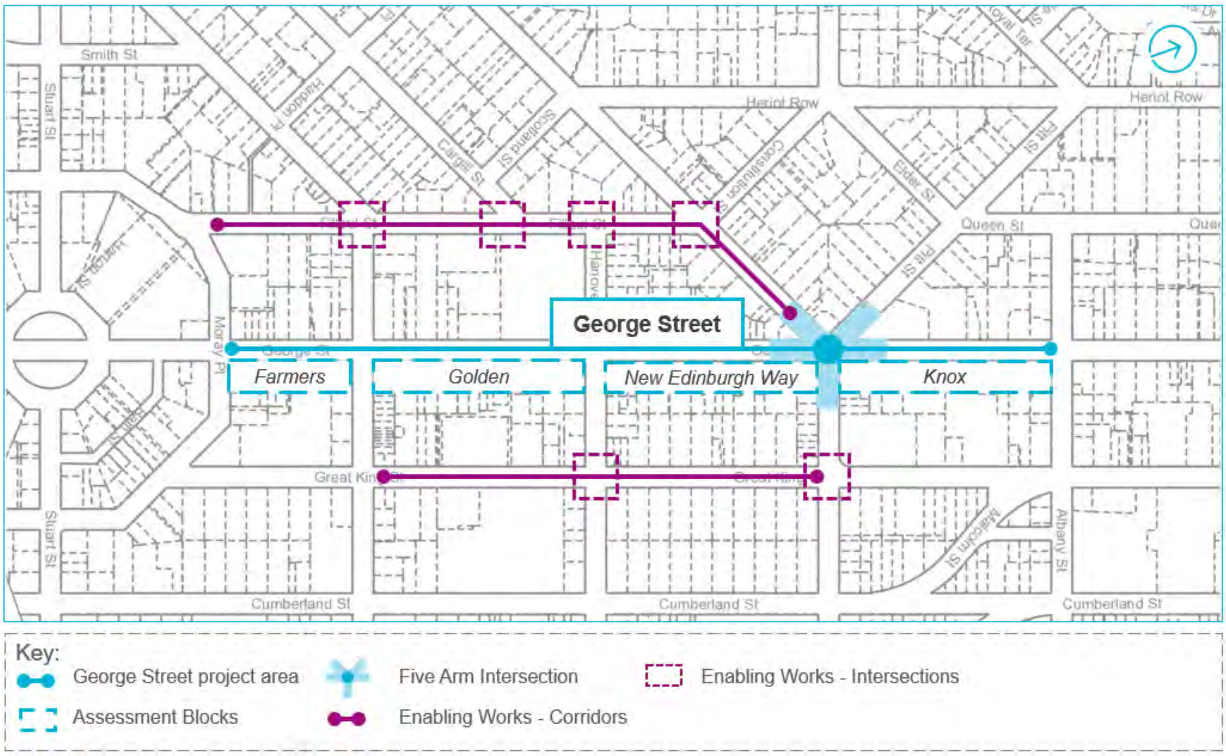

Figure 2-1: Site Location of George Street and Enabling Works

2.1 Long list options

The longlist for the Retail Quarter looked at 9 options. The different options looked at different configurations of two-way, one-way and pedestrian only options for each segment.

Table 2-1 summarises the pros and cons of each option, which was based on the explanations that underpinned the MCA scoring.

Table 2-1 Long-list options

	Option	Farmers	Golden	Edinburgh	Knox	Pros	Cons	Shortlist
1	*Do-min*	*2*	*2*	*2*	*2*	• *Most legible option due to consistency of treatment*	• *No changes to vehicle through movement* • *Reduced pedestrian amenity improvements*	
2	*One Way Street (northbound and southbound to be assessed)*	*1*	*1*	*1*	*2*	• *Reduced through movement and improved operation of 5-arm intersection* • *Consistency of one-way street contributes to legibility* • *Retains vehicle access to adjacent businesses*	• *Retaining traffic along George Street limits opportunities for pedestrian provision and placemaking* • *Traffic volumes will be reduced, but not to the same extent as for the pedestrianisation options* • *Bidirectional cycle provision may cause confusion*	✓
3	*Pedestrianise Half of Edinburgh block*	*1*	*1*	*2* *P*	*2*	• *Enhanced operation of 5-arm intersection* • *Through-traffic substantially reduced along George Street* • *Pedestrianisation likely to benefit adjacent businesses* • *Less opposition than complete pedestrianisation*	• *Loss of loading and servicing access to small number of businesses* • *Less legible due to two-way section on largely one-way street* • *Turning required on Edinburgh Way, reducing space for placemaking* • *Challenges in delivery due LGA 1974 pedestrian mall process*	✓
4	*Pedestrianise Golden block only*	*1*	*P*	*1*	*2*	• *High pedestrian amenity due to pedestrianisation alignment with busiest pedestrian block* • *Removes through movement function* • *Provides some safety benefits at 5-arm intersection*	• *Direct vehicle access, loading and servicing reduced* • *Lesser safety benefits in comparison to options that pedestrianise Edinburgh Way connecting into intersection* • *Displaces vehicles onto wider network*	
5	*Pedestrianise Farmers block only*	*P*	*1*	*1*	*2*	• *Removes through movement function* • *Direct vehicle access to adjacent business is reduced, but still available*	• *Provides fewer benefits in comparison to pedestrianizing other blocks by restricting through movement from the Octagon* • *Offers fewer safety benefits* • *May limit future options for the Octagon* • *Displaces vehicles onto wider network*	

	Option	Farmers	Golden	Edinburgh	Knox	Pros	Cons	Shortlist
6	*Pedestrianise Farmers and Golden block*	*P*	*P*	*1*	*2*	• *Significantly enhances pedestrian and public realm amenity*	• *Reduces direct vehicle access, loading and servicing of adjacent businesses, though some form of permitted service access is assumed* • *Lesser safety benefits in comparison to options that pedestrianise Edinburgh Way connecting into intersection* • *May limit future opportunities for the Octagon and Lower Stuart St* • *Displaces vehicles onto wider network*	
7	*Pedestrianise Farmers and half of Edinburgh*	*P*	*1*	*2* *P*	*2*	• *Offers safety improvement to 5-arm intersection due to pedestrianisation of Edinburgh Way*	• *Haphazard pedestrianisation / typology of the street is illegible and confusing to users* • *Busy pedestrian blocks remain open to vehicles* • *Limits direct vehicle access, loading and servicing of adjacent businesses*	
8	*Pedestrianise Golden and half of Edinburgh*	*1*	*P*	*2* *P*	*2*	• *Removes through movement function* • *Pedestrianises busiest pedestrian block*	• *Limits direct vehicle access, loading and servicing of adjacent businesses*	
9	*Maximum Pedestrinisation*	*P*	*P*	*2* *P*	*2*	• *Significant road safety benefits for pedestrians, as through traffic is removed entirely* • *Significant road safety benefits at 5-arm intersection* • *Most legible option due to consistency of treatment*	• *Most expensive option* • *Vehicle access to adjacent properties significantly decreased, though some form of permitted service access is assumed* • *Likely to result in community disfavour* • *Challenges in delivery due to LGA 1974 pedestrian mall process* • *May limit future opportunities for the Octagon and Lower Stuart St* • *Displaces vehicles onto wider network*	✓

2.2 Short list options

Following the long-list assessment, a sensitivity test was undertaken to test different investment objective weighting. As a result of this testing, it demonstrated that options 2, 3 and 9 were the highest ranked options, thus they best address the problems.

Assessment of these options are summarised in the sections below.

2.2.1 IBC Option 2

Option 2 is summarised in Figure 2-2, and recommends:

- Farmers block, Golden block, Edinburgh way – One way
- Knox block – Two-way

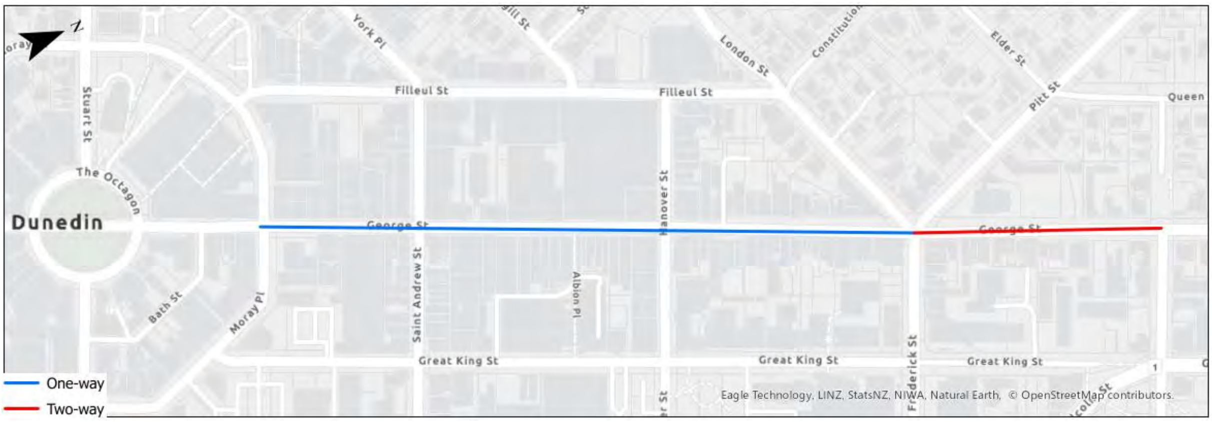

Figure 2-2: IBC Option 2

The pros, cons and opportunities/risks of this option are summarised in Table 2-2.

Table 2-2: Assessment of IBC Option 2

Pros	Cons	Opportunities/Risks
• Reduced traffic flow along George Street • Legible option • Improved operation of 5-arm intersection • Access to businesses and properties retained	• Retaining traffic along George Street limits opportunities for pedestrian provision and placemaking • Least traffic reduction and placemaking opportunities out of all shortlist options • Bidirectional cycle provision may cause confusion •	• Step-change to further traffic reduction and placemaking measures along George Street • Opportunity for design features that further limit through-traffic e.g. opposing traffic flows • Direction of traffic along Edinburgh Way will significantly impact 5-arm operation

2.2.2 IBC Option 3

Option 3 is summarised in Figure 2-3, and recommends:

- Farmers block, Golden block – One-way
- Edinburg way (southern half) – Two-way
- Edinburgh way (northern half) – Pedestrianised
- Knox block – Two-way

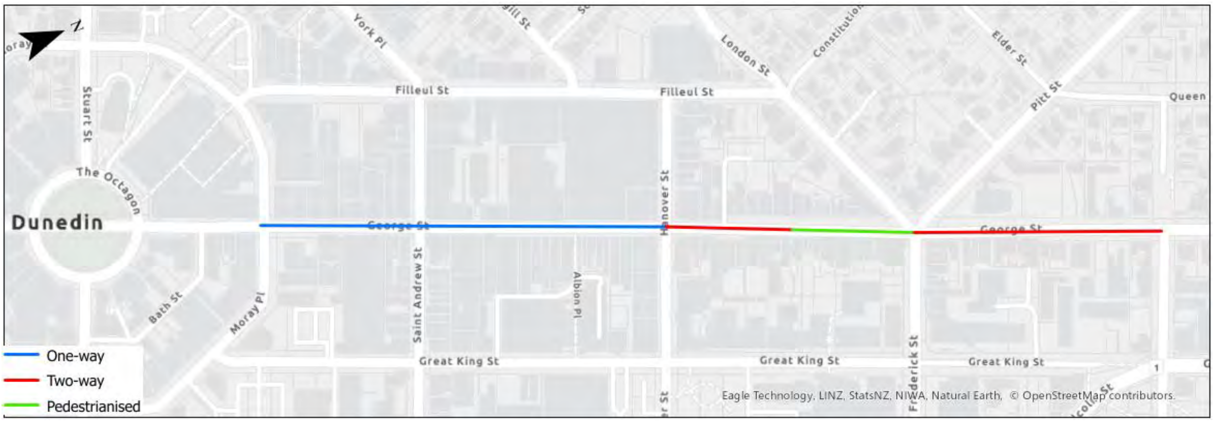

Figure 2-3: IBC Option 3

The pros, cons and opportunities/risks of this option are summarised in Table 2-3.

Table 2-3: Assessment of IBC Option 3

Pros	Cons	Opportunities/Risks
• Enhanced operation of 5-arm intersection • Through-traffic substantially reduced along George Street • Pedestrianisation likely to benefit adjacent businesses • Less opposition than complete pedestrianisation	• Loss of loading and servicing access to small number of businesses • Less legible due to two-way section on largely one-way street • Turning hear required on Edinburgh Way, reducing space for placemaking • Challenges in delivery due to Local Government Act pedestrian mall process	• Access provided to traffic during certain times of the day for service and delivery • Step-change for future traffic reduction and placemaking treatments

2.2.3 IBC Option 9

Option 9 is summarised in Figure 2-4, and recommends:

- Farmers block, Golden block – Pedestrianised
- Edinburgh way (southern half) – Two-way
- Edinburgh way (northern half) – pedestrianised
- Knox block – Two-way

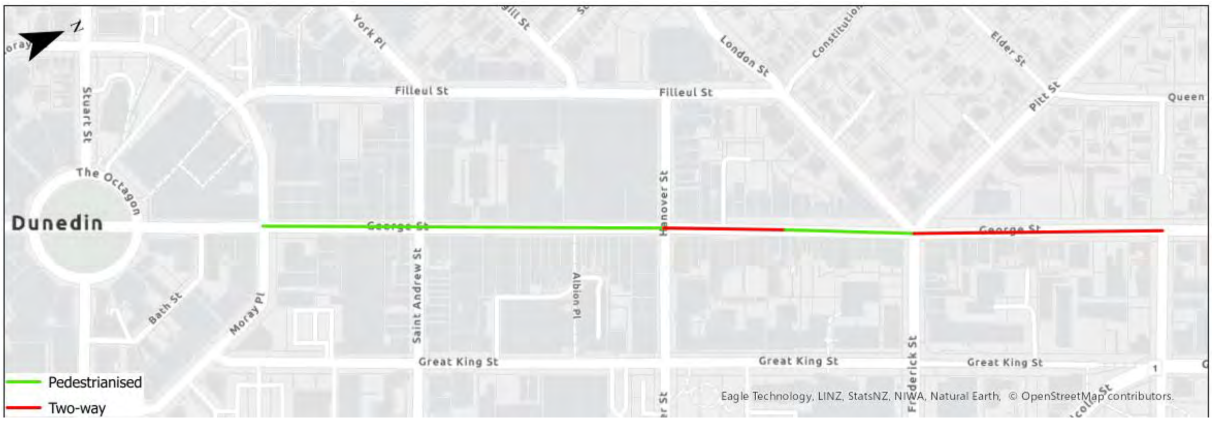

Figure 2-4: IBC Option 9

The pros, cons and opportunities/risks of this option are summarised in Table 2-4.

Table 2-4: Assessment of IBC Option 9

Pros	Cons	Opportunities/Risks
• Substantial road safety benefits for pedestrians • Substantial road safety benefits at 5-arm • Through traffic removed entirely • Highly legible option	• Most expensive option • Access to adjacent properties significantly decreased • Likely least favourable among retail community • May limit future options for the Octagon and lower Stuart Street • Challenges in delivery due to Local Government Act pedestrian mall process	• Flexibility to allow vehicle access during certain times of the day

2.3 IBC Recommendations

Overall, the IBC recommended that the DBC further assess both Option 2 and Option 3. Both of these options were viewed as cheaper and more balanced than Option 9. In addition, Option 9 posed a number of significant risks to the project success with stakeholders.

3.0 Peer Review

3.1 Review of the IBC recommended option

In July 2020, Urbanism+ were appointed to carry out an independent review following concerns regarding impacts of preferred IBC options and lack of public engagement. Based on this assessment, the following options were assessed:

- Option 1: Two-way street design – flexibility to convert to one-way in future
- Option 2: One-way street – flexibility to convert to two-way in future

3.1.1 Independent Review Option 1

Option 1 is summarised in Figure 3-1, and recommends:

- Farmers Block, Golden Block, Edinburgh Way – Shared two-way street design with flexibility to convert to one-way in future
- Knox Block – Two-way

The assessment also noted that it was preferrable if an appropriate clean-energy bus service can be delivered along George Street in a reasonable timeframe

Figure 3-1: Urbanism+ Option 1

The pros and cons of this option are summarised in Table 3-1.

Table 3-1: Assessment of Peer Review Option 1

Pros	Cons
• Can accommodate public transport services • Option preferred by 70% of Central City Advisory Group • Will allow vulnerable users to access George St more easily • Increased vehicle through movement may support retail visitation by car • Easy access to parking areas/buildings • Flexible design to adapt to future needs • Meets CPTED objectives	• More space allocated to vehicle movement and reduced opportunity to create people-focussed spaces • Less favourable for cycling and micro-mobility • Ability to improve safety of 5-arm intersection is reduced – may impact funding available from NZTA

Option 2 is summarised in Figure 3-2, and recommends:

- Farmers Block, Golden Block, Edinburgh Way – Shared one-way street design with flexibility to convert to two-way in future
- Knox Block – Two-way

The assessment noted it would be preferable if an appropriate clean energy bus service can be delivered along George Street in a reasonable timeframe.

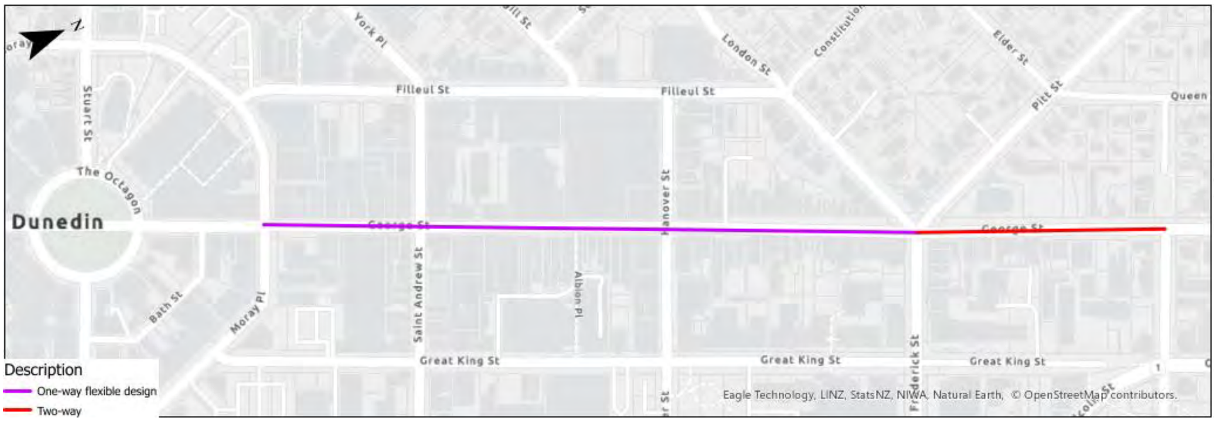

Figure 3-2: Urbanism+ Option 2

The pros and cons of this option are summarised in Table 3-2.

Table 3-2: Assessment of Peer Review Option 2

Pros	Cons
• Second ranked option by Central City Advisory Group • Flexible design to adapt to future needs • Safer, and therefore may attract more funding • Greater opportunities to create public amenity • Better provision for cycling and micro-mobility • Addresses safety issues at the 5-arm intersection	• Less potential for CPTED due to reduced through movement • Accessibility to car parking and retail buildings is reduced • Reduced vehicle through-movement may impact retail trade •

4.0 Council Resolution

4.1 Review of Peer Review recommendations

Following the peer review recommendations, the following options were discussed in further detail:

- Option 1: Two-way street design – flexibility to convert to one-way in future
- Option 2: One-way street – flexibility to convert to two-way in future

Based on the assessments to date, the following pros and cons were summarised, as shown in Table 4-1.

Table 4-1: Assessment of flexible street options

Option	Pros	Cons
1	• Can accommodate public transport services • Option preferred by 70% of Central City Advisory Group • Will allow vulnerable users to access George St more easily • Increased vehicle through movement may support retail visitation by car • Easy access to parking areas/buildings • Flexible design to adapt to future needs • Meets CPTED objectives	• More space allocated to vehicle movement and reduced opportunity to create people-focussed spaces • Less favourable for cycling and micro-mobility • Ability to improve safety of 5-arm intersection is reduced – may impact funding available from NZTA
2	• Second ranked option by Central City Advisory Group • Flexible design to adapt to future needs • Safer, and therefore may attract more funding • Greater opportunities to create public amenity • Better provision for cycling and micro-mobility • Addresses safety issues at the 5-arm intersection	• Less potential for CPTED due to reduced through movement • Accessibility to car parking and retail buildings is reduced • Reduced vehicle through-movement may impact retail trade

Based on the assessment, the council staff recommended that Option 1 proceed to DBC and developed design. However, the Planning and Environment Committee recommended that Option 2 proceed to DBC and developed design.

5.0 DBC Scoping Workshop

Given the evolution of the recommended options since the submission of the IBC, a workshop was undertaken with DCC and Waka Kotahi in April 2021 and the following options were confirmed for further assessment in this DBC:

- Do Minimum – Three waters replacement and replacement of George Street to existing road layout with minor improvements such as replacement of pavers.
- Option 1 - George Street to be made One Way Northbound with a 10km/hr speed limit.
- Option 2 – George Street to be made One Way Southbound with a 10km/hr speed limit.
- Option 3 – George Street to be retained as Two Way with a 10km/hr speed limit.
- Option 4 – Two Way smart street with a 10km/hr speed limit

These options formed the basis of the DBC option development and will be further discussed and assessed in the Economic Case. However, it was decided that the ‘flexible street’ option of converting a design later to a different configuration would not be possible. This was determined given that funding and analysis for the preferred option would be based on a particular design. It was therefore deemed that should the design want to be changed in the future, this would require a separate assessment and funding stream allocation.

Appendix B

Transport Assessment and Modelling Report

Prepared for
Dunedin City Council
Co No.: N/A

AECOM

Dunedin Retail Quarter

Transport Modelling and Engineering Report

29-Jul-2021

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Delivering a better world

Dunedin Retail Quarter

Transport Modelling and Engineering Report

Client: Dunedin City Council

Co No.: N/A

Prepared by

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Reviewed by Robyn Hyde

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Rev	Revision Date	Details	Authorised	
			Name/Position	Signature
	28-May-2021	DRAFT	Nick Bristed	

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1.0 Introduction

AECOM has been appointed by Dunedin City Council (DCC) to undertake a Detailed Business Case (DBC) for the proposed Retail Quarter network changes. This Transport Modelling and Engineering Report will examine the existing situation and detail the proposed impacts of the various options.

The Project is being driven by the need to replace and upgrade the underground Three Waters infrastructure on George Street which has reached the end of its useful life. To undertake the works, George Street will be dug up to replace the underground infrastructure. There is an opportunity therefore to improve the streetscape to provide a more attractive solution than currently exists.

This report will detail the following:

- **Section 2.0 Existing environment**: This section details the current George Street network and layout.
- **Section 3.0 Options**: Section 3.0 will set out the proposed options which are being considered within the DBC.
- **Section 4.0 Network** : Section 4.0 details the transport impacts of the enabling works as well as bus network changes.
- **Section 5.0 Transport modelling**: This section sets out the changes made to the traffic models to incorporate the enabling works and test the various proposed options.
- **Section 6.0 Traffic** : The assessment section details the expected impacts of the proposed options on the transport network.
- **Section 7.0 Conclusion**: This section sets out the proposed preferred options based on the assessment undertaken.

2.0 Existing environment

2.1 Site location

George Street is located within Central Dunedin and provides connection from the Octagon in the south to Bank Street in the north. **Figure 1** below shows the strategic location of George Street in relation to the wider network.

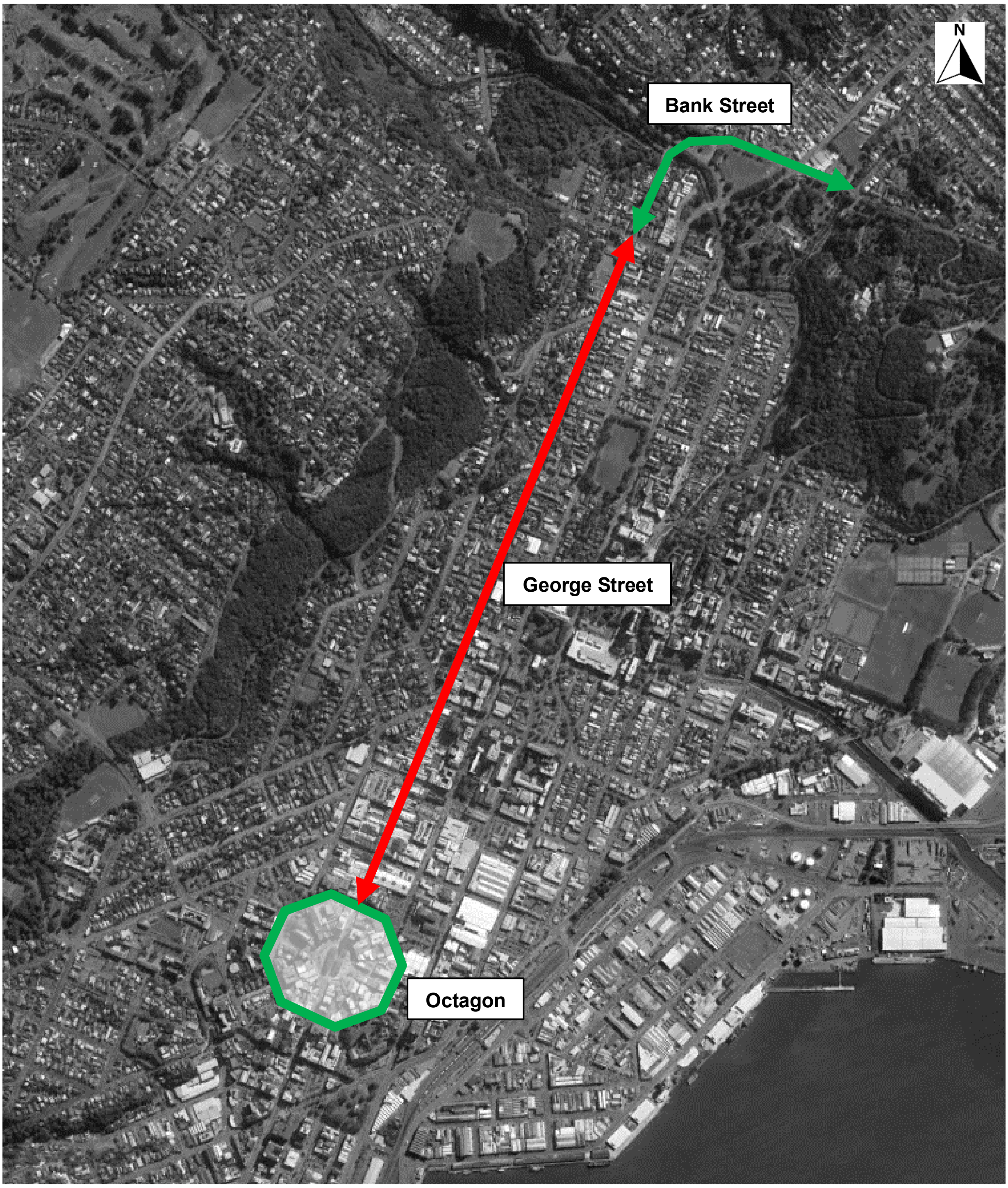


Figure 1: Strategic location of George Street

The Project area is a section of George Street and is shown in **Figure 2** below.

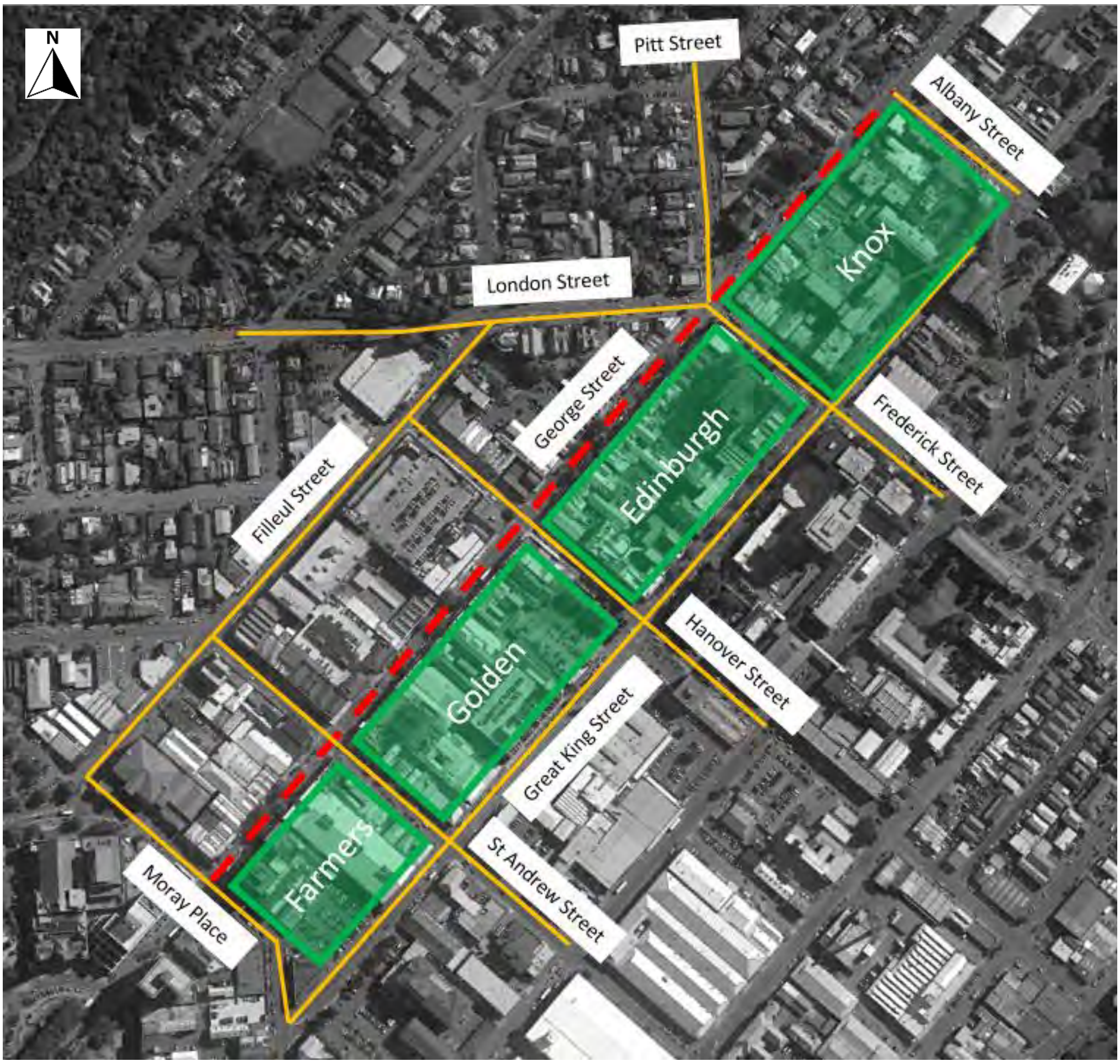


Figure 2: Project area

As **Figure 2** above shows, the proposed changes to George Street will be between Albany Street to the north and Moray Place to the south. This section consists of four blocks namely Farmers, Golden, Edinburgh and Knox. The sections below will detail the existing situation along George Street.

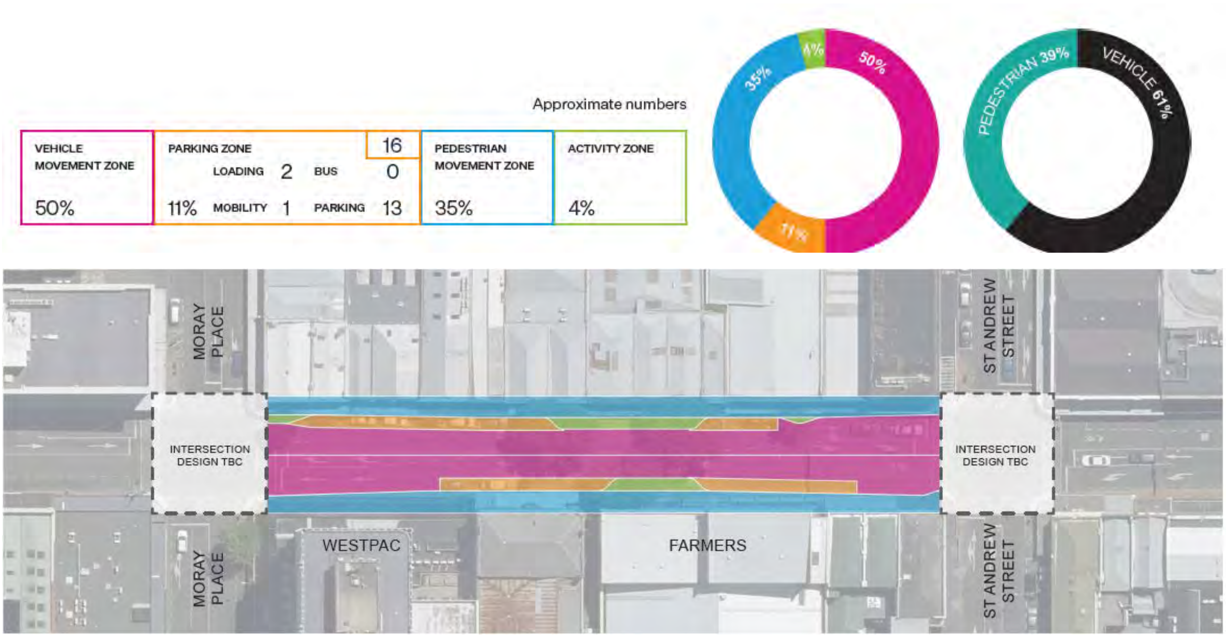
2.1.1 Farmers block

The Farmers block connects Moray Place to St Andrew Street. At the southern end of George Street, a signalised intersection connects George Street to Moray Place. This traffic signal is a four-arm intersection with pedestrian crossing facilities on all approaches including a Barnes Dance arrangement.

Along the block, George Street has a total width of approximately 19m and has a single vehicular lane in each direction. The traffic lanes are approximately 4m in width in each direction. Footpaths are located on both sides of the carriageway with a width of approximately 3m. There are no dedicated cycling facilities along this section, however cyclists are encouraged to take the lane with the use of sharrow markings. Parking bays are present on both sides of the carriageway. There are currently 14 parking spaces within this section, one of which is for mobility users and two areas designated for loading vehicles.

Along this section George Street is fronted by mostly retail properties including Farmers - a large anchor department store located almost central within the block.

The graphic below shows that currently this block is dominated by vehicles, with 61% of the available space being dedicated to cars. The remaining 39% is allocated to pedestrians and activity zones[1].



[1] Retail Quarter Detailed Business Case Drawings_Rev A, Ō3 Collective, July 2021

Along the block there are numerous elements of kerb side activity and these are shown in **Figure 3**[2].

Figure 3: Existing kerbside restrictions – Farmers Block

The Farmers Block ends at the signalised intersection of George Street / St Andrew Street which is a four-arm intersection. The George Street northbound approach widens at the intersection to provide an ahead / left turn lane with a separate short right turn lane. St Andrew Street has two lanes on approach with an ahead / left turn lane and a right turn lane. Pedestrian crossings are in place on all arms and a Barnes Dance has been implemented at the intersection. No dedicated cycling facilities are in place at the intersection.

The existing cross section for the Farmers Block is shown in **Figure 4**.

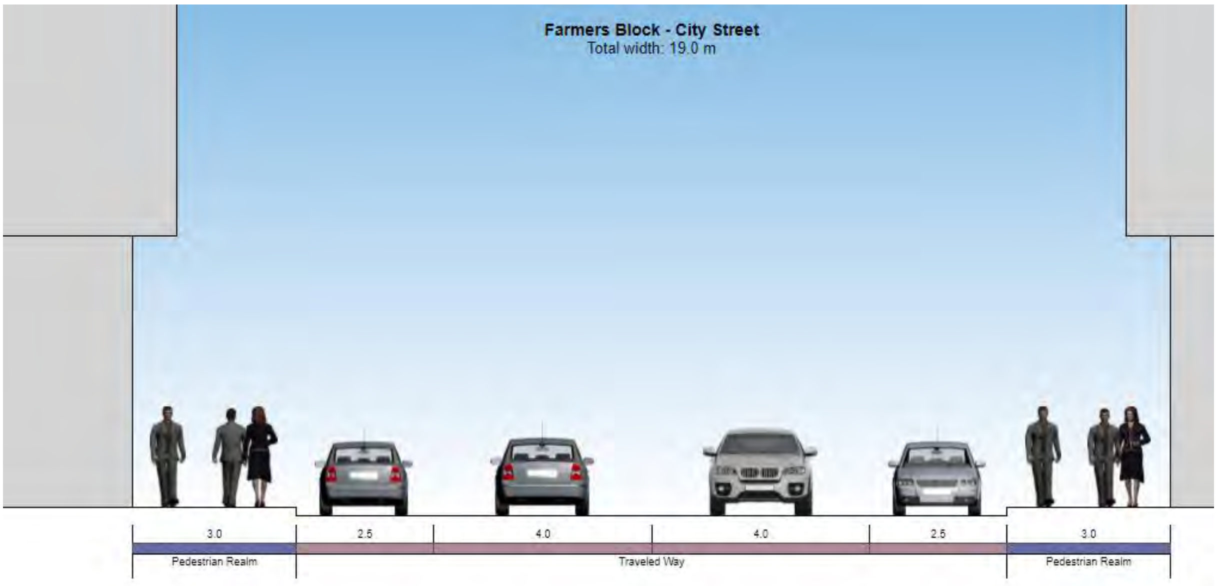


Figure 4: Farmers Block: George Street between St Andrew Street and Moray Place

[2] Parking controls - approved by Council 23 February 2021 (arcgis.com)

2.1.2 Golden block

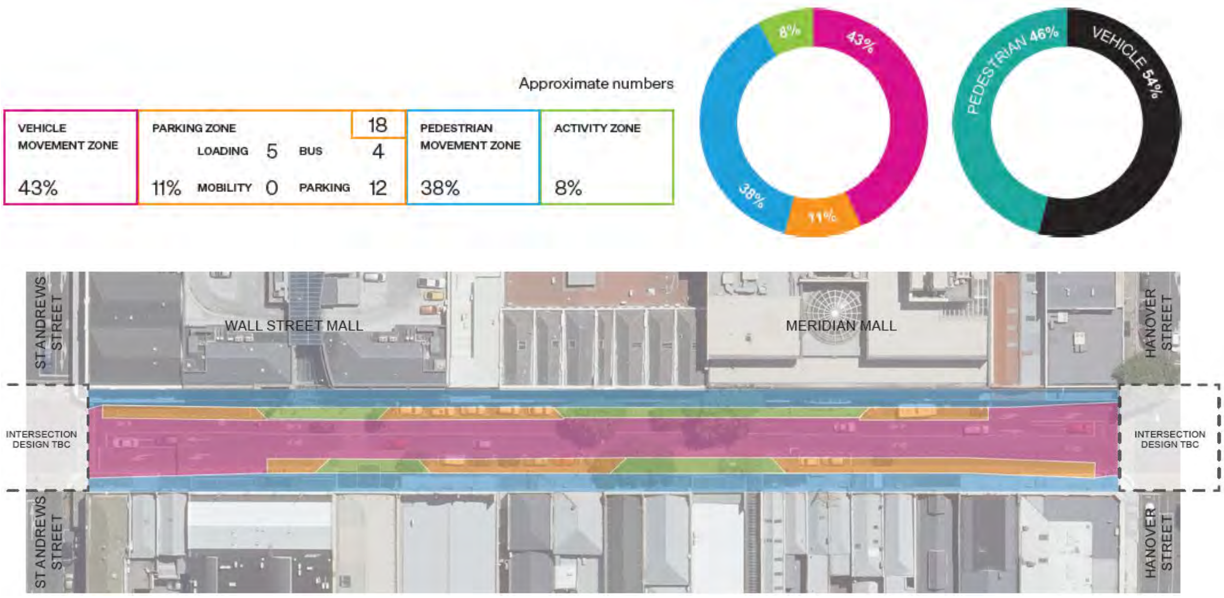
The Golden Block on George Street links St Andrew Street in the south to Hanover Street in the north. The intersection layout for George Street and St Andrew Street is detailed in **Section 2.1.1** above.

Along the block the carriageway is wide with approximate widths of 4m per lane. Footpaths are located adjacent to the carriageway and are of similar width to that of the Farmers Block. For cyclists, whilst no dedicated facilities are provided, sharrow markings are provided on the carriageway to alert drivers to the presence of on-street cyclists. There are currently 12 parking spaces, none of which are dedicated for mobility users, and an additional four loading areas.

A northbound bus stop is located just north of the intersection with St Andrew Street with a southbound bus stop located close to the intersection with Hanover Street. No facilities or shelters are provided for waiting patrons.

The Golden Block is fronted largely by retail development with a large Starbucks located at the intersection of George Street and St Andrew Street. The Wall Street and Mall 218 malls front George Street within this section.

The graphic below shows that currently this block has approximately 54% of the space dedicated to vehicles and 46% for pedestrian and activity zones.



Along the block there are numerous elements of kerb side activity as shown in **Figure 5** below.

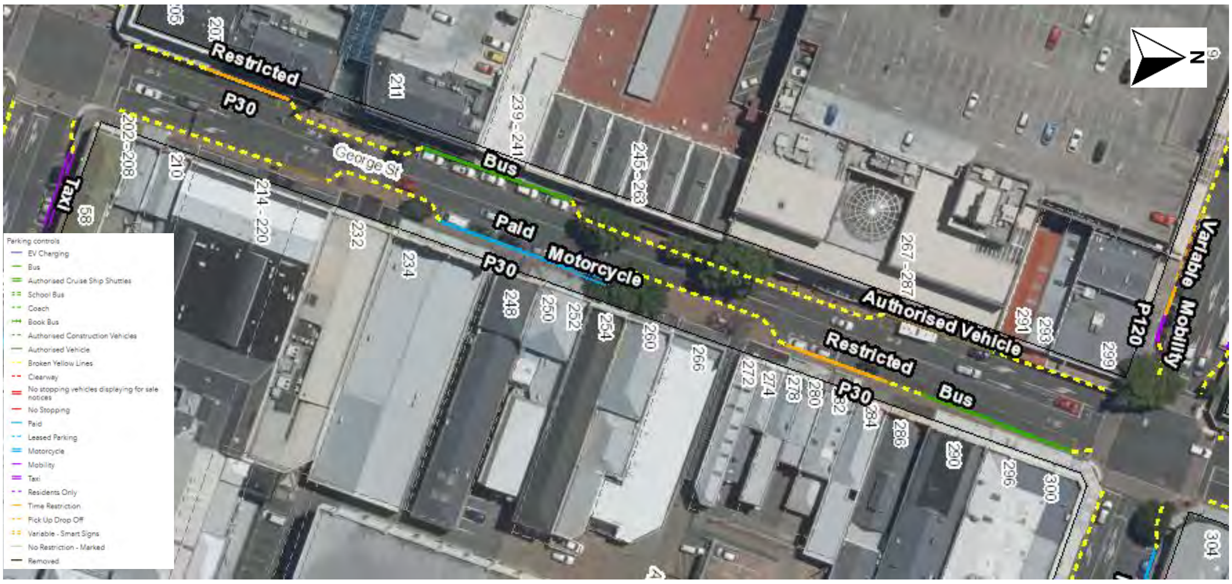


Figure 5: Existing kerbside restrictions – Golden Block

At the northern extent of the Golden Block, George Street intersects with Hanover Street. The George Street northbound approach has a nearside lane for left and ahead movements, and a second short lane for right turning traffic into Hanover Street. George Street southbound, has the same lane configuration. Hanover Street has two lanes on approach with the nearside lane being left and ahead with the second lane as a right turn lane. The intersection has full pedestrian crossing facilities including a Barnes Dance. There are no dedicated cycling facilities at the intersection.

The existing cross section for the Golden Block is shown in **Figure 6**.

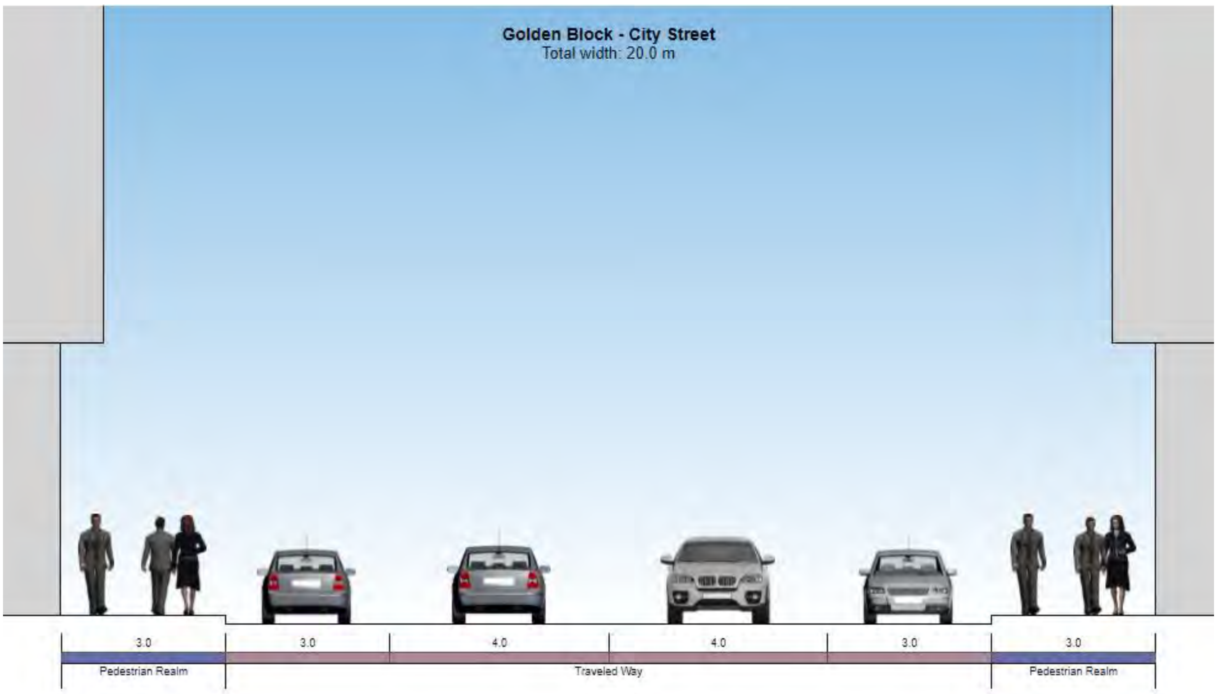


Figure 6: Golden Block: George Street between Hanover Street and St Andrews Street

2.1.3 Edinburgh block

The Edinburgh block of George Street is the longest section of the project area. At its southern end it connects to Hanover Street at a signalised intersection, the details of which are included in **Section 2.1.2**.

Along the block, the lane width is approximately 4m and footpaths of approximately 3m width front the carriageway. There are no dedicated cycleways along the block however, sharrow markings are provided within the carriageway to alert drivers to the presence of cyclists. At present, there are 21 parking spaces, none for mobility users and eight areas for loading vehicles. There are no bus stops provided within this block.

This block consists of slightly different frontage compared to the Farmers and Golden blocks in that it is a mix of retail and cafes / takeaways. The southern section is primarily retail with the northern section being cafes and takeaways. A large public house "the Bog" is located at the northern extent.

The graphic below shows that currently this block has approximately 57% of the space dedicated to vehicles with 36% for pedestrian and activity zones.

Along the block there are numerous elements of kerb side activity, as shown in **Figure 7**.

Figure 7: Existing kerbside restrictions – Golden Block

At the Edinburgh Block northern extent, the five-arm signalised intersection of George Street / London Street / Pitt Street and Frederick Street is located, **Figure 8** below shows the layout.

Figure 8: Layout of five arm intersection

Figure 8 above shows that the George Street northbound approach widens at the intersection to provide three lanes. A left turn lane to both London and Pitt Street, a through lane to George Street and a right turn lane onto Frederick Street. The London Street approach has two lanes with the nearside lane being a left turn lane onto Pitt Street and George Street northbound and the offside lane being designated for movements to Frederick Street and George Street southbound. Pitt Street approach has a dedicated left turn lane to make the tight left turn onto George Street northbound and an offside lane for all other movements. George Street southbound has three approach lanes with a dedicated left turn lane to Frederick Street, a through lane to George Street southbound and a right / sharp right turn lane to London Street and Pitt Street, respectively. On Frederick Street, two approach lanes are in place with the nearside lane designated for movements to George Street southbound and to London Street, and the offside lane providing an ahead to Pitt Street and a right to George Street northbound.

Pedestrian crossings are provided on all approaches however, these have safety concerns. On each approach, when the pedestrian crossing is activated, a green-time of only five seconds is given. After this short green-time, the flashing red man is shown. At this point, left / right turners on opposing movements are released, allowing vehicles to progress into a give-way scenario with pedestrians that still need to complete their crossing. This results in pedestrians being halfway across the crossings when vehicles can then progress. This arrangement was highlighted in site visits and during the stakeholder consultation, furthermore, students are understood to avoid this intersection due to it feeling unsafe.

The existing cross section is shown in **Figure 9** below.

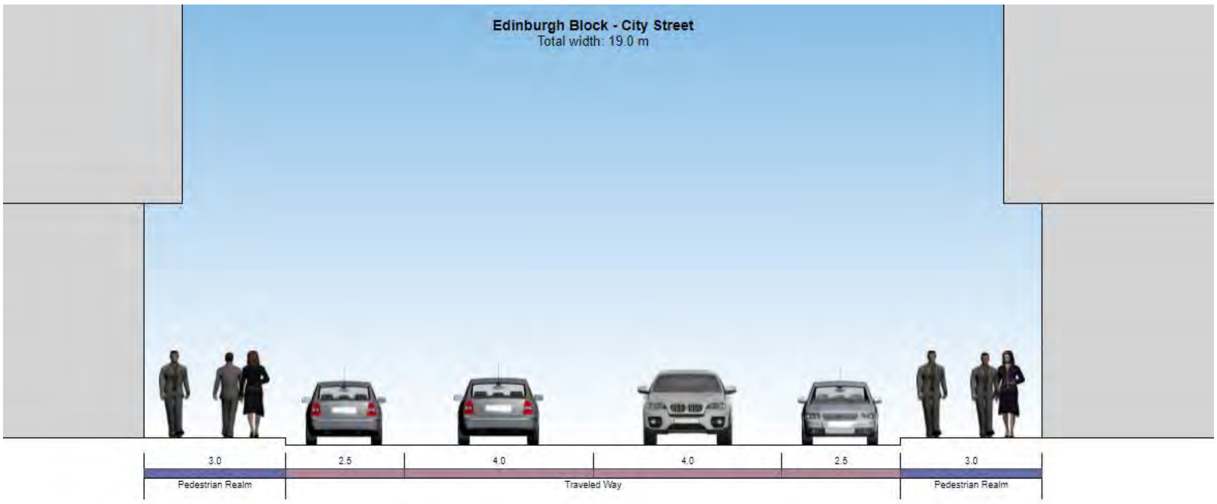


Figure 9: Edinburgh Block: George Street between Hanover and Frederick Street

2.1.4 Knox Block

The Knox block of George Street is a short section which links the London Street / Pitt Street / Frederick Street five-arm intersection in the south with Albany Street in the north. The intersection layout for the five-arm intersection is detailed in **Section 2.1.3** above.

The existing carriageway consists two 4m traffic lanes (one lane per direction) and kerbside parking on each frontage. Footpaths are located either side of the carriageway and vary in width, especially outside Knox Church where the footpath narrows down adjacent to the stairs into the church. For cyclists, whilst there are no dedicated cycle facilities, there are sharrow markings located to alert drivers to the presence of cyclists on the carriageway. Bus stops are located on this section of George Street. A review of Google Streetview indicates this section currently provides 26 parking spaces (none reserved for mobility users) and three loading spaces.

The signalised intersection of George Street / Albany Street is located at the northern extent of the Project. The George Street northbound approach widens to two lanes at the intersection to provide separate through and right turn lanes. The Albany Road approach provides separate left turn and right turn lanes. The George Street southbound approach also consists of two lanes with the nearside lane identified as a left turn lane and, the offside lane being ahead only.

Along the block there are numerous elements of kerb side activity, as shown in **Figure 10**.

Figure 10: Existing kerbside restrictions – Knox Block

2.2 Speed Data

Speed data has been obtained from DCC for each of the sections detailed above. The median and 85th percentile is of these blocks is detailed below in Table 1

Table 1 Speed Data on George Street

Section	Date of Survey	85%ile (km/hr)	Median (km/hr)
Hanover to Frederick	05/04/2019	32.5	25.92
Hanover to St Andrews St	14/12/2020	31.4	24.75
Moray Place to St Andrews St	01/08/2016	34.2	27.98
Octagon to Moray Place	05/05/2017	32.4	26.64
Frederick Street to Albany Street	24/09/2020	41.8	34.74

The above table shows that through the majority of George Street the 85th percentile speed is just above 30kmph apart from the section between Frederick Street and Albany Street which is 41kmph. The median speed along the entrie section of Geroge Street is below 30kmhr apart from the section of Frederick Street and Albany Street which is 34kmht.

2.3 Public transport

George Street currently has several bus stops which are located along its length. Bus stops are located within the Golden Block and Knox Block only. Whilst bus bays have been provided, there are no bus shelters provided or information on services at the stop locations.

The main bus hub has recently been developed and is located on Great King Street. Buses travelling southbound on George Street need to turn left at St Andrew Street and then right onto Great King Street. For buses leaving the bus hub to head north, they do the same route in reverse.

Figure 11 below shows the bus routes across Dunedin with **Figure 12** zooming into the George Street area[3].

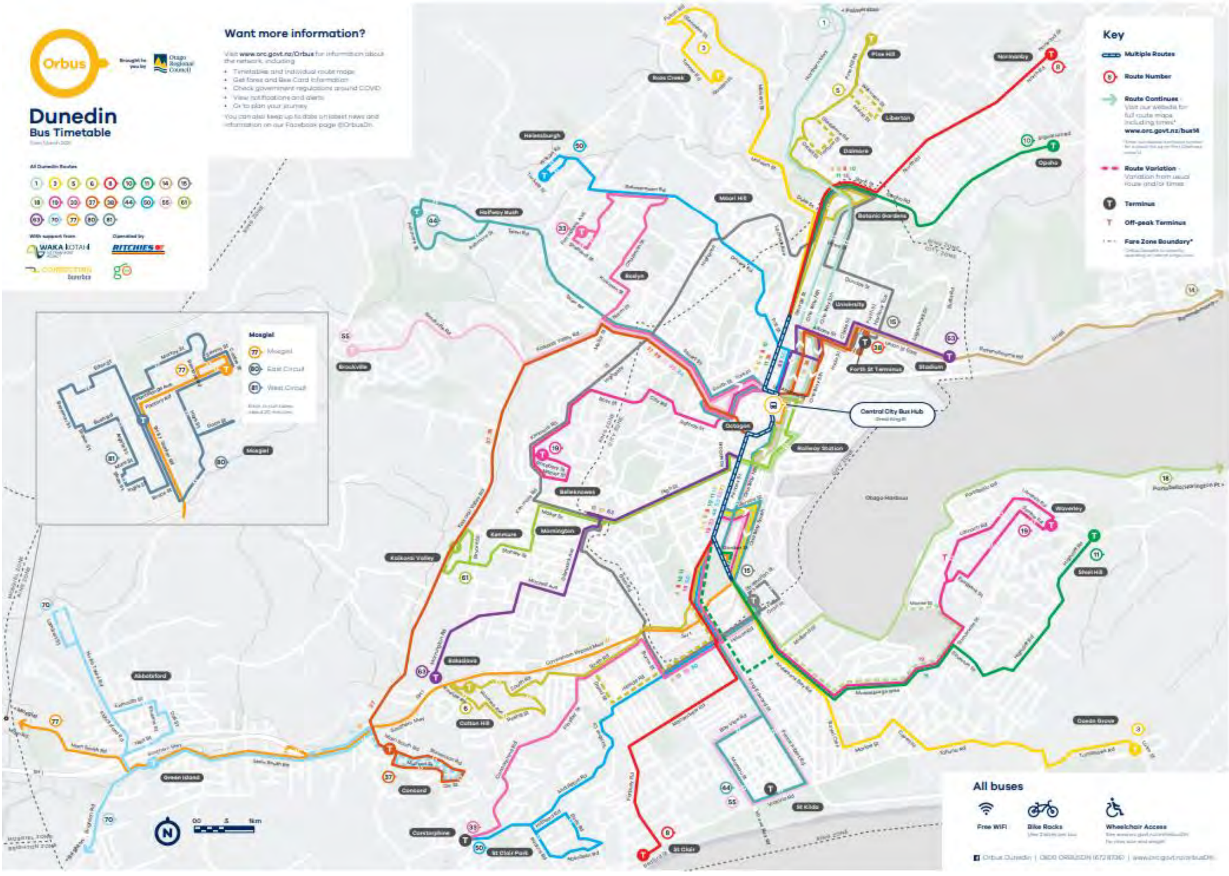


Figure 11: Bus routes across Dunedin

[3] https://www.orc.govt.nz/media/9921/orbus_dn-map_a2-forprint_210311.pdf

Figure 12: Bus routes along George Street

There are currently seven bus services which travel along George Street. **Table 2** below demonstrates that there are approximately 26 buses utilising George Street in both directions over the peak periods[4].

Table 2: Existing George Street buses

Direction	Bus No	Route	Peak			Off Peak		
			Hours	Mins	# per hour	Hours	Mins	# per hour
West	6	Carlton Hill to Pine Hill	7am – 9am	20	3	9:40am – 2:20pm	40	1.5
West	11	Shiel Hill to Opoho	6:30am – 9:10am	20	3	9:50am – 3:10pm	40	1.5
West	8	St Clair to Normanby	6:05am – 6:50pm	15	4	7:20pm – 10:20pm	30	2
West	3	Ross Creek to Ocean Grove	6:17am – 6:47pm	30	2	7:47pm – 8:47pm	60	1
East	3	Ocean Grove to Ross Creek	6:32am – 6:32pm	30	2	7:32pm – 8:32pm	60	1
East	8	Normanby to St Clair	6am – 7pm	15	4	7:30pm – 10:30pm	30	2
East	5	Pine hill to Calton Hill	7am – 9am	20	3	9:40am – 3pm	40	1.5
East	10	Opop to Shiel Hill	6:50am – 9:10am	20	3	9:50am – 3:10pm	40	1.5
East	38	University to Concord	6:52am – 6:52pm	30	2	7:52pm – 8:52pm	60	1

2.4 Cycling network

Central Dunedin has an extensive cycle network which is shown in **Figure 13**[5]. The cycle network around the Retail Quarter currently consists of cycleways and direct routes (sealed) however, no dedicated cycle facilities are provided on George Street itself.

[4] https://www.orc.govt.nz/media/9921/orbus_dn-map_a2-forprint_210311.pdf
[5] https://www.dunedin.govt.nz/__data/assets/pdf_file/0005/133529/Dunedin-Cycling-Map-2019.pdf

Figure 13: Dunedin cycle network

Figure 13 above shows that the primary cycle routes are along the main State Highway pair. George Street is defined as a primary cycle route in the Dunedin Network Operating Framework. Whilst there are no dedicated cycling facilities on George Street, there are cycle Sharrow markings located on the carriageway to alert drives to the presence of cyclists (see **Figure 14**)[6].

Figure 14: George Street layout showing Sharrow markings

2.5 Summary

This section has detailed the existing conditions of George Street and has demonstrated that there is significant road space allocated to vehicles thereby benefitting and encouraging this transport mode over other modes such as active transport.

[6] Google Streetview, Sep 2020

3.0 Options

As part of the DBC, this Transport Modelling and Engineering Report considered four proposed options. These options are detailed in **Table 3** below.

Table 3: Option description

Reference	Description
Do Minimum	Three Waters replacement and replacement of George Street to existing scenario with minor improvements such as replacement of pavers.
Option 1	George Street to be made One-Way Northbound with a 10km/h speed limit.
Option 2	George Street to be made One-Way Southbound with a 10km/h speed limit.
Option 3	George Street to be retained as Two-Way with a 10km/h speed limit.

3.1 Cross sections

This section sets out the indicative cross sections for both the one way and two-way options.

3.1.1 One-way cross section

Figure 15 below shows the proposed indicative cross section provided by the one-way scheme.

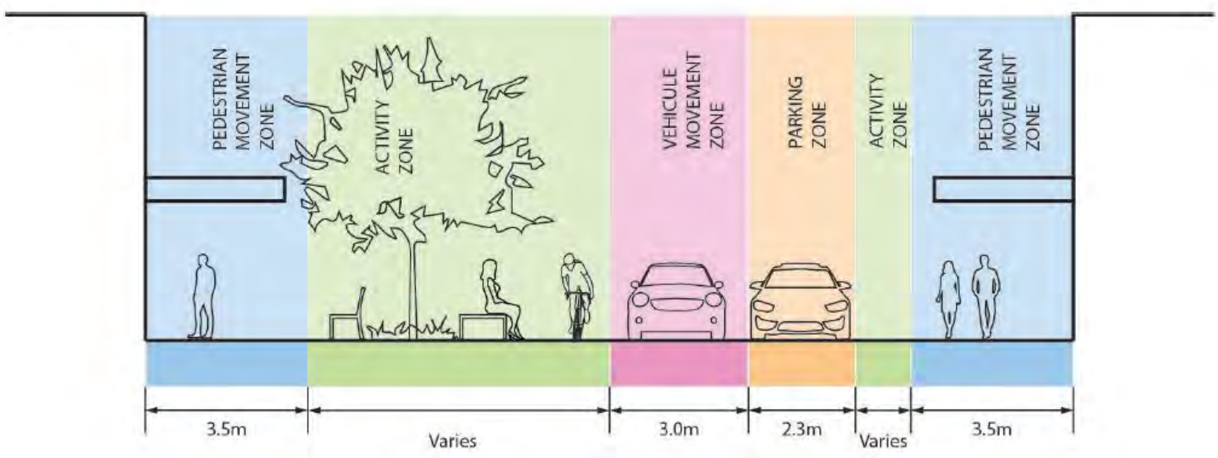


Figure 15: One-way cross section

As can be seen in **Figure 15**, this option provides a single vehicle movement zone of 3.0m in width. Adjacent to this parking zones will be provided, more information on parking is included within **Section 3.5**. Two activity zones are provided either side of the vehicle movement zone, these are areas for street furniture, rain gardens, planting, and community activation. It should be noted that within the wider area of activity zones, a clear route is provided adjacent to the carriageway to allow opposing flow for cyclists, skateboards, and scooters. At the extent of the cross section, adjacent to the building line, are 3.5m pedestrian movement zones. These zones provide pedestrian routes to be free of street furniture.

3.1.2 Two-way cross section

Figure 16 shows the indicative cross section for the two-way option.

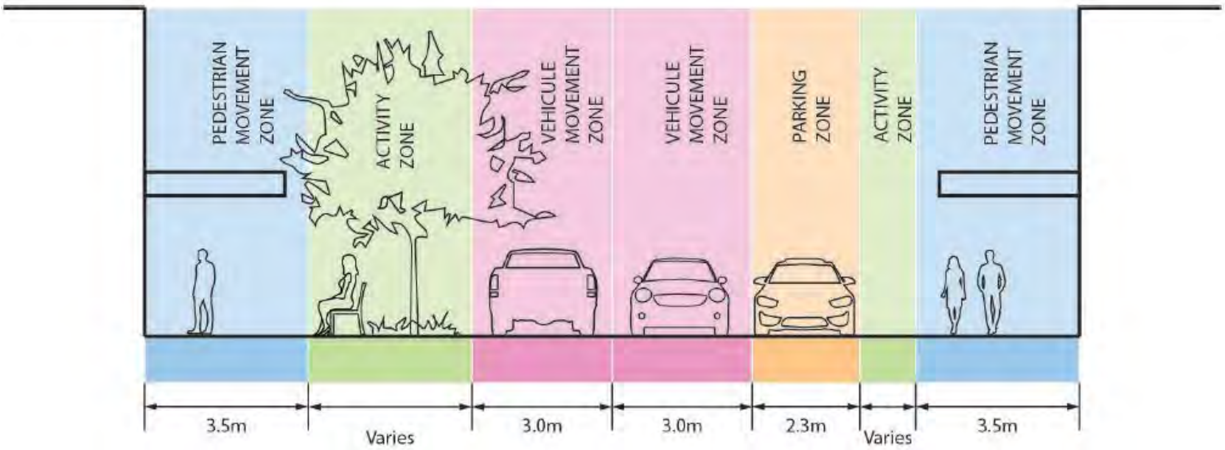


Figure 16: Two-way cross section

As can be seen, two vehicle lanes are provided with 3.0m traffic lanes (6m width in total). Adjacent to this is a 2.3m parking zone (see **Section 3.5** for information on parking). Either side of the "vehicle" space, activity zones are provided. As set out in **Section 3.1.1**, these areas are for street furniture, planting, seating etc. Two pedestrian movement zones of a minimum of 3.5m in width are provided next to the building lines.

3.2 One-way street options

The sections below will detail the sketch plans for options considered in the DBC. The plans have been prepared to allow for costing of each proposed option. The designs are indicative of the street layout for each proposed option. The final location of street furniture, materials, trees, planting and alignment of carriageways will be determined in the developed design phase in collaboration with project partners and stakeholders.

It should be noted that all options include the following base assumptions:

- One-way between Moray Place and the five-arm intersection (Farmers, Golden and New Edinburgh Way blocks). The Knox block is always to remain two way.
- A 10km/h speed limit through the same area.
- On the approach to the intersections, the proposal removes the existing turning lanes. The proposed single lane approach will cater for the existing movements (left, ahead and right).

3.2.1 Farmers block

Figure 17 shows a sketch plan of the proposed layout of the one-way street option for the Farmers Block.

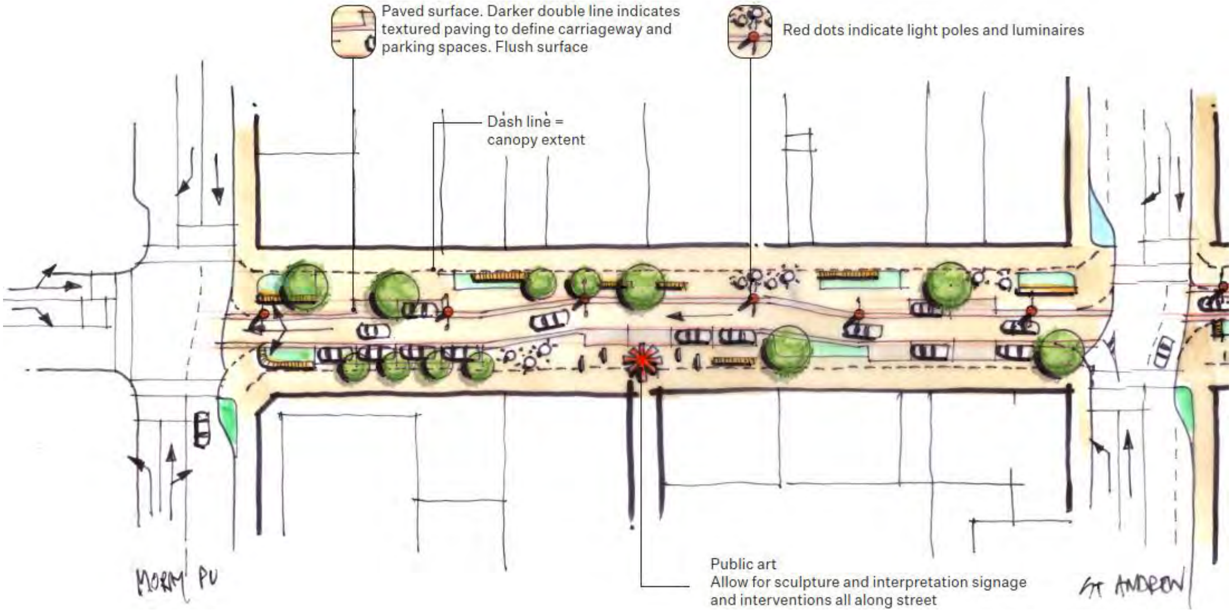
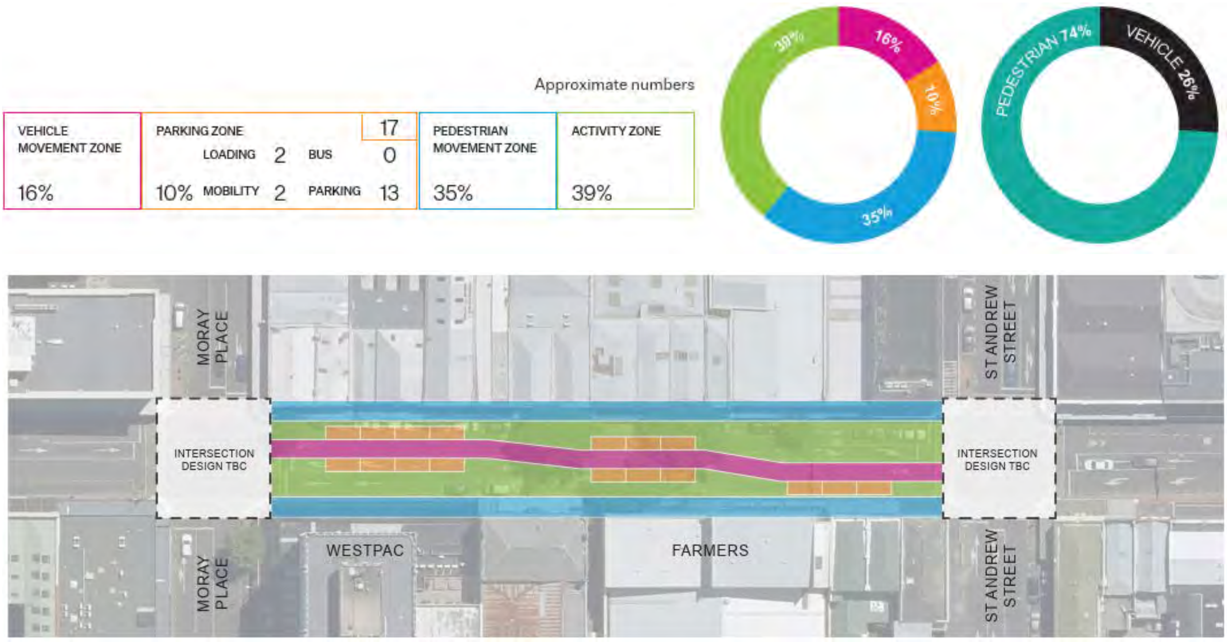


Figure 17: Proposed layout, one-way option – Farmers Block

The graphic below shows the approximate area allocation per transport mode within the Farmers Block under the one-way street option. Compared to the existing situation, space allocation to general vehicles decreases from 61% to 26%, and pedestrian space increases from 39% to 74%.



3.2.2 Golden block

Figure 18 shows a sketch plan of the proposed layout of the one-way street option for the Golden Block.

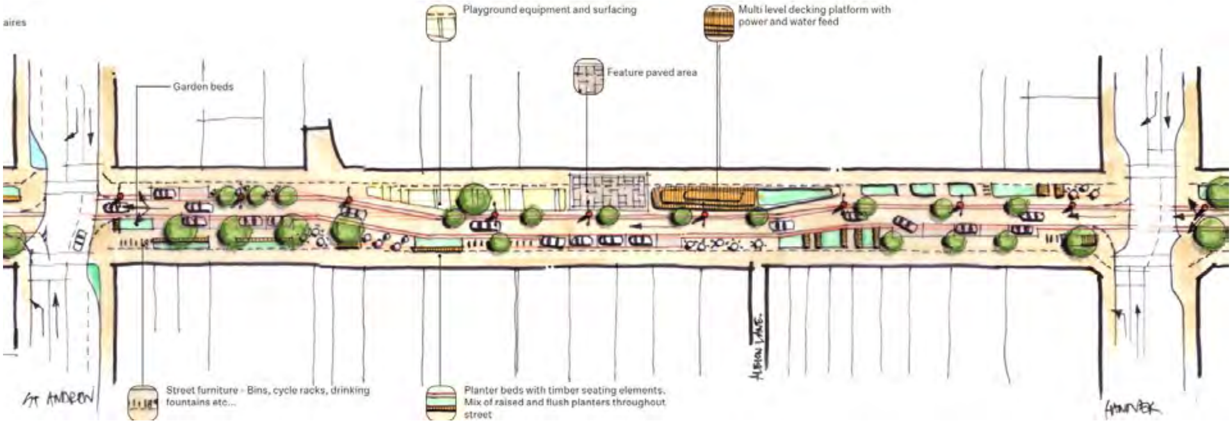
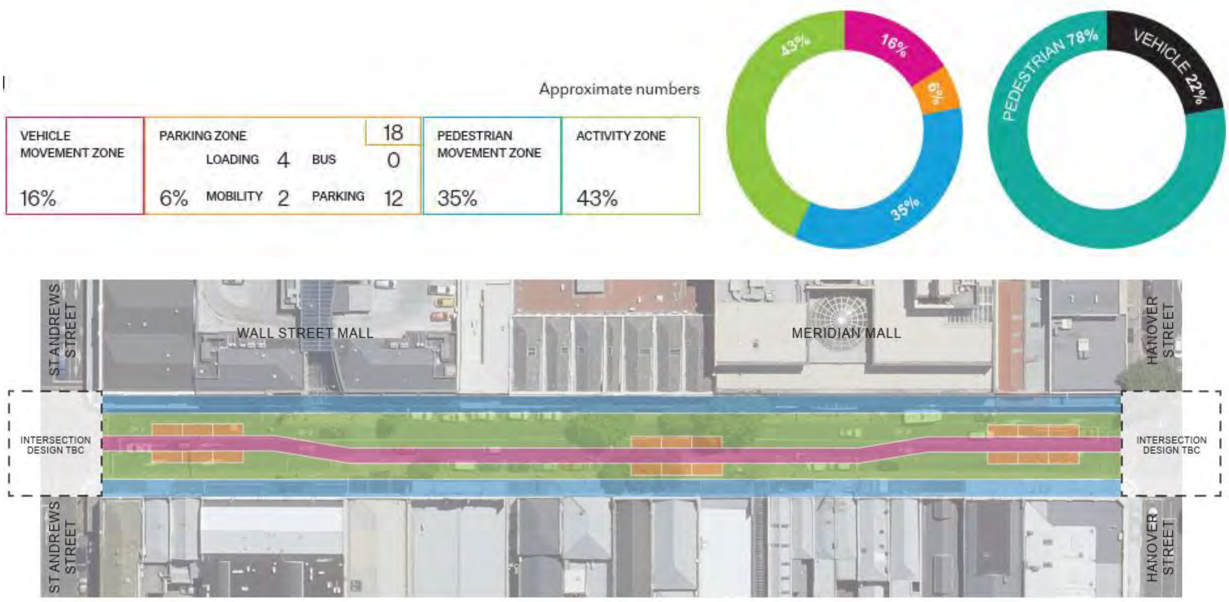


Figure 18: Proposed layout, one-way option – Golden Block

The graphic below shows the approximate area allocation per transport mode within the Golden Block under the one-way street option. Compared to the existing situation, space allocation to general vehicles decreases from 54% to 22%, and pedestrian space increases from 46% to 78%.



3.2.3 Edinburgh block

Figure 19 shows a sketch plan of the proposed layout of the one-way street option for the Edinburgh Block.

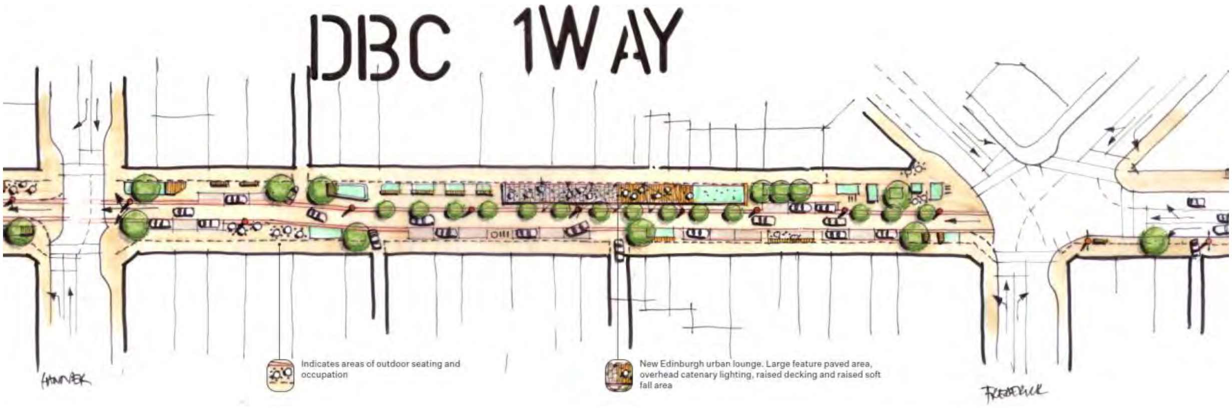
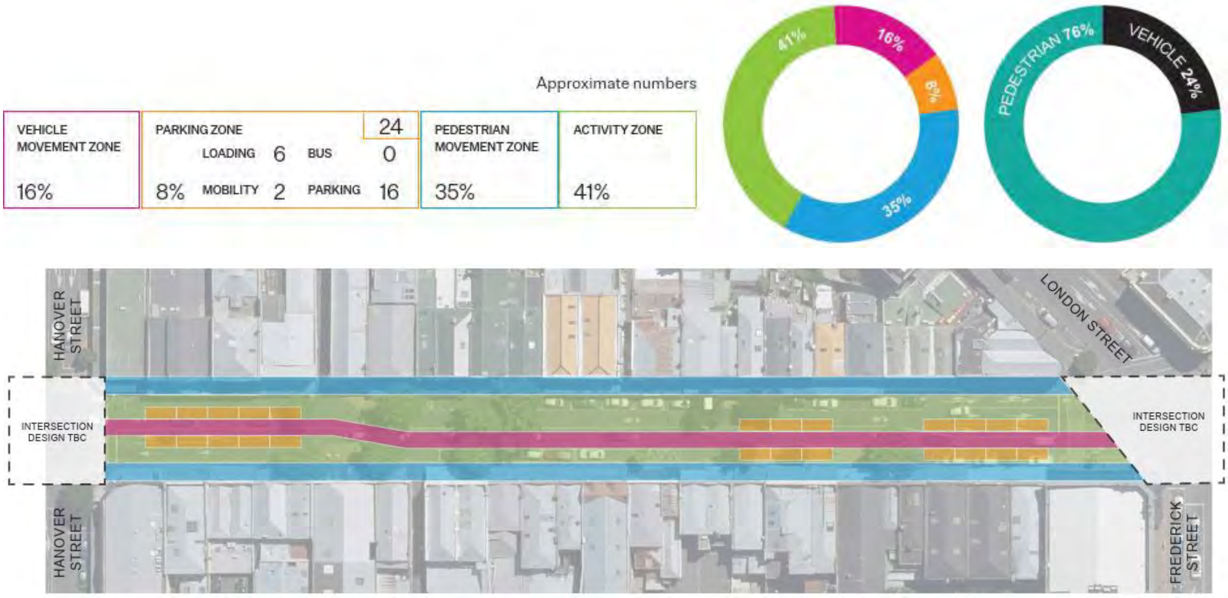


Figure 19: Proposed layout, one-way option – Edinburgh Block

The graphic below shows the approximate area allocation per transport mode within the Edinburgh Block under the one-way street option. Compared to the existing situation, space allocation to general vehicles decreases from 57% to 24%, and pedestrian space increases from 43% to 76%.



3.3 Two-way street option

Similar to the previous sections, the sections below will detail the sketch plans for options considered in the DBC. The plans have been prepared to allow for costing of each proposed option. The designs are indicative of the street layout for each proposed option. The final location of street furniture, materials, trees, planting and alignment of carriageways will be determined in the developed design phase in collaboration with project partners and stakeholders.

3.3.1 Farmers block

Figure 20 shows a sketch plan of the proposed layout of the two-way street option for the Farmers Block.

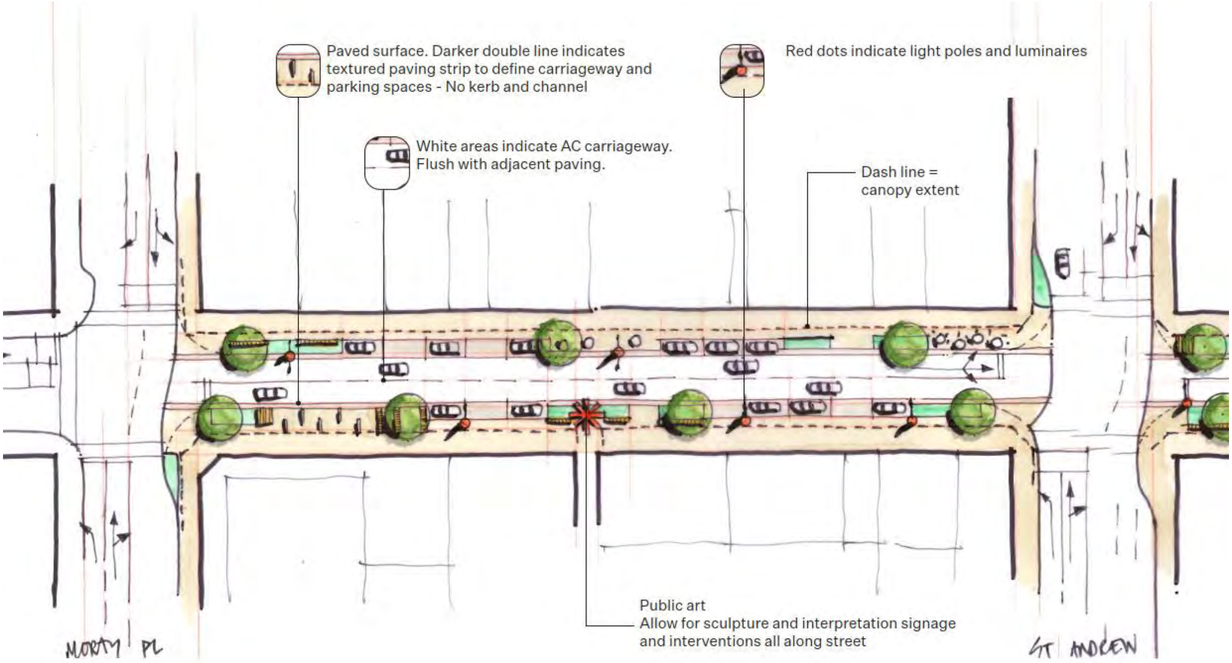
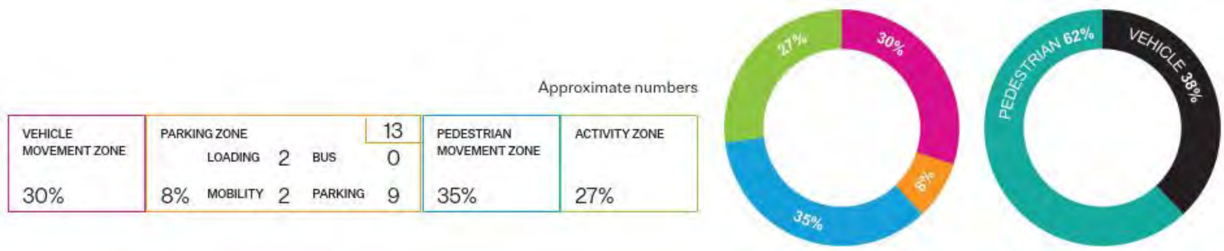


Figure 20: Proposed layout, two-way option – Farmers Block

The graphic below shows the approximate area allocation per transport mode within the Farmers Block under the two-way street option. Compared to the existing situation, space allocation to general vehicles decreases from 61% to 38%, and pedestrian space increases from 39% to 62%.



3.3.2 Golden block

Figure 21 shows a sketch plan of the proposed layout of the two-way street option for the Golden Block.

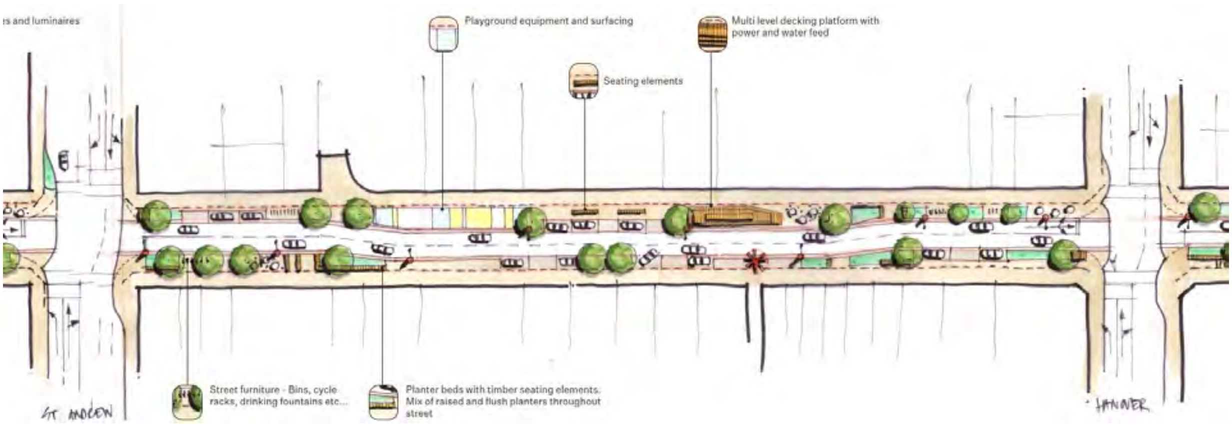


Figure 21: Proposed layout, two-way option – Golden Block

The graphic below shows the approximate area allocation per transport mode within the Golden Block under the two-way street option. Compared to the existing situation, space allocation to general vehicles decreases from 54% to 34%, and pedestrian space increases from 46% to 66%.

3.3.3 Edinburgh block

Figure 22 shows a sketch plan of the proposed layout of the two-way street option for the Edinburgh Block.

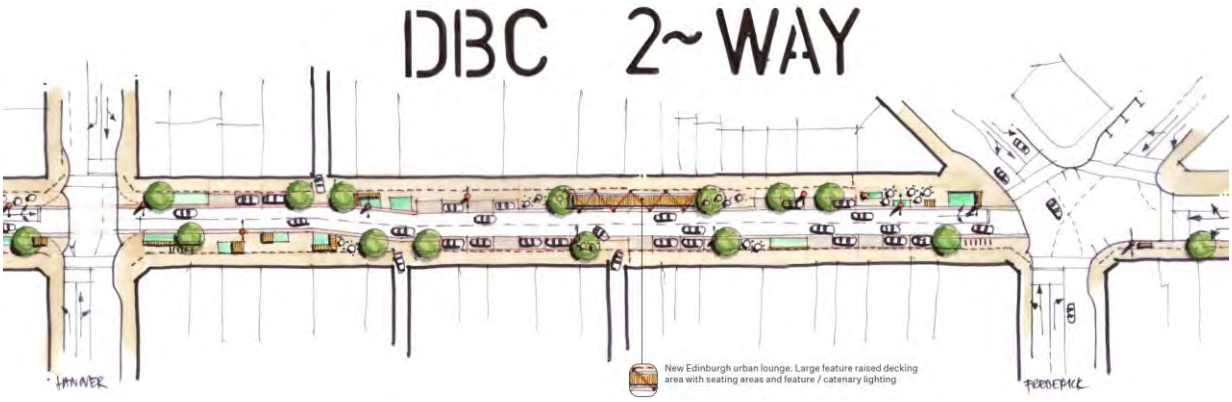
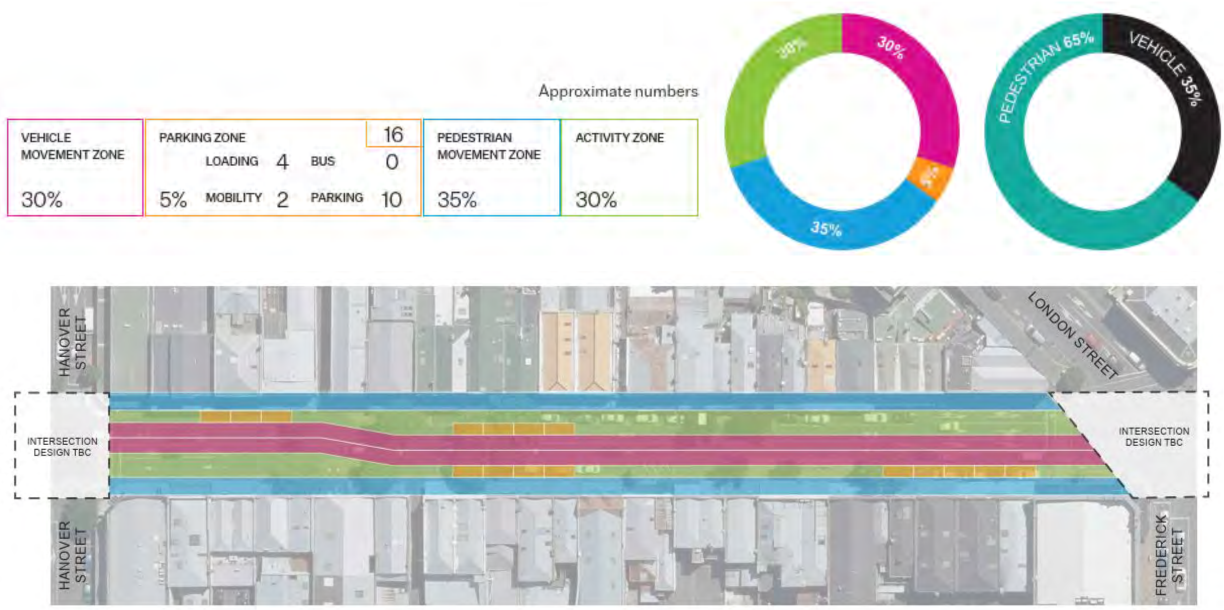


Figure 22: Proposed layout, two-way option – Edinburgh Block

The graphic below shows the approximate area allocation per transport mode within the Edinburgh Block under the two-way street option. Compared to the existing situation, space allocation to general vehicles decreases from 57% to 35%, and pedestrian space increases from 43% to 65%.



3.4 Knox block – all options

Figure 23 shows a sketch plan of the proposed layout under all options for the Edinburgh Block.

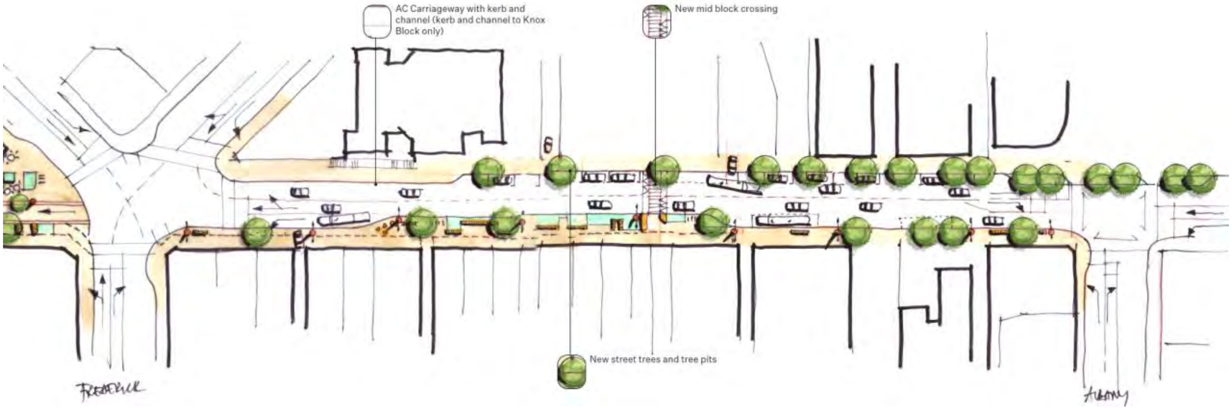


Figure 23: Proposed layout, all options – Knox Block

As discussed in the introduction to this section, this section will remain two way in all options. The proposal includes local footpath widening outside the Knox Church to provide a footpath which is consistent with the rest of the block. Outside the cafes, it is proposed to widen the footpath to create activity space. This would remove a section of existing parking. It is therefore proposed to relocate this parking to the opposite side of the carriageway and provide a mid-block crossing point to allow people to cross George Street.

3.5 Parking

This section will summarise the existing parking along the Project area discussed in the previous sections and the proposed changes expected with the new schemes. **Table 4** sets out the existing parking in each block.

Table 4: Existing parking

Type	Farmers Block	Golden Block	Edinburgh Block	Knox Block
General vehicle Parking	13	12	21	26
Mobility parking	1	0	0	0
Bus stops	0	4	0	2
Loading zones	2	5	8	3

It is evident from the table above that the existing environment is dominated by general vehicles and mobility parking is scarce. **Table 5** details the parking provided under the one-way options.

Table 5: Proposed parking, one-way option

Type	Farmers Block	Golden Block	Edinburgh Block	Knox Block
General vehicle Parking	13	12	16	13
Mobility parking	2	2	2	2
Bus stops	0	0	0	2
Loading zones	2	4	6	2

Under the one-way street options the available space within the corridor is utilised in a more balanced approach. General vehicle parking spaces are reduced while increasing mobility parking spaces. Bus stops are also reduced along George Street and will be discussed in further detail in **Section 4.1.2** of this report. Loading zones are also proposed to be reduced.

Table 6 details the parking provided under the two-way option.

Table 6: Proposed parking, two-way option

Type	Farmers Block	Golden Block	Edinburgh Block	Knox Block
General vehicle Parking	9	6	10	13
Mobility parking	2	2	2	2
Bus stops	0	0	0	2
Loading zones	2	4	4	2

The two-way street option proposes to allocate more running space to motorised traffic and as such general vehicle parking will be reduced further. The number of mobility parking spaces and bus stops are proposed to be similar as the one-way options. Loading zones are reduced by two spaces within the Edinburgh Block.

The proposed schemes envisage that parking along George Street will be short-term parking which aligns with the Project objective of providing a more attractive Retail Quarter. However, the Project area will still be well serviced with long-term parking by the multi-storey Filleul Street and Great King Street carparks which are within walking distance.

4.0 Network changes

4.1.1 Enabling works

With significant traffic calming planned for George Street, most displaced traffic is expected to use Filleul Street and Great King Street as diversion routes. The scope of the enabling works is shown below in **Figure 24** below.

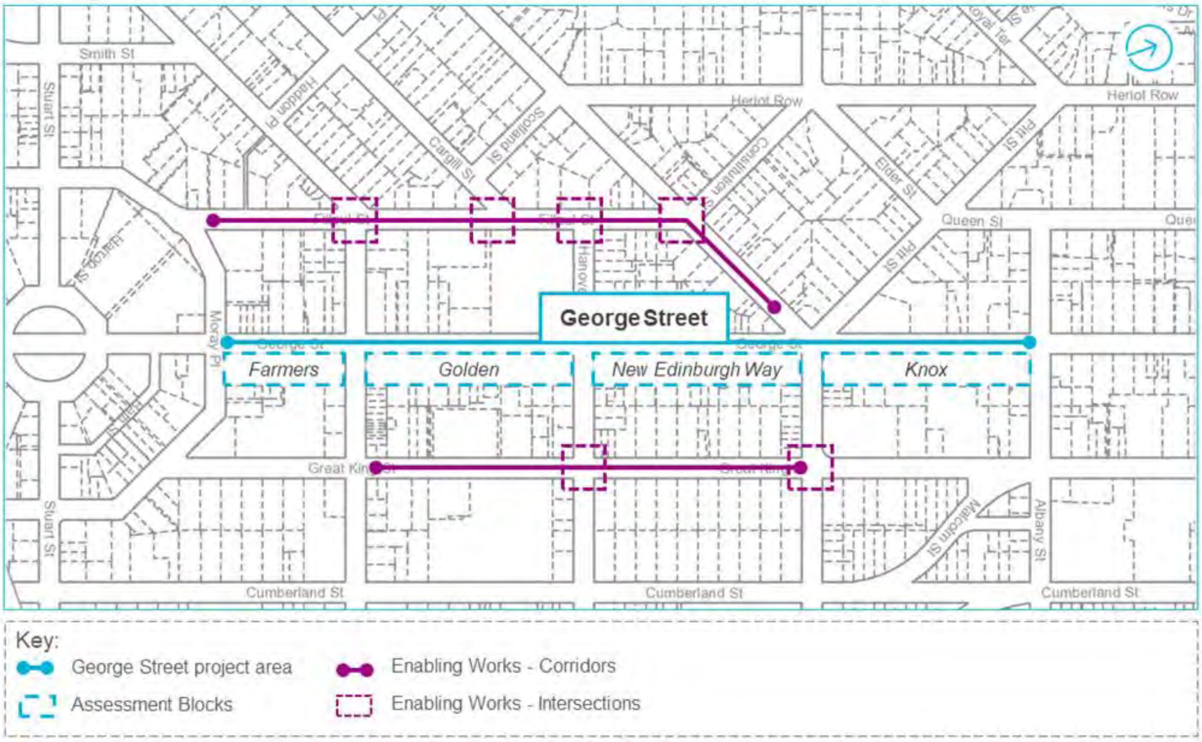


Figure 24: Enabling works

The intent of these works is to:

- Provide alternative options to George Street for through movement, assisting in making the street a more people-focused place in the long-term
- Make Great King Street an efficient, convenient, and attractive route for buses
- Improve access to off-street parking opportunities and reduce traffic circulation
- Improve east-west connectivity and reduce the transport impacts of several construction projects on the central city transport network, including the road closures associated with the George Street upgrade itself

The design approach of the upgrades to Great King Street and Filleul Street has focused on safely providing for, and welcoming all modes by:

- Improving pedestrian crossing movements using Barnes Dance signal phasing and buildouts to reduce crossing distances as well as prioritising the safety of vulnerable users through the identification and provision of safe road crossing facilities
- Supporting efficiency by providing intersection and mid-block layouts designed to facilitate increased traffic flows
- Increasing the size and accessibility of bus stops and expanding infrastructure for bus users
- Providing more cycle parking opportunities
- Minimising on street parking loss from safety and intersection improvements.

Construction of the enabling works will need to be completed prior to construction of the upgrades to George Street to enable the diversion routes to function during any construction related closures of George Street. As a result, the enabling works have been expedited to progress preliminary design as quickly as possible.

The enabling works are not dependent on any specific design option on George Street, but rather focus on improving vehicle movement through both Filleul Street and Great King Street, including improving access to parking buildings and with a specific focus on facilitating the bus movements on Great King Street.

4.1.2 Bus network Changes

With the proposed closure of George Street for the three-water replacement, buses will be redirected from George Street to Great King Street.

Figure 25 below shows the existing and proposed routing.

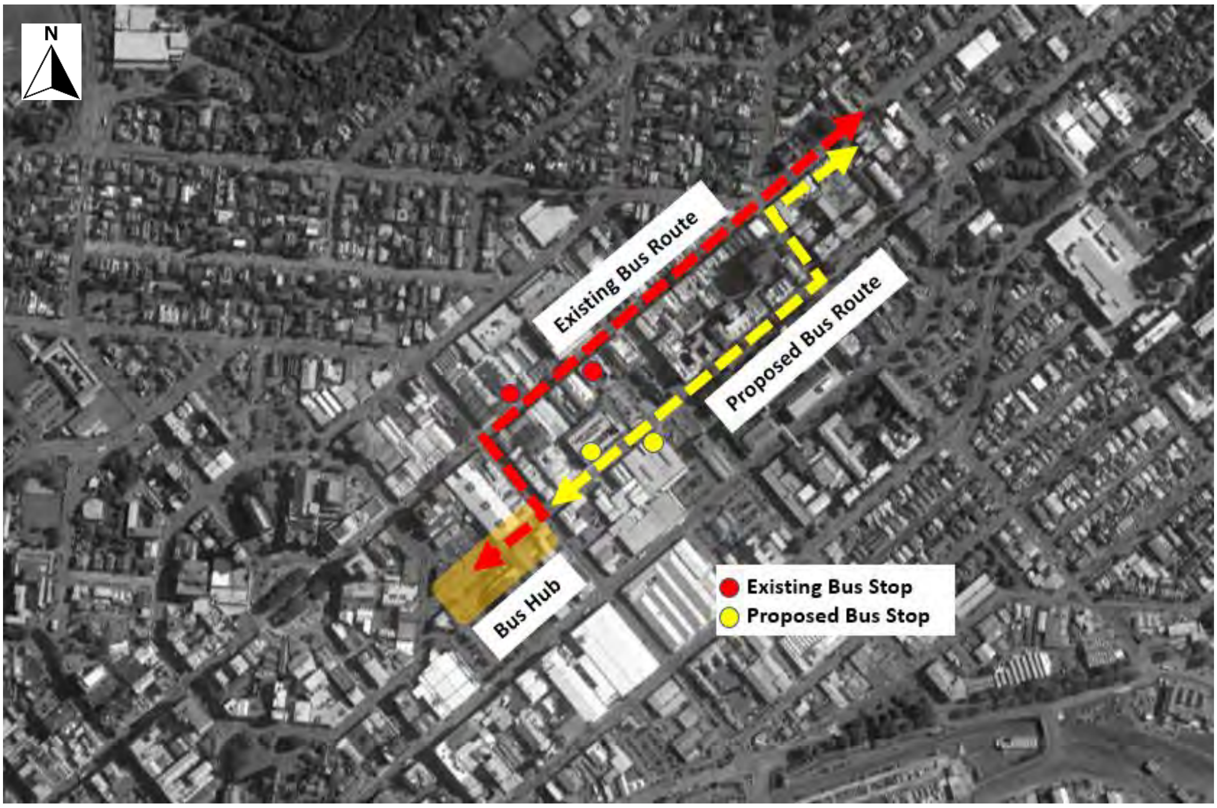


Figure 25: Existing and proposed bus route

As **Figure 25** above shows, buses accessing the Bus Hub from the northeast, progress along George Street, turn left on St Andrew Street and then right onto Great King Street. With the proposed changes, buses will no longer be able to progress along George Street and will turn left at the five-arm intersection from George Street to Frederick Street and then turn right onto Great King Street. As part of the proposals, two new bus stops will be provided on Great King Street to ensure that the current level of accessibility is maintained. Note that the bus stops in the Knox Block are to be retained.

To assess the impact of relocating the bus stops, Basemap TRACC has been used. This is a multi-modal accessibility software tool used to analyse the walk travel times from the public transit stops. Outputs include walk contours from the existing and proposed bus stop locations which are visualised and quantified.

The following assumptions were made:

- Origin - a 100m x100m grid covering the whole of Dunedin Central Business District;
- Public transport stops were taken from the General Transit Feed Specification (GTFS) (May 2021) and were used for the bus stop locations and their frequencies.

Walking speed and catchment -

- **Table** 7 shows the walking catchments based on walking speed (1.5m/s were used for able bodied people, 1.2m/s for people with limited mobility and 0.8m/s was used for those with reduced mobility).

Table 7: Waking catchments to public transport

Speed	5-min Catchment	10-min Catchment
1.5m/s	450m	900m
1.2m/s	360m	720m
0.8m/s	240m	480m

The results of the assessment of the existing environment and the proposed network changes are shown in **Figure 26** and **Figure 27**, respectively.

For able bodied people or people with limited mobility, the entirety of George Street and the Octagon is accessible within a five-minute walk. For those who have reduced mobility issues, whilst George Street is just accessible, the Octagon is not, however this is due to the location of the bus hub and not adjusting the routing of the buses.

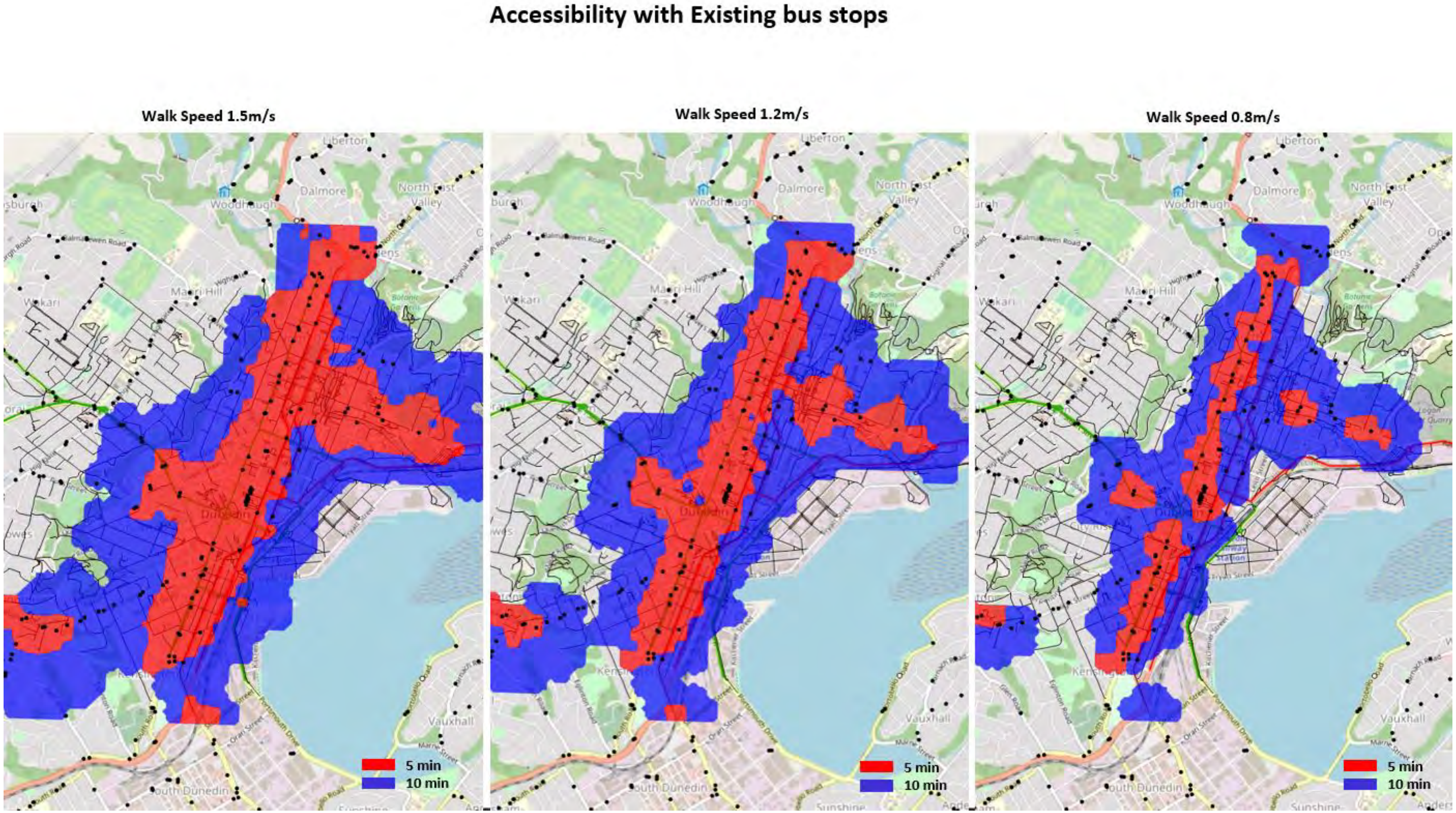


Figure 26: Accessibility to existing bus stops

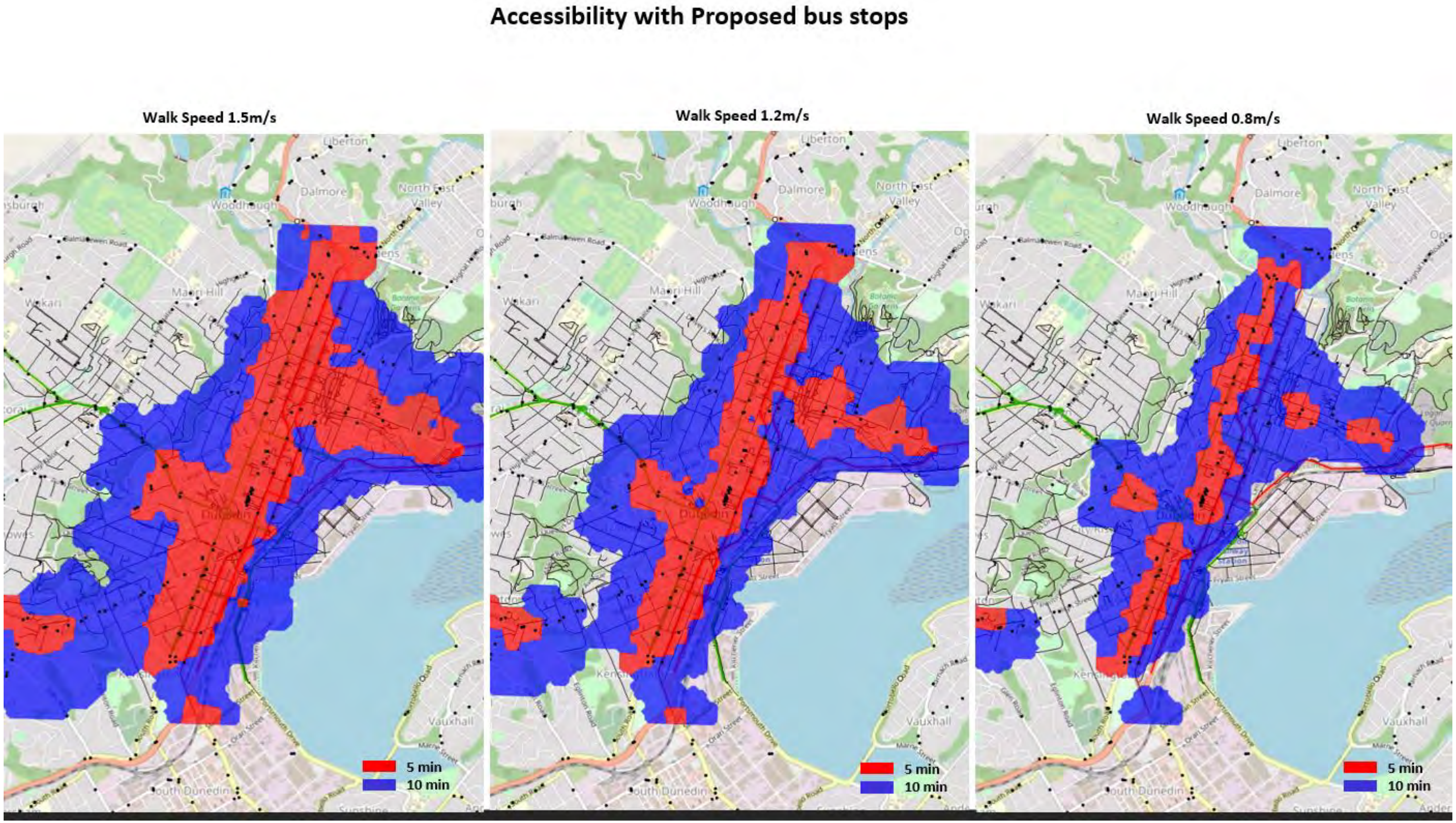


Figure 27: Accessibility to proposed bus stops

5.0 Transport modelling

5.1 Transport Model

For this project the Dunedin Microsimulation Model (DMM) was used for modelling purposes, which has been built within the PARAMICS Discovery Software. The model scenario used was the DMM-2019 Base Model which was updated in September 2020. All model work was completed by the DCC Panel of DCC, Flow, WSP and Abley with AECOM as recipients of extracts thereof.

One of the key comments from the IBC was the integration of this project and the Shaping Future Dunedin Transport (SFDT) project. Therefore, future projects which would influence the future scenarios were discussed and agreed with DCC and several changes were made to the Paramics model to ensure the committed projects were included. It should be noted, that at this stage, the future Dunedin Hospital has not been included.

5.2 Future base year improvements

To ensure the transport model for the George Street Project was configured correctly the model was updated as follows:

5.2.1 2019 Base odel

- Reviewed link classifications for Filleul Street, London Street, Cargill Street and York Street and updated these links as per the SFDT model.

5.2.2 2028 Base model

For the 2028 Base Model the following assumptions were included:

- Added in the Harbourside detail as per the SFDT model.
- Added the Wharf Street / Kitchener Street signalised intersection as per SFDT and ensured the cycle times and offsets were consistent with the nearby Strathallan Street intersection, per peak period.
- Added the Wharf Street / Roberts Street signalised intersection.
- Amended the Wharf Street / Birch Street intersection.
- Reviewed link classifications for Filleul Street, London Street, Cargill Street and York Street and updated these links as per the SFDT model (same as 2019 base model).
- Added all output collectors as per the SFDT model including turning volumes per intersection, LOS per intersection and travel time sections.

5.2.3 2028 Do-Minimum scenario

The changes in the base models were carried through to the Do Minimum option. In addition to this the enabling works were added to ensure all options were tested with the network changes proposed. These include:

- Added in the Great King Street / Hanover Street intersection Barnes Dance arrangement and removed the east and west left turn lanes on Hanover Street. Signal timings were also amended to allow 22 seconds for the Barnes Dance arrangement and re-allocated green times elsewhere.
- Removed buses from George Street and re-assigned to Great King Street (left turn from George Street southbound to Frederick Street and then right onto Great King Street in the inbound direction, and vice versa in the outbound direction).
- Amended the Filleul Street / York Street / St Andrews Street intersection – Filleul Street approaches to consist of a shared left and ahead lane on the kerbside and a dedicated right turn in the offside lanes.

- Added right into Meridian Mall from Filleul Street.
- Amended the London Street / Filleul Street intersection to ban the London Street east to London Street west through movement up the hill and the right turn out of London Street eastbound into Filleul Street.
- George Street coded as existing with a 30km/h speed limit.

5.2.4 Option 1 scenario(Northbound One-Way 10km/h)

The main changes within the Option 1 scenario were:

- George Street configured to be one way northbound (from the five-arm intersection to the intersection of Moray Place / George Street).
- Speed limit decreased from 30km/h to 10km/h through the George Street section above.
- George Street approaches to intersections coded as single lane approaches through the section above.

5.2.5 Option 2 scenario (Southbound One-Way 10km/h)

The main changes within the Option 2 scenario were:

- George Street configured to be one way southbound (from the five-arm intersection to the intersection of Moray Place / George Street).
- Speed limit decreased from 30km/h to 10km/h through the George Street section above.
- George Street approaches to intersections coded as single lane approaches through the section above.

5.2.6 Option 3 scenario (Two-Way 10km/h)

The main changes within the Option 3 scenario were:

- Speed limit decreased from 30km/h to 10km/h through the George Street section above.
- George Street approaches to intersections coded as single lane approaches through the section above.

6.0 Traffic assessment

6.1 Introduction

The transportation assessment section of this report will focus on the outputs from the Paramics transport modelling, which was carried out by the consortium of Flow, WSP and Abley[7]. This modelling work was used to determine the impact the proposed options will have both on the Project area as well as the city centre extent of the transport model.

The transport model scenarios are as follows:

- 2028 Base AM and PM,
- 2038 Base AM and PM,
- 2028 Do-Minimum AM and PM,
- 2038 Do-Minimum AM and PM,
- 2028 Option 1 AM and PM,
- 2038 Option 1 AM and PM,
- 2028 Option 2 AM and PM,
- 2038 Option 2 AM and PM,
- 2028 Option 3 AM and PM, and
- 2038 Option 3 AM and PM.

6.2 Paramics / SIDRA Validation

As part of the assessment, and to confirm that the Paramics outputs for intersection Level of Service (LOS) were relevant, a total of five intersections were developed within SIDRA software to check that delay and LOS outputs were similar and therefore support the use of the Paramics outputs to be reported. SIDRA is a standalone intersection assessment tool used to calculate queue lengths, degree of saturation and delay, and LOS of intersections.

The 2028 Do-Minimum scenario was used for this assessment and the outputs from SIDRA were compared to the outputs from Paramics for the AM, IP and PM peaks for the five intersections shown in **Table 8** below.

[7] George Street DMM Testing for CCG Business Case_v1_270721

Table 8: Differences between Sidra and Paramics (2028)

Intersections	Peak Period	SIDRA		PARAMICS	
		Delay [Sec]	LOS	Delay [Sec]	LOS
Filleul / York / St Andrew	AM	12.4	B	16.9	B
	IP	12.6	B	13.9	B
	PM	21.7	C	20.8	C
George / Moray	AM	25	C	28.7	C
	IP	25.4	C	24.7	C
	PM	25.9	C	66.1	E
George / St Andrew	AM	27.8	C	30.5	C
	IP	28.9	C	29.1	C
	PM	36.1	D	41.5	D
George / Hanover	AM	27	C	28.8	C
	IP	26.9	C	26	C
	PM	27.7	C	30	C
George / Frederick / Pitt / London	AM	78.4	E	76.2	E
	IP	50.7	D	53.9	D
	PM	96.6	F	71.7	E

The above results demonstrate that the SIDRA and Paramics models produce similar results under similar conditions and therefore it was determined that the Paramics results are sufficient for reporting purposes.

6.3 2028 Assessment

6.3.1 2028 AM Network assessment

The transport model outputs have focused both on George Street as well as the wider impacts across the city. The network impacts are shown as flow difference plots, **Figure 28** below shows the flow differences between Option 1 and the Do-Minimum in the 2028 AM peak.

Figure 28: 2028 AM flow differences – Option 1 (northbound one-way) vs Do-Minimum

Figure 28 shows that for Option 1 (George Street northbound only), a significant reduction in traffic along George Street is expected. Whilst the largest impact is between the five-arm intersection and Moray Place, this reduction follows through George Street to the Octagon and Princess Street to the south. The northern section of George Street between the intersection of Warrender Street / Howe Street and the five-arm intersection also sees a reduction.

An increase in traffic is observed along both the northbound and southbound elements of State Highway 1 which is part of the reason for the Project, removing through traffic off George Street. A larger increase is observed on Filleul Street southbound as traffic utilises the parallel route to avoid the 10km/h speed limit and increased red times of the Barnes Dances arrangements which currently exist on George Street. **Figure 29** shows the flow differences between Option 2 and the Do-Minimum in the AM peak.

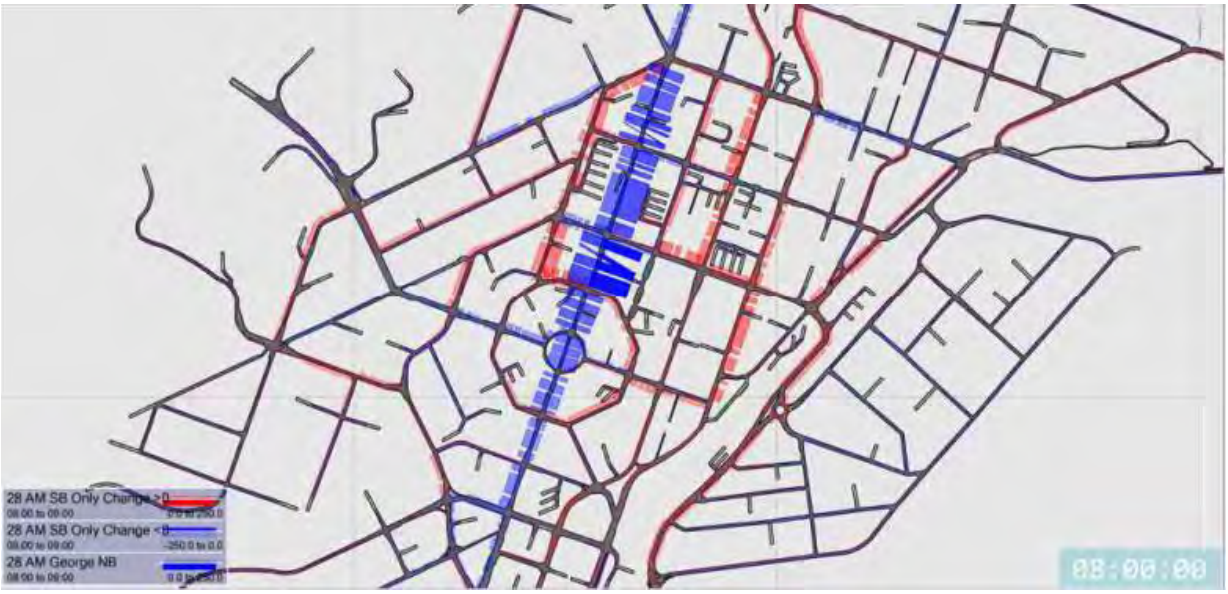


Figure 29: 2028 AM flow differences – Option 2 (southbound one-way) vs Do-Minimum

Figure 29 above demonstrates a similar pattern of traffic reassignment on George Street compared to Option 1. However, a smaller increase is observed on Filleul Street with this traffic seemingly switching to State Highway 1. **Figure 30** shows the flow differences between Option 3 and the Do-Minimum in the AM peak.

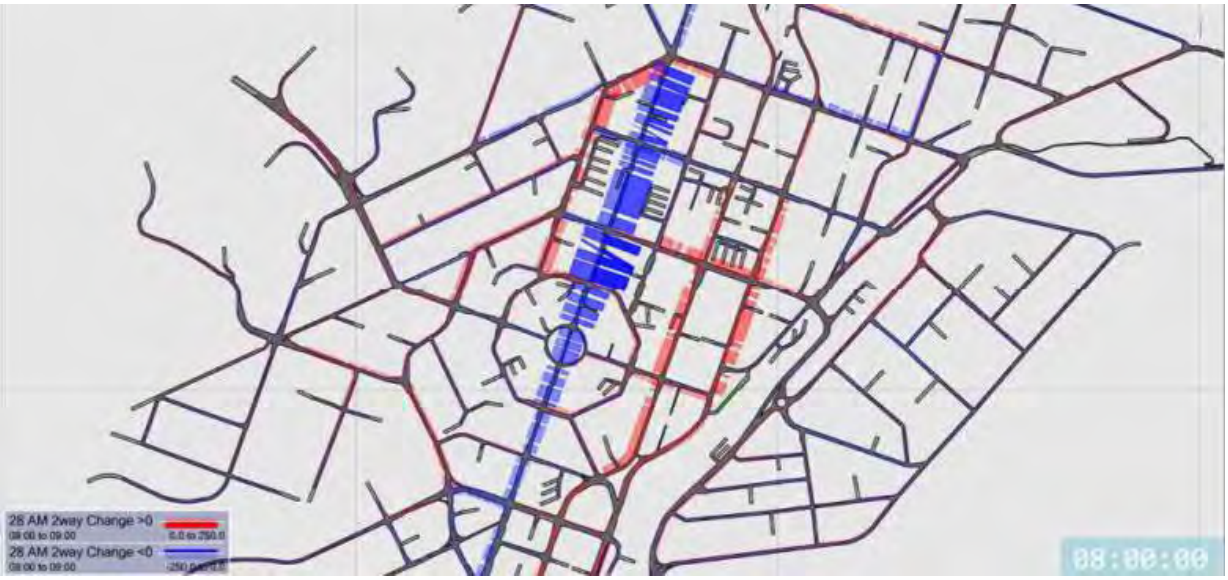


Figure 30: 2028 AM flow differences – Option 3 (two-way) vs Do-Minimum

Figure 30 shows a similar pattern in reductions on George Street. However, this option sees a larger impact of diverted traffic to State Highway 1 than both Option 1 and 2.

All the options show that George Street is being used by through traffic rather than destination traffic. The relocation of this traffic to the primary road corridor of State Highway 1 is a desired effect of the Project and on that basis the three options achieve this.

6.3.2 2028 AM Link volumes

The flow difference plots above are based on bandwidth assessments using a 200-vehicle maximum setting which is why it appears that substantial traffic is being displaced. **Table 9** shows the 2028 AM bi-directional link volumes on George Street and the immediately adjacent north-south links of Filleul Street and Great King Street for the Base scenario and all options.

Table 9: 2028 AM link volumes

Option	George St NB	Great King St NB	Filleul St NB	George St SB	Great King St SB	Filleul St SB
Base	195	283	203	162	132	355
Do-Minimum	91	291	378	150	161	357
Option 1	27	277	406	0	163	421
Option 2	0	277	415	11	187	383
Option 3	10	281	395	5	175	395

Table 10 shows the 2028 AM change in link volumes between the Base scenario and all options along the three corridors.

Table 10: 2028 AM change in link volumes

Option	George St NB	Great King St NB	Filleul St NB	George St SB	Great King St SB	Filleul St SB
Do-Minimum	-104	8	176	-12	29	2
Option 1	-168	-7	203	-162	31	66
Option 2	-195	-6	212	-151	55	28
Option 3	-185	-2	192	-157	43	40

As shown in the table above, George Street northbound has a significant reduction in volumes in all options. The southbound link of George Street sees a minor decrease in volume in the Do-Minimum option and then a significant reduction in all other options.

6.3.3 2028 AM Intersection Assessment

Table 11 below provides the LOS for the intersections which are located within the George Street area. It provides a comparison between the Base, Do-Minimum and the options for the 2028 AM peak.

Table 11: 2028 AM Intersection n Level of Service

Intersection	Base	Do-Min	Option 1	Option 2	Option 3
George St / London St / Frederick St	F	E	E	E	E
Hanover St / George Str	C	C	C	B	C
St Andrews St / George St	C	C	C	C	C
George St / Moray Pl (north)	C	C	C	C	C
Frederick St / Great King St	D	C	C	C	C
Hanover St / Great King St	C	C	C	C	C
St Andrews St / Great King St	C	C	C	C	C
Filleul St / London St	C	C	C	D	C
Filleul St / Cargill St	A	A	A	A	A
St Andrews St / Filleul St	B	B	B	B	B
Filleul St / Meridian Access	A	B	B	A	B
Moray Pl / Filleul St	A	A	A	A	A
Stuart St / London St	B	B	B	B	B
Smith St / Stuart St	D	D	D	D	C

The results presented in **Table 11** are direct extracts from the transport model. The results demonstrate that in the AM peak the five-arm intersection of George Street / London Street / Frederick Street / Pitt Street currently fails in the AM peak Base scenario. This intersection experiences similar issues throughout the other scenarios and is discussed in further detail in **Section 6.5** of this report.

The LOS on the remaining intersections operate in a similar manner demonstrating a limited impact by the options compared to the Base and Do-Minimum scenarios.

6.3.4 2028 PM Network sssessment

Figure 31 below shows the flow differences between Option 1 and the Do-Minimum in the 2028 PM peak.

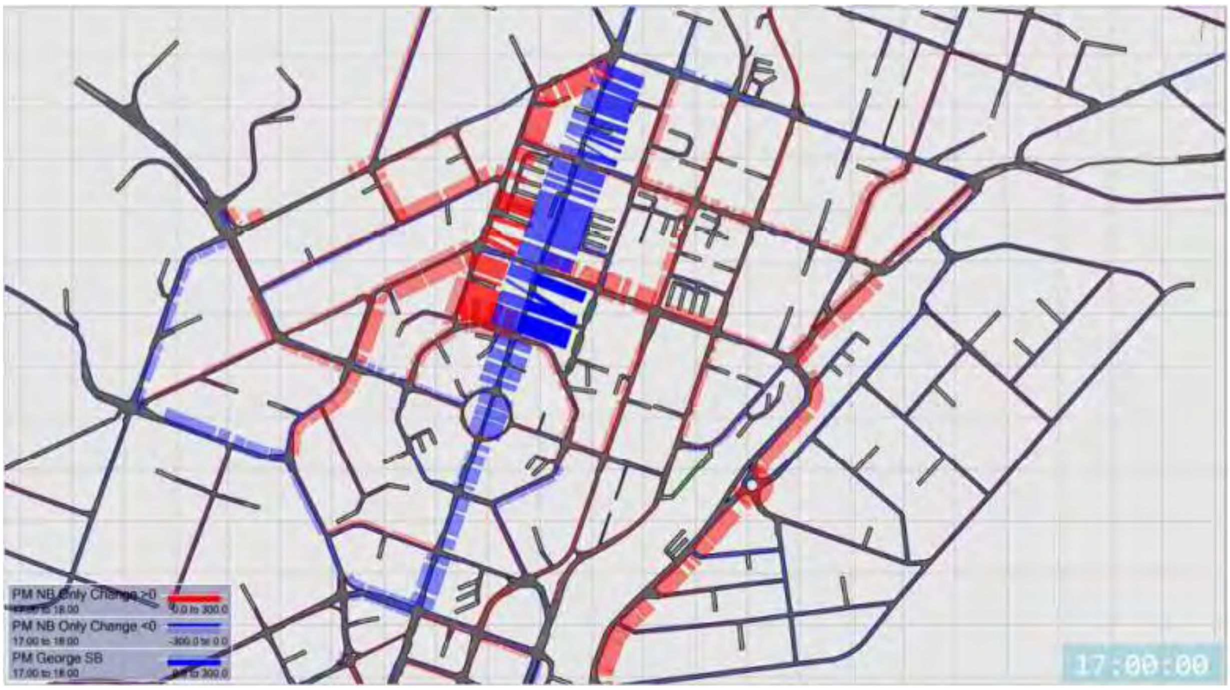


Figure 31: 2028 PM flow differences – Option 1 (northbound one-way) vs Do-Minimum

Figure 31 above highlights that there is a large reduction of through traffic on George Street. This appears to be displaced to Filleul Street and the Harbour connections. The demand is likely to be through traffic, moving across the city, and using Filleul Street as the connector. **Figure 32** below shows the flow differences between Option 2 and the Do-Minimum in the 2028 PM peak.

Figure 32: 2028 PM flow differences – Option 2 (southbound one-way) vs Do-Minimum

Figure 32 shows a similar impact on George Street with a large reduction in through movement traffic. Large increases of traffic demand are observed on Filleul Street and St Andrews Street, with minor increases on the remainder of the network. **Figure 33** below shows the flow differences between Option 3 and the Do-Minimum in the 2028 PM peak.

Figure 33: 2028 PM flow differences – Option 3 (two-way) vs Do-Minimum

Figure 33 shows the network impacts of Option 3, a two-way slow speed arrangement on George Street. A reduction in traffic demand is observed on George Street as well as Stuart Street. Both the northbound and southbound links of State Highway 1 see an increase in volumes. Similar to Option 1, the George Street northbound option, the Harbour areas see an increase in demand.

6.3.5 2028 PM Link Volumes

Table 12 shows the 2028 PM bi-directional link volumes on George Street and the immediately adjacent north-south links of Filleul Street and Great King Street for the Base scenario and all options.

Table 12: 2028 PM link volumes

Option	George St NB	Great King St NB	Filleul St NB	George St SB	Great King St SB	Filleul St SB
Base	319	247	171	210	374	818
Do-Minimum	182	259	434	183	405	769
Option 1	29	285	448	0	385	954
Option 2	0	273	438	26	391	935
Option 3	20	262	433	16	393	927

Table 13 shows the 2028 PM change in link volumes between the Base scenario and all options along the three corridors.

Table 13: 2028 PM change in link volumes

Option	George St NB	Great King St NB	Filleul St NB	George St SB	Great King St SB	Filleul St SB
Do-Minimum	-137	12	262	-27	31	-49
Option 1	-290	39	277	-210	11	136
Option 2	-319	27	267	-184	18	117
Option 3	-299	15	262	-194	20	109

As shown in the table above, George Street northbound has a significant reduction of volumes in all options. Similar to the 2028 AM peak, the southbound link of George Street sees a minor decrease in volume in the Do-Minimum option and then a significant reduction in all other options. Filleul Street southbound is expected to experience a minor decrease in demand in the Do-Minimum 2028 PM peak.

6.3.6 2028 PM Intersection assessment

Table 14 below provides the LOS for the intersections located within the George Street area and provides a comparison between the Base, Do-Minimum and the options for the 2028 PM peak.

Table 14: 2028 PM Intersection Level of Service

Intersection	Base	Do-Min	Option 1	Option 2	Option 3
George St / London St / Frederick St	F	E	E	E	E
Hanover St / George Str	C	C	B	C	C
St Andrews St / George St	D	E	C	C	C
George St / Moray Pl (north)	E	E	C	C	C
Frederick St / Great King St	D	C	D	D	C
Hanover St / Great King St	C	D	C	D	C
St Andrews St / Great King St	D	C	D	D	D
Filleul St / London St	A	A	B	B	B
Filleul St / Cargill St	C	B	C	C	C
St Andrews St / Filleul St	C	C	C	C	C
Filleul St / Meridian Access	C	C	C	C	C
Moray Pl / Filleul St	D	A	B	B	B
Stuart St / London St	D	C	D	D	D
Smith St / Stuart St	D	D	E	E	E

The results clearly demonstrate the PM peak to be the critical period, with more intersections operating in the LOS D to LOS E range. Similar to the AM peak, a minor improvement is forecast at the five-arm intersection compared to the Base scenario, albeit maintaining a poor level of operation (LOS E across all other scenarios).

As might be expected, the lower volumes on George Street in the three main options result in less overall delay along this corridor. There is however little change to the operational results along Filleul Street, despite the additional volumes. Across the wider network, there is little impact on traffic operation, on the key north-south alternative routes.

6.4 2038 Assessment

6.4.1 2038 AM Network assessment

Figure 34 below shows the flow differences between Option 1 and the Do-Minimum in the 2038 AM peak.

Figure 34: 2038 AM flow differences – Option 1 (northbound one-way) vs Do-Minimum

In the 2038 AM peak there is an observable increase in reassignment. The spread of volume decrease (blue links) is more related to congestion in the network resulting in less traffic reaching destinations compared to the Do-Minimum.

Figure 34 below shows the flow differences between Option 2 and the Do-Minimum in the 2038 AM peak.

Figure 35: 2038 AM flow differences – Option 2 (southbound one-way) vs Do-Minimum

Option 2 in 2038 AM peak results in higher traffic reassignment, especially to the State Highway. A similar pattern of volume spread is observed along City Road and Rattray Street compared to Option 1.

Figure 36 below shows the flow differences between Option 3 and the Do-Minimum in the 2038 AM peak.

Figure 36: 2038 AM flow differences – Option 3 (two-way) vs Do-Minimum

Observable network reassignment occurs in the Option 3 2038 AM peak, with a similar decrease in demand in the western region of the Project area compared to Option 2. Traffic demand on the State Highway southbound is also increased.

6.4.2 2038 AM Link Volumes

Table 15 shows the 2038 AM bi-directional link volumes on George Street and the immediately adjacent north-south links of Filleul Street and Great King Street for the Base scenario and all options.

Table 15: 2038 AM link volumes

Option	George St NB	Great King St NB	Filleul St NB	George St SB	Great King St SB	Filleul St SB
Base	206	300	240	169	140	361
Do-Minimum	108	301	388	165	181	397
Option 1	30	304	409	0	183	457
Option 2	0	283	409	11	179	443
Option 3	13	293	389	6	186	428

Table 16 shows the 2038 AM change in link volumes between the Base scenario and all options along the three corridors.

Table 16: 2038 AM change in link volumes

Option	George St NB	Great King St NB	Filleul St NB	George St SB	Great King St SB	Filleul St SB
Do-Minimum	-98	1	148	-4	41	36
Option 1	-176	4	169	-169	43	95
Option 2	-206	-17	169	-158	39	82
Option 3	-194	-7	149	-163	46	66

Similar to the 2028 AM scenarios, George Street northbound has a significant reduction in volumes in all options. The southbound link of George Street sees a minor decrease in volume in the Do-Minimum option and then a significant reduction in all other options.

6.4.3 2038 AM Intersection assessment

Table 17 below provides the LOS for the intersections which are located within the George Street area. It provides a comparison between the Base, Do-Minimum and the options for the 2038 AM peak.

Table 17: 2038 AM Intersection Level of Service

Intersection	Base	Do-Min	Option 1	Option 2	Option 3
George St / London St / Frederick St	F	E	F	F	E
Hanover St / George Str	C	C	C	B	C
St Andrews St / George St	C	C	C	C	C
George St / Moray Pl (north)	C	C	C	C	C
Frederick St / Great King St	D	C	C	C	C
Hanover St / Great King St	C	C	C	C	C
St Andrews St / Great King St	C	C	D	C	C
Filleul St / London St	E	D	D	E	D
Filleul St / Cargill St	A	A	A	A	A
St Andrews St / Filleul St	B	B	B	B	B
Filleul St / Meridian Access	B	B	A	A	B
Moray Pl / Filleul St	A	A	A	A	A
Stuart St / London St	C	C	B	C	C
Smith St / Stuart St	D	D	D	D	D

The results show little change between the scenarios, demonstrating minimal impact in the 2038 AM peak. The five-arm intersection however remains the critical constraint in the local network, and the poor performance in the Option 1 and Option 2 scenarios at this intersection suggest that the restriction in movements to the south on George Street is resulting is some issues in balancing capacity and demand at this location.

The Filleul Street / London Street intersection is expected to operate near capacity in the Base and Option 2 scenarios. The remaining intersections show no material change in LOS which demonstrates a limited impact by the options compared to the Base and Do-Minimum scenarios.

6.4.4 2038 PM Network Assessment

Figure 37 below shows the flow differences between Option 1 and the Do-Minimum in the 2038 PM peak.

Figure 37: 2038 PM flow differences – Option 1 (northbound one-way) vs Do-Minimum

Figure 37 above highlights that there is a large reduction of through traffic on George Street. Similar to the 2038 AM peak for this option, the spread of volume decrease (blue links) is more related to congestion in the network resulting in less traffic reaching destinations compared to the Do-Minimum.

Figure 38 below shows the flow differences between Option 2 and the Do-Minimum in the 2038 PM peak.

Figure 38: 2038 PM flow differences – Option 2 (southbound one-way) vs Do-Minimum

Figure 38 shows a similar impact on George Street with a large reduction in through movement traffic. Compared to the 2028 PM peak for this option, a smaller increase in traffic demand is observed on Filleul Street, however a greater increase is observed on the Harbour connections. Cargill Street and Royal Terrace are also expected to experience increased traffic demand under the Option 2 scenario.

Figure 39 below shows the flow differences between Option 3 and the Do-Minimum in the 2038 PM peak.

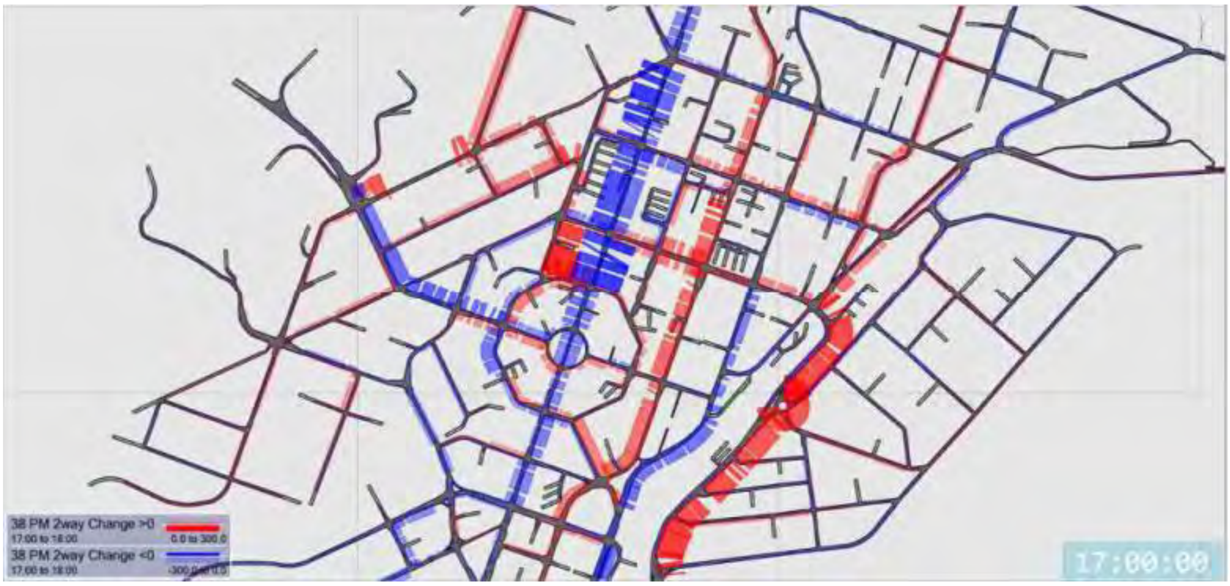


Figure 39: 2038 PM flow differences – Option 3 (two-way) vs Do-Minimum

Figure 39 shows the network impacts of Option 3, a two-way slow speed arrangement on George Street. A reduction in traffic demand is observed on George Street as well as Stuart Street. The Harbour areas are expected see an increase in traffic demand.

6.4.5 2038 PM Link Volumes

Table 18 shows the 2038 PM bi-directional link volumes on George Street and the immediately adjacent north-south links of Filleul Street and Great King Street for the Base scenario and all options.

Table 18: 2038 PM link volumes

Option	George St NB	Great King St NB	Filleul St NB	George St SB	Great King St SB	Filleul St SB
Base	321	278	236	179	385	812
Do-Minimum	186	292	439	139	387	851
Option 1	35	279	476	0	385	914
Option 2	0	290	511	35	395	925
Option 3	23	254	466	34	411	908

Table 19 shows the 2038 AM change in link volumes between the Base scenario and all options along the three corridors.

Table 19: 2038 PM link change in link volumes

Option	George St NB	Great King St NB	Filleul St NB	George St SB	Great King St SB	Filleul St SB
Do-Minimum	-135	14	204	-40	2	39
Option 1	-286	1	240	-179	-1	102
Option 2	-321	13	275	-144	10	113
Option 3	-298	-24	230	-145	26	96

As shown in the table above, George Street northbound has a significant reduction of volumes in all options. Similar to the 2038 AM peak, the southbound link of George Street sees a minor decrease in volume in the Do-Minimum option and then a significant reduction in all other options. Great King Street is expected to experience a minor decrease in traffic demand under Option 3 in the 2038 PM peak.

6.4.6 2038 PM Intersection assessment

Table 20 below provides the LOS for the intersections located within the George Street area and provides a comparison between the Base, Do-Minimum and the options for the 2038 PM peak.

Table 20: 2038 PM Intersection Level of Service

Intersection	Base	Do-Min	Option 1	Option 2	Option 3
George St / London St / Frederick St	F	E	F	F	F
Hanover St / George Str	D	D	C	C	D
St Andrews St / George St	F	F	C	C	C
George St / Moray Pl (north)	F	F	C	C	C
Frederick St / Great King St	D	C	D	D	D
Hanover St / Great King St	D	D	D	D	D
St Andrews St / Great King St	D	D	D	D	D
Filleul St / London St	D	B	D	E	F
Filleul St / Cargill St	E	E	D	C	D
St Andrews St / Filleul St	C	D	C	C	D
Filleul St / Meridian Access	C	D	C	C	C
Moray Pl / Filleul St	A	F	C	D	D
Stuart St / London St	D	D	D	C	D
Smith St / Stuart St	D	E	E	E	E

In the 2038 PM peak, the results show that operation performance declines. Several more intersections are operating in the LOS E to LOS F range compared to the 2028 demand set. The main points of congestion are moved between the Base/Do Minimum and the three options, with George Street being more congested in the Base and Do Minimum as traffic seeks to use the corridor, whereas poor operation is predicted on the alternative corridors in the three proposed options.

It was noted in the Paramics transport modelling report that in all five model scenarios during the 2038 PM peak the model was unstable, with around 25% of models failing to run the full period (due to locking up issues). Several features were added to the model parameters to minimise the chance of this occurring, but the demand levels are such that queues are extending back through several intersections across several corridors. This in turn lead to some questionable re-assignment in the model as traffic increasingly sought to assign away from these areas.

As a result, the 2038 PM peak results should be viewed with some caution, as there was significant variation between model runs, and the subsequent analytical output. Efforts were made to minimise the impact of "outlier" runs by removing these from the analysis, but significant variations were still present.

6.4.7 Through traffic

As part of the assessment of George Street, one element of assessment which was required to be tested was the total through traffic volumes. The transport model has been used to extract the information and this is shown in Table 21.

Table 21 Through traffic 2038

Direction	Scenario	2038 PM Peak				
		Base	Do Min	10kmh NB Only	10kmh SB Only	10kmh Two-Way
Northbound	Flow – Meridian Block	321	186	35	0	23
	Through Flow (Moray to Frederick)	44	47	0	0	1
	% Through	14%	25%	0%	0%	4%
Southbound	Flow – Meridian Block	179	139	0	35	34
	Through Flow (Moray to Frederick)	82	83	0	0	2
	% Through	46%	60%	0%	1%	6%

As can be seen above the current level of through traffic is around 14% in the northbound direction and 46% southbound. This increases in the Do Min scenario to 25% and 60%. Both the one-way options see a large reduction in through traffic to 0%, with the two-way being reduced to 4% northbound and 6% southbound. It is considered that whilst this is a significant reduction the model has allocated trips for purpose and therefore may not be representative of the future scenario. Additionally, it should be noted that the George Street corridor is modelled with a 10km/hr speed environment making the route very unattractive from a time perspective. In reality it is very hard to travel at 10km/hr and therefore vehicles may travel slightly faster than this which will see a few more vehicles use this route.

6.4.8 Network Performance Statistics

The Base Case (Do Nothing), Do Minimum and Options scenarios were modelled by WSP using the Paramics model. The total network travel distance and travel times were extracted from the models. A summary of these are shown in

Table 22 2019 Paramics Model Network Statistics Summary

Time Period	Network Statistics	Base
AM Peak Hour	Travel Time (hr)	1,697
	Trip distance (km)	49,886
Interpeak Hour	Travel Time (hr)	1,228
	Trip distance (km)	38,360
PM Peak Hour	Travel Time (hr)	2,110
	Trip distance (km)	55,989

Table 23 2028 Paramics Model Network Statistics Summary

Time Period	Network Statistics	Base	Do Min	Two-Way	One-Way NB	One-Way SB
AM Peak Hour	Travel Time (hr)	1,809	1,805	1,794	1,803	1,809
	Trip distance (km)	51,513	51,610	51,622	51,735	51,710
Interpeak Hour	Travel Time (hr)	1,278	1,275	1,279	1,286	1,293
	Trip distance (km)	39,457	39,505	39,603	39,589	39,608
PM Peak Hour	Travel Time (hr)	2,303	2,402	2,386	2,394	2,467
	Trip distance (km)	56,794	56,868	57,084	56,966	57,095

Table 24 2038 Paramics Model Network Statistics Summary

Time Period	Network Statistics	Base	Do Min	Two-Way	One-Way NB	One-Way SB
AM Peak Hour	Travel Time (hr)	1,967	1,942	1,980	1,978	2,016
	Trip distance (km)	52,665	52,674	52,898	52,770	52,861
Interpeak Hour	Travel Time (hr)	1,381	1,408	1,349	1,382	1,380
	Trip distance (km)	41,254	41,264	41,220	41,304	41,310
PM Peak Hour	Travel Time (hr)	2,651	2,686	2,738	2,689	2,695
	Trip distance (km)	55,569	55,299	55,430	55,249	54,732

As shown above there is very little difference between the base and the options in terms of travel time and trip distances across each of the modelled years.

6.4.9 Summary

This section of the report has looked at the likely impacts the proposed options would have on the operation of the central city's transport network. It has demonstrated that all options have little impact on the network in 2028 and that.. At a local level, the through traffic volumes on George Street are expected to reduce significantly which is positive in the nature of the project. In 2038, the transport model has shown some intersections failing however, the Paramics model has also had issues with stability with 25% of the models failing to run. Based on this it is recommended that further refinement is carried out on the Paramics model to ensure stability before the assessment is carried out again. This cannot be done in the time frames of this project.

6.5 Five-arm intersection assessment

The five-arm intersection of George Street, London Street and Pitt Street is an issue from both a pedestrian and vehicle movement assessment. For vehicles, there is long cycle time of approximately 137 seconds between cycles and, for pedestrians, there is no full red crossing phase, which results in conflict within the intersection and poor operational performance. As set out in the sections above, this intersection is proposed to fail in all scenarios. The intersection assessment has been carried out using the traffic volumes, extracted from the transport model as well as the signal phasing provided by DCC. In addition, site-based observations have been carried out to confirm the signal phasing.

6.5.1 History of the intersection

The five-arm intersection has previously been classified as one of the most dangerous intersections within New Zealand. This safety concern was driven primarily by the five-arm layout as well as pedestrian safety concerns. However, this intersection has improved based on recent collision data presented within the DBC. Limited collisions have occurred recently leading to this intersection falling out of the top 10 unsafe intersection list.

There could be a number of reasons for this, and from site observations it is believed that pedestrians from the University, are now using the intersection of Frederick Street / Great King Street (where a Barnes Dance has been installed) to avoid this intersection.

During site observations, near misses were witnessed with pedestrians trying to cross the road when vehicles were permitted to move. This indicates that there remains a high-level of risk at this intersection, and whilst data captures only reported incidents, near misses can be a good indicator of potential future crashes.

6.5.2 Assessment

Figure 40 below shows the existing layout of the intersection.

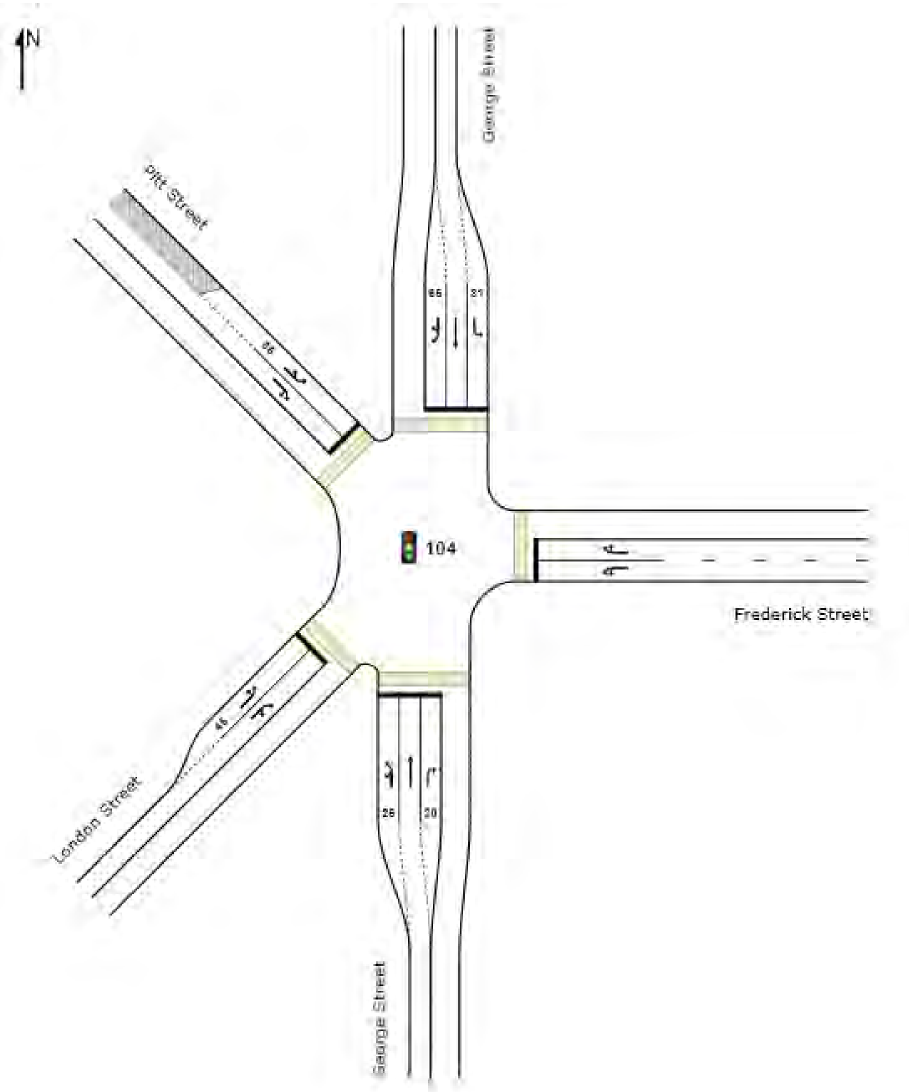


Figure 40 – Existing Layout of Five Arm Intersection.

Figure 41 and below shows the existing level of service of the intersection.

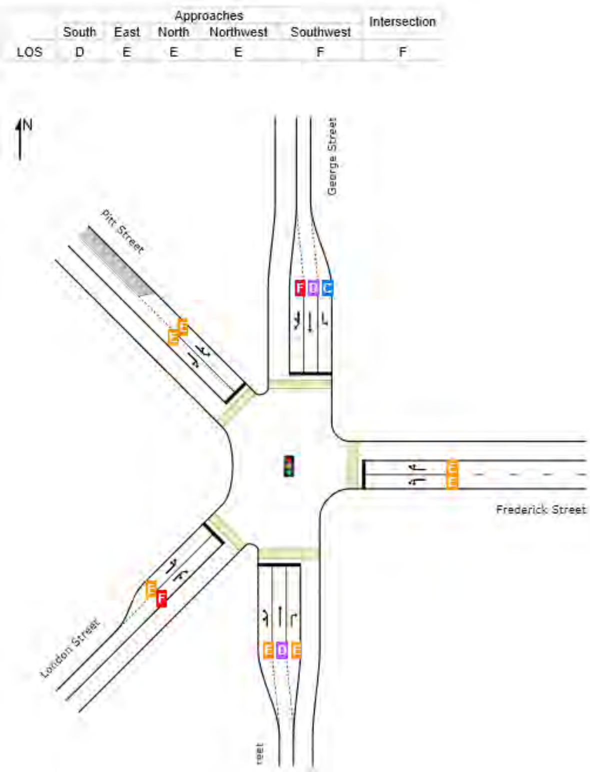


Figure 41 Five Arm Intersection AM Base LoS

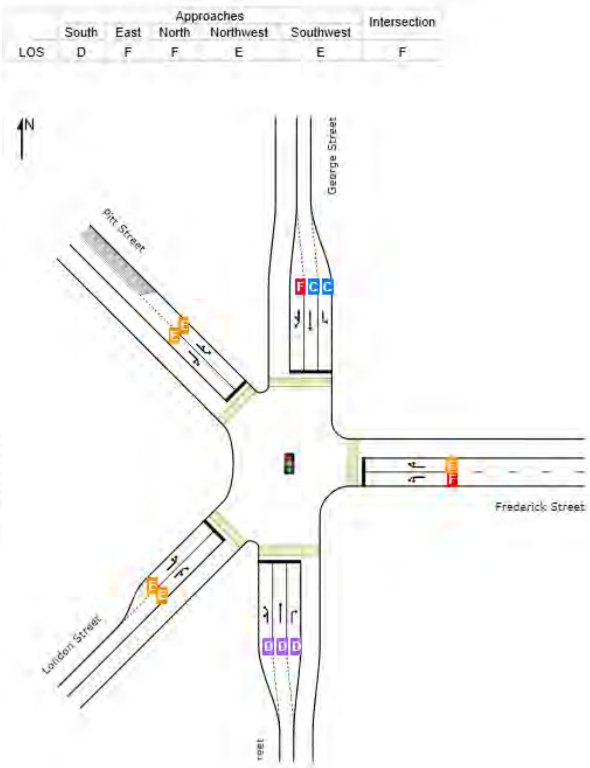


Figure 42 Five Arm Intersection Base PM LoS

As the above figures show, the existing intersection is a Level of Service F in both the AM PM peak. The majority of traffic in the AM peak utilises Pitt Street and London Street to access Frederick Street and then the State Highway. The right turn from George Street to London Street is F in the AM peak and E in the PM peak. The signal phasing, provided by DCC, for the AM and PM peak scenario are shown in Table 25 and Table 26 below.

Table 25 Five Arm Intersection AM Base Signal Phase and timing

Phase	A	B	C	D	F
Phase Change time (sec)	0	29	54	87	113
Green Time (sec)	23	19	27	20	18
Phase Time (sec)	29	25	33	26	24
Phase Split (sec)	21%	18%	24%	19%	18%

Table 26 Five Arm Intersection PM Base Signal Phase and timing

Phase	A	B	C	D	F
Phase Change time (sec)	0	34	61	86	117
Green Time (sec)	28	21	19	25	14
Phase Time (sec)	34	27	25	31	20
Phase Split (sec)	25%	20%	18%	23%	15%

As part of the assessment process, the current intersection was optimised within SIDRA to see if the timings provided were the reason for failure.

Figure 43 Five Arm Intersection AM optimised

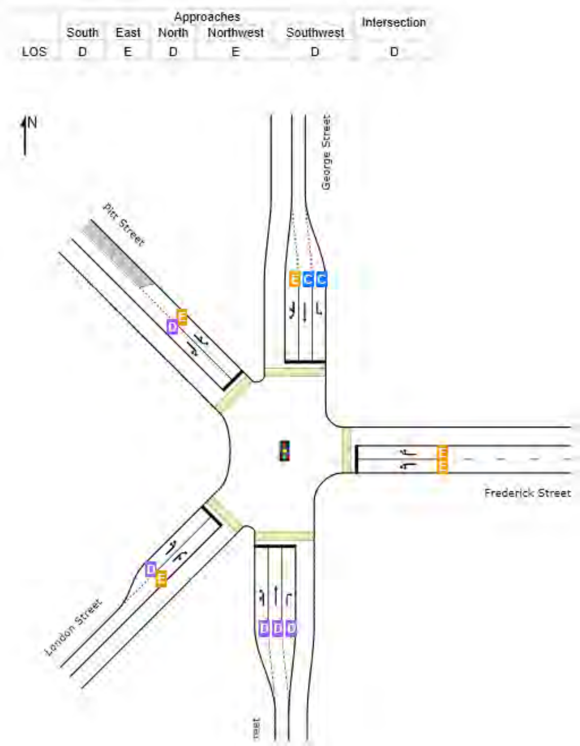
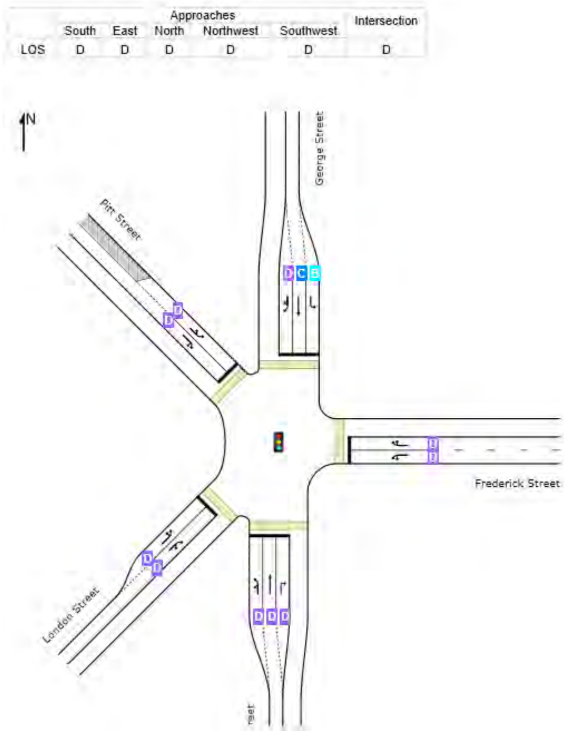


Figure 44 Five Arm Intersection PM optimised



As shown above, just by optimising the signal intersection, we can improve the LoS and operation of the intersection to D.

The below table provides the assessment for the various options discussed above. It should be noted all options are optimised.

Table 27 2028 Level Of Service Five Arm Intersection

Option	Reference	2028 (LoS)	
		AM	PM
Option 1	One Way NB	D	D
Option 2	One Way SB	D	D
Option 3	Two Way Slow	D	D

As set out above the intersection will have the same Level of Service regardless of option. However, one of the potential improvements for the one-way southbound option would be to remove a signal phase (as vehicles travelling north no longer required) and this would therefore remove some delay at the intersection.

Pedestrians at the five-arm have reported near misses and these are reflected in detail within the DBC. Following a review of the design, one of the options would be to introduce a full red pedestrian phase at the intersection to allow pedestrians to cross safely. This would result in LoS E for all vehicle movements. A test was carried out to introduce a Barnes dance at the intersection and this would result in a Level of Service F. The reason for this is the red time required to allow pedestrians to cross the diagonal crossing from London Street to George Street significantly reduces the LoS for vehicles. The crossing distance are shown in Figure 45 and the crossing times required are shown in Table

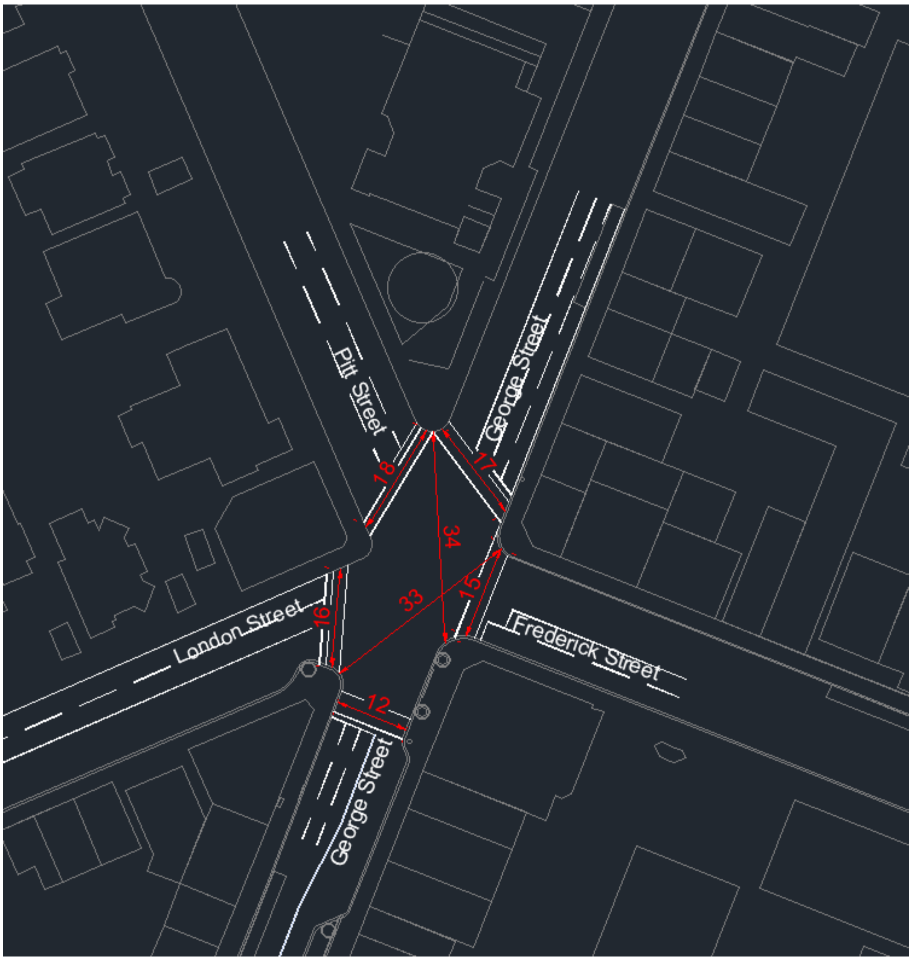


Figure 45

Crossing Arm	Distance (m)	Time required to cross at 1.5m/s
George Street (south)	12	8 seconds
London Street	16	11 seconds
Pitt Street	18	12 seconds
George Street (north)	17	11 seconds
Frederick Street	15	10 seconds
Corner of Pitt / George to corner of George / Frederick	33	22 seconds
Corner of London / George to corner of George N / Frederick	34	23 seconds.

From a pedestrian safety perspective, it would be inappropriate to implement a full red phase on the intersection without a Barnes Dance as there is potential for people to not be able to complete the crossing before the signals change.

6.5.3 Summary

The assessment work carried out on this intersection demonstrates that by optimising the signal phasing the intersection could be improved for vehicles. This is unlikely to improve pedestrian movement, however. The key challenge to this intersection is the balance of vehicles and pedestrians and it is considered that the southbound one-way option would provide a safer intersection by removing an entry arm.

Given the future projects in Dunedin such as, Shaping future Dunedin and the new hospital site, it is recommended that all these projects are included within the Paramics model, the volumes extracted and a further test carried out on the intersection to determine operational performance.

Given the significant vehicle movements from London Street and Pitt Street to Frederick Street (to access the State Highway) it is unlikely to improve unless other routes are designated primary vehicle routes and traffic is diverted from this intersection.

7.0 Conclusion

7.1 Conclusion

This report has investigated the existing transport operation of George Street as well the surrounding area.

The report has demonstrated that the current layout of George Street is heavily weighted to the movement of vehicles with the wide traffic lanes and turning lanes located at intersections. It has demonstrated that significant numbers of vehicles utilise George Street as a through route to navigate through the City. It has also shown that there is a significant number of vehicles using George Street to access the Meridian Mall car park, given that there is no right turn into the car park from Filleul Street.

Transport modelling, has been carried out in the Paramics software by WSP, Abley and Flow, and a copy of the report is included within Appendix A. The transport modelling work focuses on the 2028 and 2038 future network and includes testing of the following scenarios:

- 2019 Base Model
- 2028 & 2038 Do Minimum (Enabling Works & Committed Highway improvements only)
- 2028 & 2038 Option 1 Northbound
- 2028 & 2038 Option 2 Southbound
- 2028 & 2038 Option 3 Two Way Slow

The transport modelling has demonstrated that the road network within the base has a network peak of approximately 15 minutes in both the AM and PM Peak. The main failure is located at the five-arm intersection with the remainder of the network appearing to operate well with limited congestion.

With the enabling works and committed highway improvements added, in 2028 we observe a reduction of traffic on George Street and an increase of traffic on Filleul Street. This is primarily due to the new right turn into the Median Mall car park and therefore the traffic that had been forced to use George Street to circulate, is now using Filleul Street instead.

When the options are added to the assessment, the vehicle volumes on George Street, decrease further which is a positive sign that the through traffic has been relocated. A review of the network has shown limited impacts on the wider network with some intersections operating with a slightly higher delay than in the base and do minimum. It is considered that this delay is minimal, and this is demonstrated in the network statistics.

The main failure point on the network is the five-arm intersection of Filleul / London / George / Frederick Street. This five-arm used to be ranked as one of the worst intersections in Dunedin from a safety perspective. However, over time this has improved. Several reasons are set out for this and whilst just improving the signal timing would improve the intersection from a capacity perspective, there is a need to balance this against pedestrian safety. An all red is an option but, the management of this to prevent a Barnes Dance scenario would be difficult. It is recommended that this intersection be retested when the Shaping Future Dunedin works and the hospital works, are included within the Paramics model to determine the total impacts on the intersection.

Overall, the options tested have little difference across the wider network in relation to travel times and congestion. At a local level, all options see a large reduction in through traffic especially with the provision of the right turn into the Meridian Mall car park.

The transport report demonstrates all options work well from a traffic perspective, they all provide more space for pedestrians and cyclists and other micro mobility users and they will provide a safer environment for users.

Based on the above it is recommended that all options are put to Council to allow a decision to be made.

DRAFT

Appendix A

Transport Model Outputs

George Street – DMM Testing for CCG Business Case

To	Ian Clark, Nick Sargent, Geoff Prince
Copy	Richard Hilliard
From	Matthew Gatenby (WSP), Chris Blackmore (Abley)
Office	Dunedin
Date	27 July 2021
File/Ref	6-CD109.52/00300
Subject	George Street Option Tests in DMM

George Street – DMM Testing for CCG Business Case

Background

WSP and Abley were commissioned by Dunedin City Council (DCC) to undertake option testing for several potential network changes on George Street. The relevant section of George Street is shown in Figure 1 covering the area between the intersections of Moray Street/George Street in the south to George Street/Frederick Street/London Street in the north.

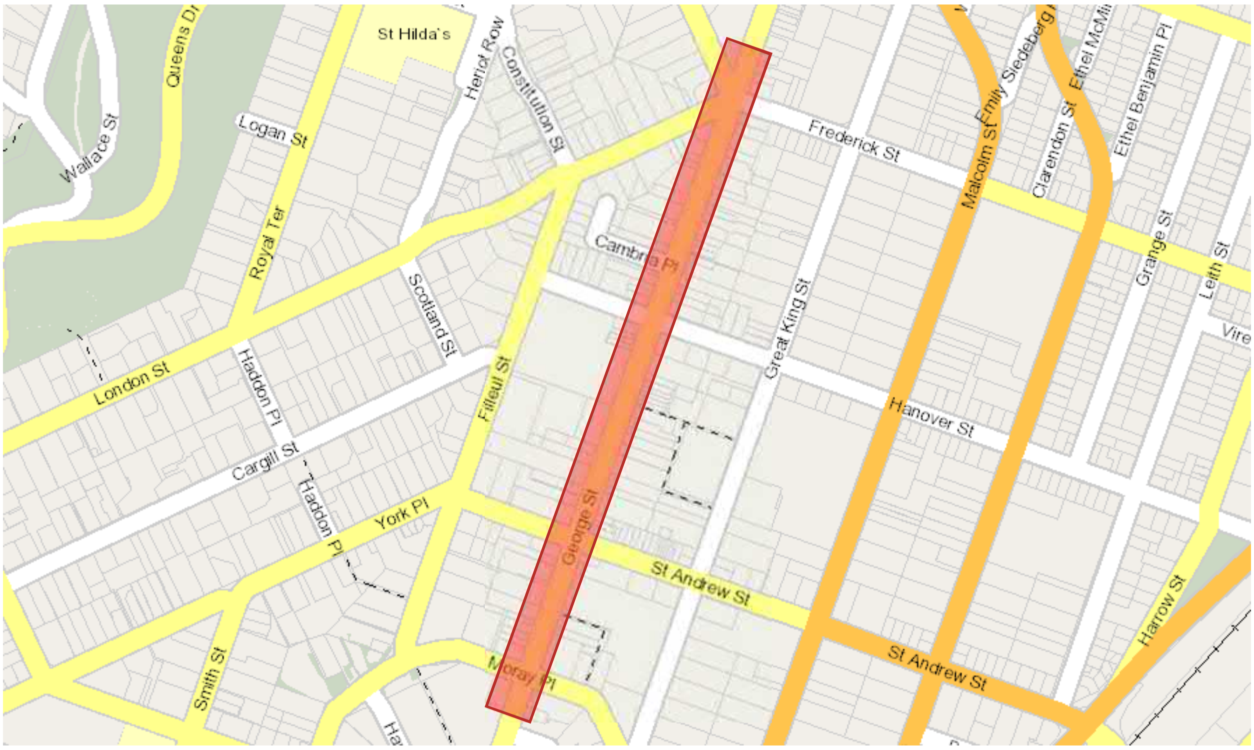


Figure 1: Extent of network changes along George Street

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150 YEARS IN AOTEAROA

This work builds upon the initial option testing using the DMM 2019 model, for further information on this initial testing please refer to the WSP tech note "**George Street DMM Testing' dated 25 September 2020**".

This tech note describes the option testing completed using the DMM Future Baseline models, considering the weekday AM peak, Interpeak and PM peak periods. For details of the development and assumptions within these Future Baseline models please refer to the WSP report "**2028 and 2038 Future Baseline Models' dated 19 February 2021**".

Subsequent to both these reports, additional testing was carried out in April 2021, for further analysis of the George Street options:

- Option 0: Existing operation on George Street
- Option 1: one-way northbound on George Street only
- Option 2: one-way southbound on George Street only
- Option 3: two-way traffic on George Street with traffic calming measures

This work was reported in the WSP technical note "**George Street Option Testing in DMM Future Models" dated 30 April 2021**. In this work, the AM peak and Interpeak models were compared using the 2038 future year demands. Due to increased network congestion in the 2038 PM model, and in agreement with DCC, the PM peak period was compared using the 2028 demand set – so as to provide a more stable model for option comparison. Three options were tested and compared with the existing 2028 (PM) and 2038 (AM and interpeak) networks:

Subsequent to this previous modelling work, AECOM has further developed the Detailed Business Case for George Street, with a number of additional network and intersection changes proposed to support the George Street options.

This report sets out the latest assessments of operation of the city centre network with these additional proposals. Consequently, the previous analysis (contained within the above reporting) can be considered superseded (although it does provide useful background to the model development and previous analysis of tests).

Modelling Scenarios

The modelling scenarios undertaken are as follows:

- Base 2019, 2028 and 2038
- Do Minimum 2028 and 2038
- One-way northbound only on George Street, 10kph speed
- One-way southbound only on George Street, 10kph speed
- Two-way traffic on George Street, 10kph speed

For the analysis of the options, a number of assumptions were made regarding the changes to current operations in each case. Appendix A contains the full assumptions matrix for each option, but a summary is provided below of the main changes:

Base 2019, 2028, 2038

The 2028 and 2038 Base models were as per the 2028 and 2038 Future Baseline models, but with some minor tweaks to improve accuracy within the central city part of the network, plus a few committed schemes:

- Harbourside detail added, as per Figure 2, to be consistent with the similar models created for the Shaping Dunedin Future Transport (SDFT) project. Buller Street, Roberts Street and French Street added with amended zone feed points
- Cargill Street added as through connection from Filleul Street to Stuart Street (see Figure 2)
- Wharf St/Kitchener signalised intersection added
- Wharf St/Roberts St intersection added, but only left out and right turn in are allowed

- Wharf St/Birch Street amended so that the northbound right turn is banned

Figure 2: Added Network Detail

The 2019 Base model also included the refined network changes as above for the 2028 and 2038 models, but not the committed intersection improvements on Wharf Street, This model was generated as a means of extrapolating VKT and VTT for the Business Case economics, and therefore the detailed results for this scenario is not reported in this technical note.

Do Minimum 2028, 2038

The 2028 and 2038 Do Minimum models were as the 2028 and 2038 Base models above, but with additional changes assumed to be implemented as part of the George Street works:

- Barnes Dance added at Great King/Hanover Barnes Dance, and east and west left turn lanes removed
- Buses removed from George Street (between Frederick Street and Moray Place south) and re-routed onto Great King Street
- Filleul/York/St Andrews – Filleul St lanes re-allocated as left and ahead in the kerbside lane, and right turn only from the offside lanes
- Right turn allowed into the Meridian Mall car park off Filleul Street
- London/Filleul – uphill London Street to London Street move banned, and the right turn out of London Street into Filleul Street also banned – see Figure 3
- George Street to be coded as existing (flared approaches at intersections)

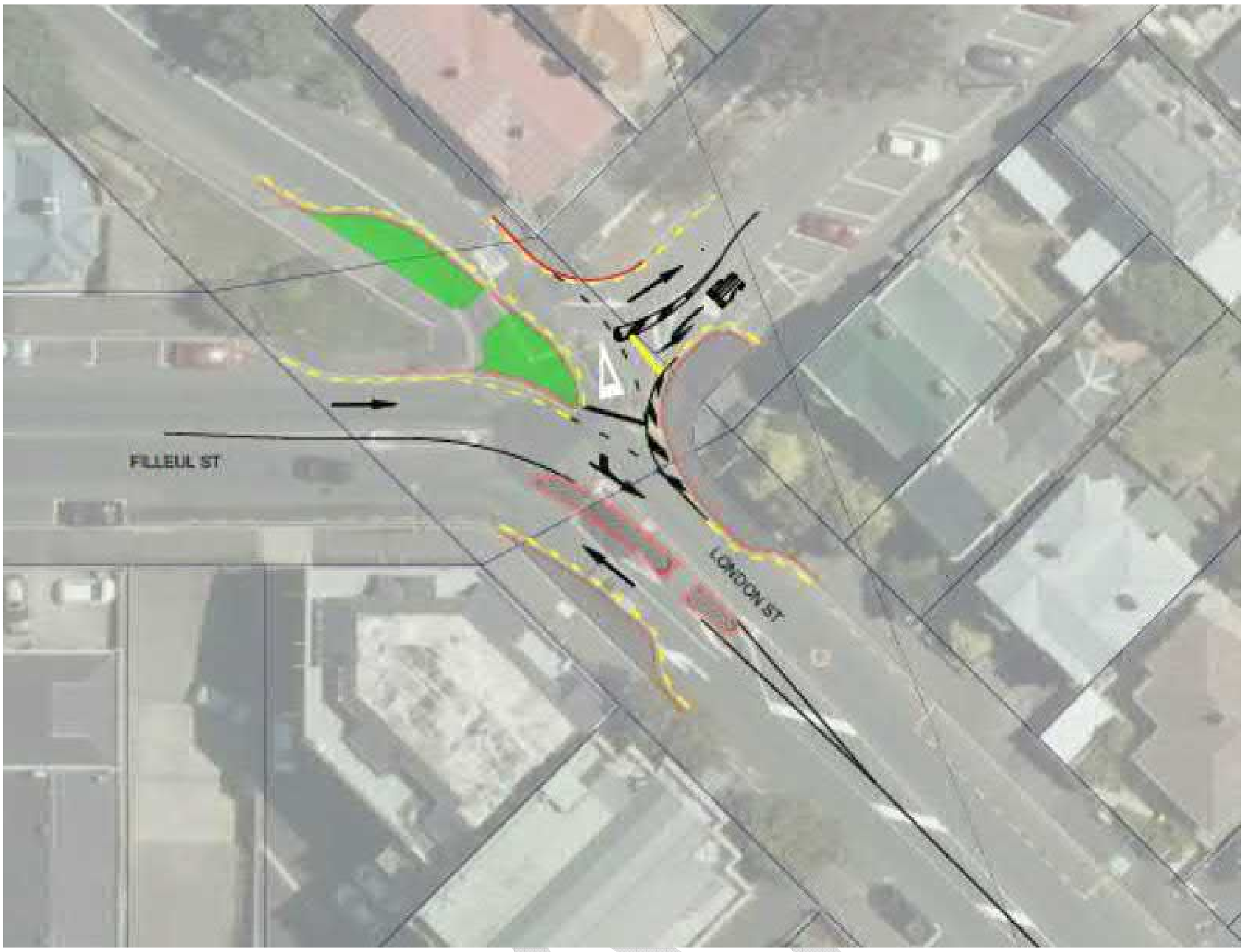

Figure 3: Proposed Layout at Filleul Street/London Street (source: AECOM Transport Modelling Specification, 20 May 2021)

George Street Northbound only 2028, 2038

The 2028 and 2038 Northbound only models were as the 2028 and 2038 Do Minimum models above, but with additional changes as below:

- Northbound George Street section between Moray Place (north) and Frederick Street set at 10kph speed
- Existing southbound lane closed
- Left and right turn flared lanes removed, so George Street as a single northbound lane

George Street Southbound only 2028, 2038

The 2028 and 2038 Northbound only models were as the 2028 and 2038 Do Minimum models above, but with additional changes as below:

- Southbound George Street section between Frederick Street and Moray Place (north) set at 10kph speed
- Existing northbound lane closed
- Left and right turn flared lanes removed, so George Street as a single southbound lane

George Street Slow Speed 2028, 2038

The 2028 and 2038 Northbound only models were as the 2028 and 2038 Do Minimum models above, but with additional changes as below:

- Northbound and southbound George Street section between Frederick Street and Moray Place (north) set at 10kph speed
- Left and right turn flared lanes removed, so George Street as a single lane in each direction

In all three options above, other minor changes to phase lengths were made to optimise the operation of each option – but subject to existing cycle times elsewhere in the network, and to retain protection of pedestrian walk and clearance times, again as per the existing situation.

The results presented below set out the forecast re-assignment patterns and turning volumes across both the full model area, and the specific George Street area.

Overview of Network Performance

In terms of overall network performance, Table 1 sets out the total trip distances and total travel times (for all vehicles) between the options investigated at 2028. All results have been re-based against the number of vehicles released in the Base scenario so as to remove any bias from differing levels of unreleased vehicles in each model run.

In the AM peak and Interpeak, the differences between the options are marginal. However, in the PM peak, there is an increase across all scenarios, compared to the Base, although still at relatively low levels. The likely reason for this is the diversion of traffic onto less direct routes (due to the restrictions in the Northbound-only, Southbound-only and slow speed options) and the closure of turns around the London Road/Filleul Street intersection in the Do Minimum.

Table 2 sets out the total trip distances and total travel times (for all vehicles) between the options investigated at 2038. As for 2028, in all three periods, the differences between the options at 2038 are relatively marginal.

Table 1: 2028 Network Performance Statistics (Peak Hour)

Time Period	Network-wide Statistics	Base	Do Min			10kmh Two Way			10kmh NB Only			10kmh SB Only		
			Result hr or km	Diff to Base		Result hr or km	Diff to Base		Result hr or km	Diff to Base		Result hr or km	Diff to Base	
				Abs	%		Abs	%		Abs	%		Abs	%
AM Peak Hour	Total Network Travel Time (hr)	1809.02	1805.07	-3.95	-0.2%	1794.40	14.62	-0.8%	1802.54	6.48	-0.4%	1808.57	0.46	0.0%
	Total Network Trip distance (km)	51513.24	51610.67	97.43	0.2%	51622.60	109.36	0.2%	51734.96	221.72	0.4%	51710.21	196.97	0.4%
Interpeak Hour	Total Network Travel Time (hr)	1278.15	1275.62	-2.54	-0.2%	1279.38	1.23	0.1%	1285.82	7.67	0.6%	1293.27	15.11	1.2%
	Total Network Trip distance (km)	39457.42	39505.00	47.58	0.1%	39602.74	145.32	0.4%	39589.37	131.95	0.3%	39607.51	150.09	0.4%
PM Peak Hour	Total Network Travel Time (hr)	2303.41	2401.85	98.44	4.3%	2385.63	82.22	3.6%	2394.26	90.84	3.9%	2467.00	163.58	7.1%
	Total Network Trip distance (km)	56793.87	56868.40	74.53	0.1%	57083.51	289.63	0.5%	56965.88	172.01	0.3%	57095.33	301.46	0.5%

Table 2: 2038 Network Performance Statistics (Peak Hour)

Time Period	Network-wide Statistics	Base	Do Min			10kmh Two Way			10kmh NB Only			10kmh SB Only		
			Result	Diff to Base		Result	Diff to Base		Result	Diff to Base		Result	Diff to Base	
			hr or km	Abs	%	hr or km	Abs	%	hr or km	Abs	%	hr or km	Abs	%
AM Peak Hour	Average Network Travel Time (hr)	1966.54	1942.48	-24.06	-1.2%	1979.71	13.17	0.7%	1978.03	11.49	0.6%	2015.65	49.10	2.5%
	Average Network Trip distance (km)	52665.10	52673.97	8.87	0.0%	52898.33	233.23	0.4%	52770.11	105.01	0.2%	52861.11	196.01	0.4%
Interpeak Hour	Average Network Travel Time (hr)	1380.95	1407.87	26.92	1.9%	1349.19	31.75	-2.3%	1381.54	0.60	0.0%	1379.54	1.41	-0.1%
	Average Network Trip distance (km)	41253.81	41264.06	10.25	0.0%	41220.39	-33.42	-0.1%	41304.07	50.26	0.1%	41310.03	56.21	0.1%
PM Peak Hour	Average Network Travel Time (hr)	2650.91	2686.45	35.54	1.3%	2738.07	87.16	3.3%	2688.76	37.85	1.4%	2694.58	43.67	1.6%
	Average Network Trip distance (km)	55568.63	55298.80	-269.82	-0.5%	55430.16	-138.47	-0.2%	55249.30	-319.33	-0.6%	54731.86	-836.77	-1.5%

Overview of Corridor Volume Changes

Figure 4, Figure 5 and Figure 6 show the 2028 bi-directional volumes on George Street and the immediately adjacent north-south links of Filleul Street and Great King Street – volumes listed are the volumes across a screenline just to the north of St Andrew Street.

Table 3 shows the same results in tabular form, with Table 4 setting out the differences in volumes between the Do Minimum in more clarity.

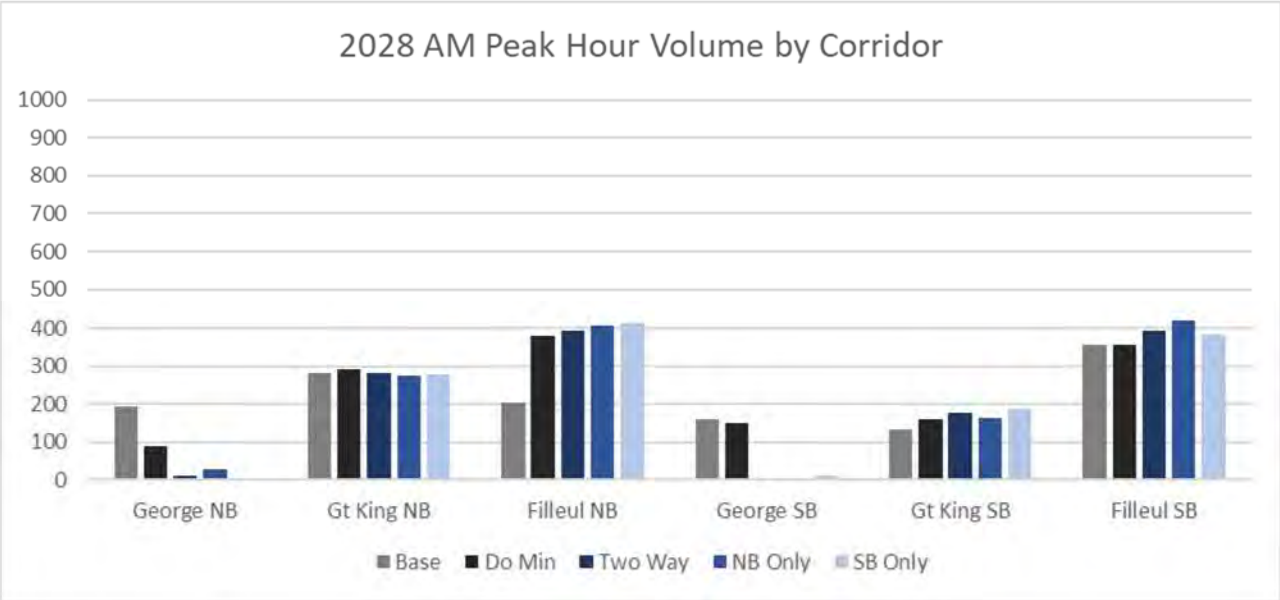

Figure 4: 2028 AM Peak (08:00-09:00) volumes by corridor

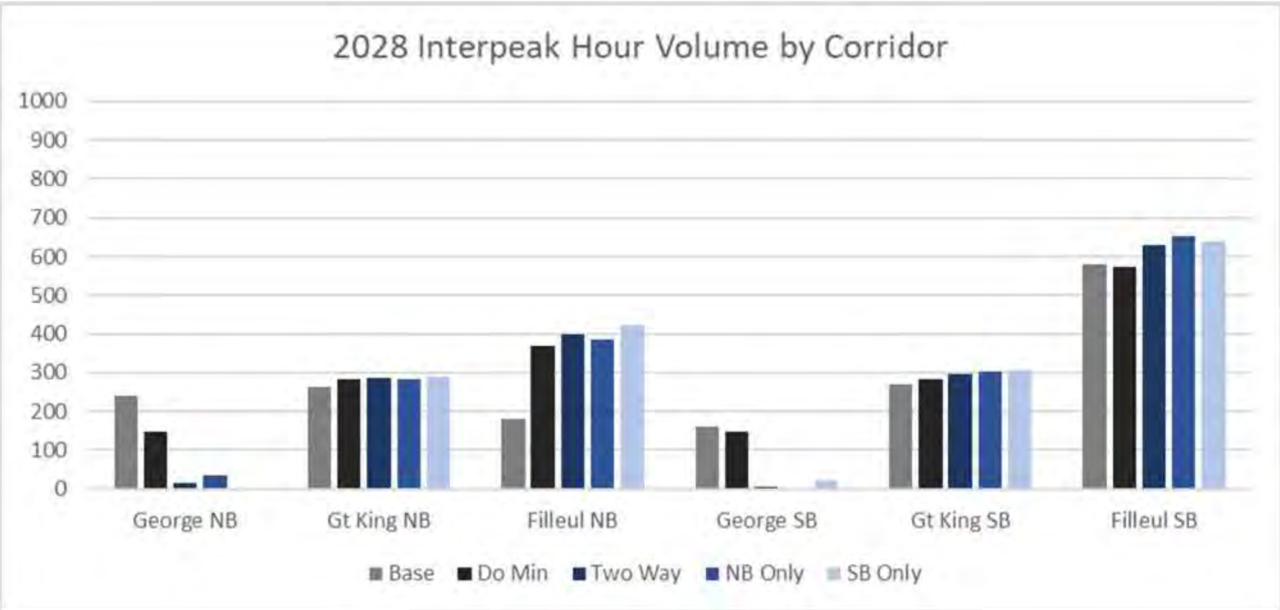

Figure 5: 2028 Interpeak (12:00-13:00) volumes by corridor

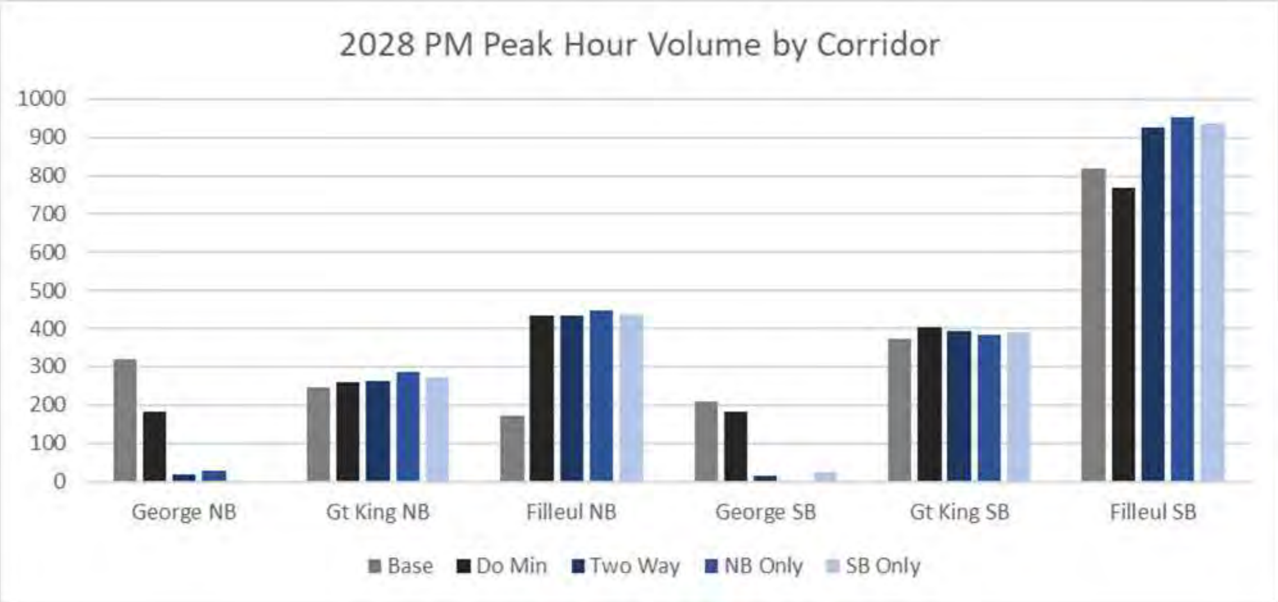

Figure 6: 2028 PM peak (17:00-18:00) volumes by corridor

Table 3: One-way volumes (v/h) on each of the three corridors (2028)

Option	Period	One Way Volumes (vph)					
		George NB	Gt King NB	Filleul NB	George SB	Gt King SB	Filleul SB
Base	AM	195	283	203	162	132	355
	IP	241	264	182	160	269	580
	PM	319	247	171	210	374	818
Do Minimum	AM	91	291	378	150	161	357
	IP	148	285	370	147	282	575
	PM	182	259	434	183	405	769
Two-way Slow	AM	10	281	395	5	175	395
	IP	16	288	400	7	298	631
	PM	20	262	433	16	393	927
Northbound Only	AM	27	277	406	0	163	421
	IP	34	283	386	0	302	653
	PM	29	285	448	0	385	954
Southbound Only	AM	0	277	415	11	187	383
	IP	0	290	421	22	305	638
	PM	0	273	438	26	391	935

Table 4: Difference in one-way volumes (v/h) between options on each of the three corridors – compared to the Base option (2028)

Option	Period	One Way Volumes (vph)					
		George NB	Gt King NB	Filleul NB	George SB	Gt King SB	Filleul SB
Do Minimum	AM	-104	8	176	-12	29	2
	IP	-93	21	188	-13	13	-5
	PM	-137	12	262	-27	31	-49
Two-way Slow	AM	-185	-2	192	-157	43	40
	IP	-226	24	218	-153	29	51
	PM	-299	15	262	-194	20	109
Northbound Only	AM	-168	-7	203	-162	31	66
	IP	-207	20	204	-160	33	73
	PM	-290	39	277	-210	11	136
Southbound Only	AM	-195	-6	212	-151	55	28
	IP	-241	27	239	-138	36	58
	PM	-319	27	267	-184	18	117

The following trends can be established:

- Volumes in the PM peak across all three routes, are generally higher than in the other time periods, although Filleul Street southbound also has high volumes in the Interpeak (mostly representing movements from the Meridian Mall car park access)
- In the Do Minimum, scenario, as would be expected, the volumes on northbound Filleul Street increase due to the introduction of the right turn into the Meridian Mall car park, with a consequential reduction in volumes on northbound George Street
- In the two-way slow option, volumes in both directions of George Street are predicted to drop by around 50-75% in all periods compared to the Base, showing that the low speed (and/or traffic calming to make the link less attractive as a through route) results in a significant re-assignment of traffic off the route
- In the northbound-only option, there is the greatest re-assignment onto southbound Filleul Street of all the options
- In the southbound-only option, there is the greatest re-assignment onto northbound Filleul Street of all the options, although volumes on Filleul Street are fairly stable across the three George Street options

From Table 4, it is also clear that the drop in volumes on George Street (in all of the options) are not fully balanced by the increase in volumes on the other two routes, showing there is a wider re-assignment occurring.

Figure 7, Figure 8 and Figure 9 show the 2038 bi-directional volumes on George Street and the immediately adjacent north-south links of Filleul Street and Great King Street. Table 5 shows the same results in tabular form, with Table 6 setting out the differences in volumes between the Do Minimum in more clarity.

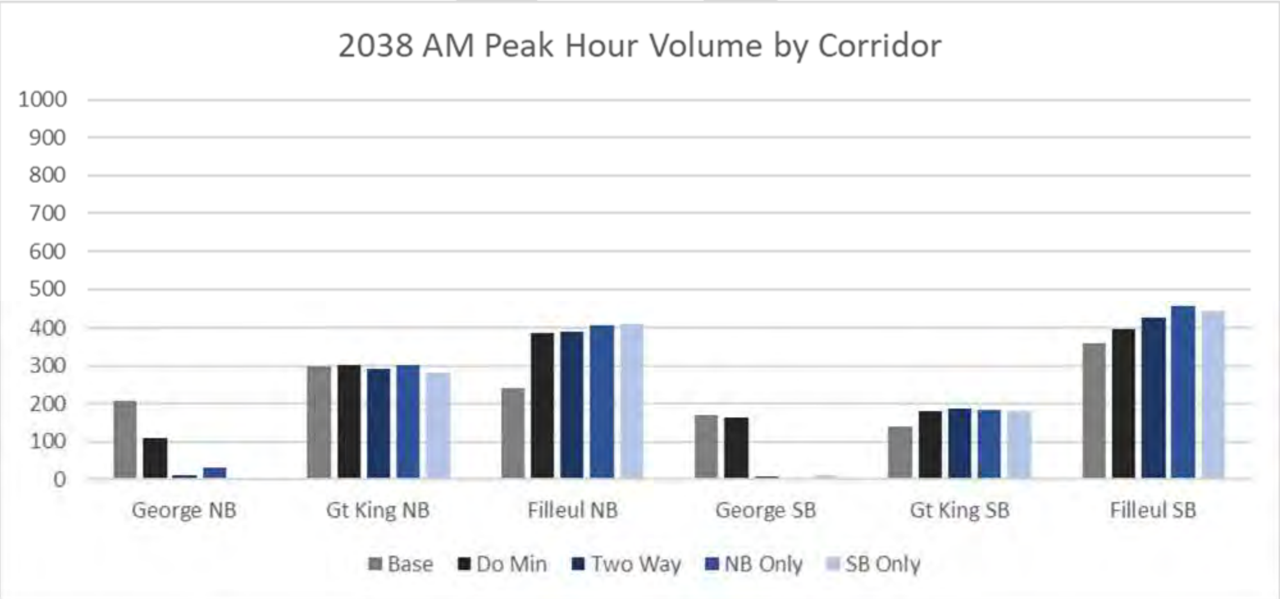

Figure 7: 2038 AM Peak (08:00-09:00) volumes by corridor

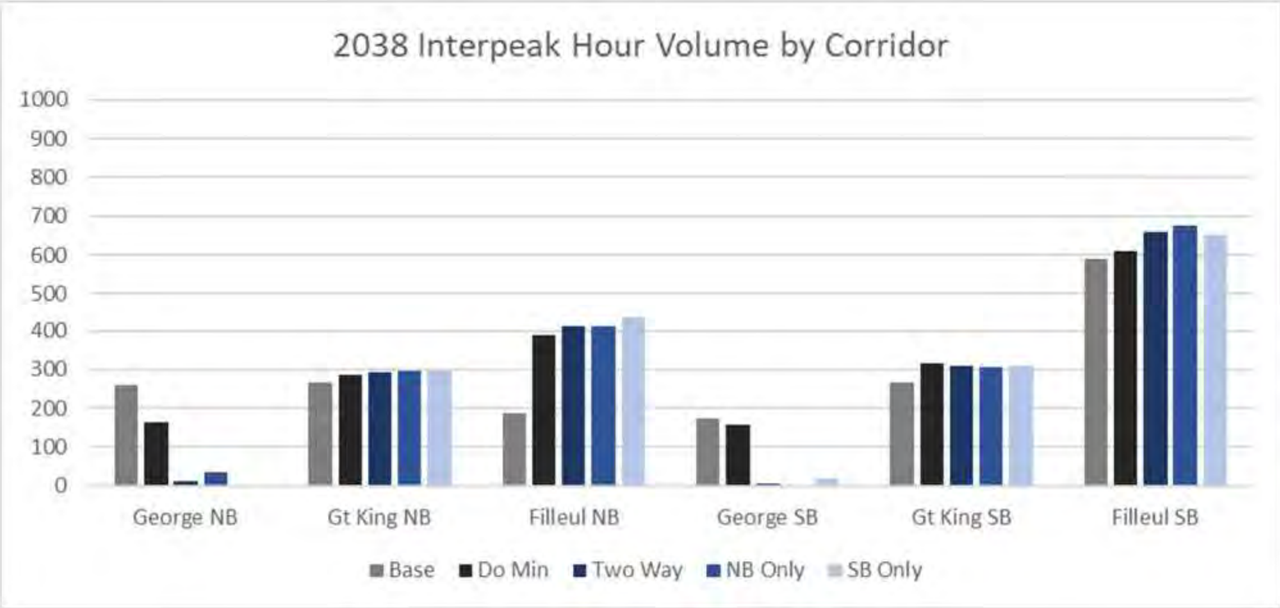

Figure 8: 2038 Interpeak (12:00-13:00) volumes by corridor

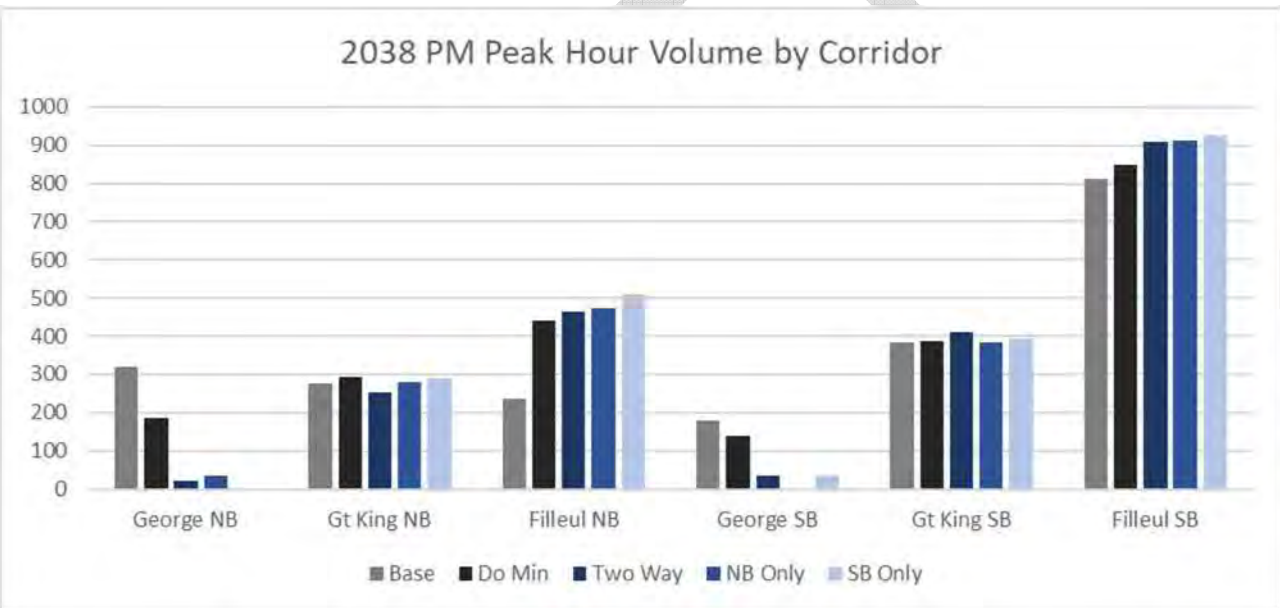

Figure 9: 2038 PM peak (17:00-18:00) volumes by corridor

Table 5: One-way volumes (v/h) on each of the three corridors (2038)

Option	Period	One Way Volumes (vph)					
		George NB	Gt King NB	Filleul NB	George SB	Gt King SB	Filleul SB
Base	AM	206	300	240	169	140	361
	IP	261	268	188	173	268	589
	PM	321	278	236	179	385	812
Do Minimum	AM	108	301	388	165	181	397
	IP	163	288	389	156	316	610
	PM	186	292	439	139	387	851
Two-way Slow	AM	13	293	389	6	186	428
	IP	13	294	412	7	309	658
	PM	23	254	466	34	411	908
Northbound Only	AM	30	304	409	0	183	457
	IP	36	295	413	0	306	676
	PM	35	279	476	0	385	914
Southbound Only	AM	0	283	409	11	179	443
	IP	0	295	435	20	311	653
	PM	0	290	511	35	395	925

Table 6: Difference in one-way volumes (v/h) between options on each of the three corridors – compared to the Base option (2038)

Option	Period	One Way Volumes (vph)					
		George NB	Gt King NB	Filleul NB	George SB	Gt King SB	Filleul SB
Do Minimum	AM	-98	1	148	-4	41	36
	IP	-98	20	201	-17	49	21
	PM	-135	14	204	-40	2	39
Two-way Slow	AM	-194	-7	149	-163	46	66
	IP	-248	27	224	-166	41	69
	PM	-298	-24	230	-145	26	96
Northbound Only	AM	-176	4	169	-169	43	95
	IP	-225	28	225	-173	38	87
	PM	-286	1	240	-179	-1	102
Southbound Only	AM	-206	-17	169	-158	39	82
	IP	-261	28	247	-153	43	64
	PM	-321	13	275	-144	10	113

In the most part, the trends in the 2028 models are repeated for the 2038 demand set, as might be expected.

Network Volume Plots

This section sets out some diagrammatic change plots of the volumes in the central part of the network, comparing the three main options to the Do Minimum.

2028 Two-way Slow

Figure 10 and Figure 11 set out the 2028 flow differences between this option and the Do Minimum, for the AM and PM peak hour periods respectively. As might be expected due to the higher congestion levels, there is considerably more re-assignment in the PM peak compared to the AM peak period.

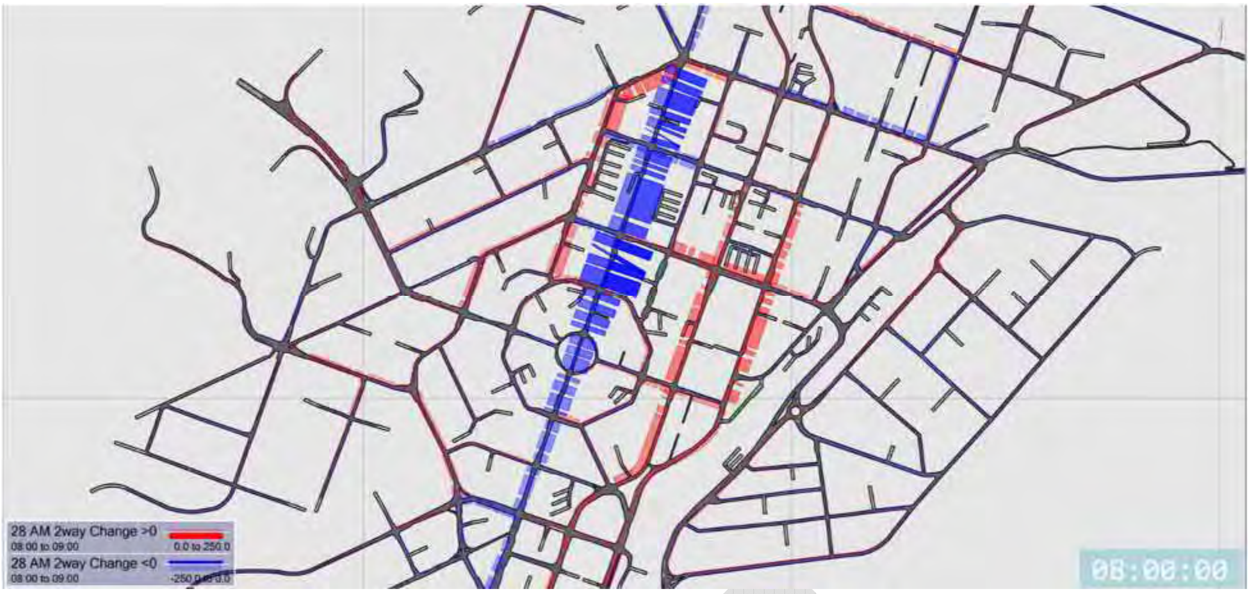

Figure 10: 2028 Two-way Slow versus Do Minimum - AM Peak Hour:

Figure 11: 2028 Two-way Slow versus Do Minimum - PM Peak Hour

2038 Two-way Slow

Figure 12 and Figure 13 set out the 2038 flow differences between this option and the Do Minimum, for the AM and PM peak hour periods respectively. At 2038 there is a observable increase in re-assignment across both peak periods.

Figure 12: 2038 Two-way Slow versus Do Minimum - AM Peak Hour:

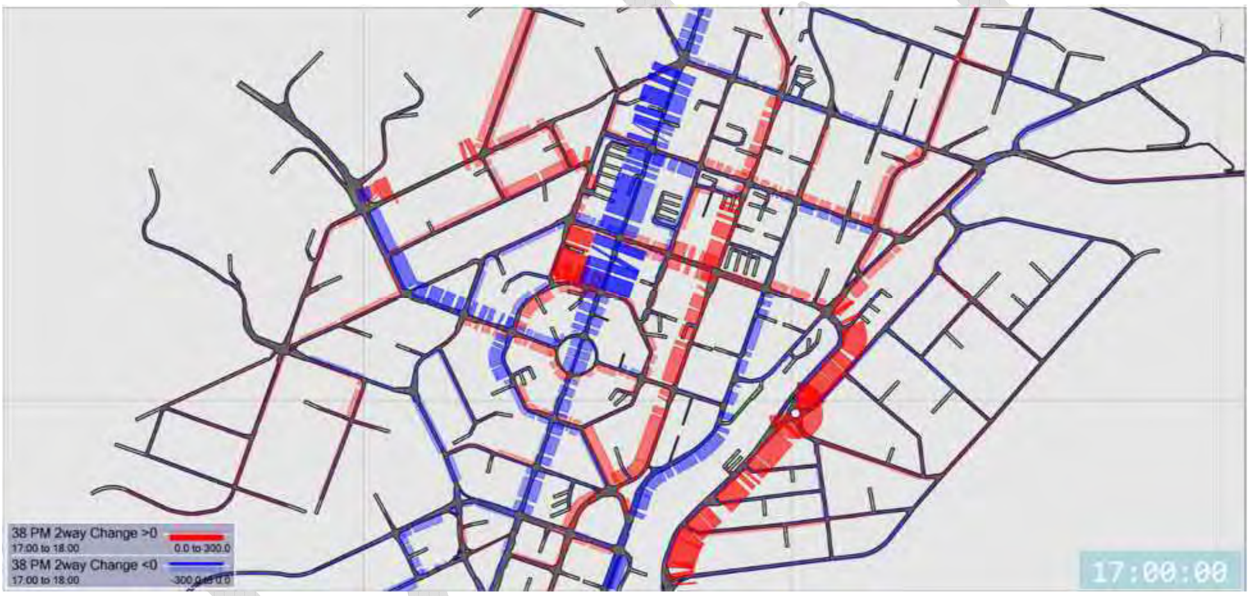

Figure 13: 2038 Two-way Slow versus Do Minimum - PM Peak Hour

2028 Northbound Only

Figure 14 and Figure 15 set out the 2028 flow differences between this option and the Do Minimum, for the AM and PM peak hour periods respectively. As might be expected due to the higher congestion levels, there is considerably more re-assignment in the PM peak compared to the AM peak period.

Figure 14: 2028 Northbound Only versus Do Minimum - AM Peak Hour:

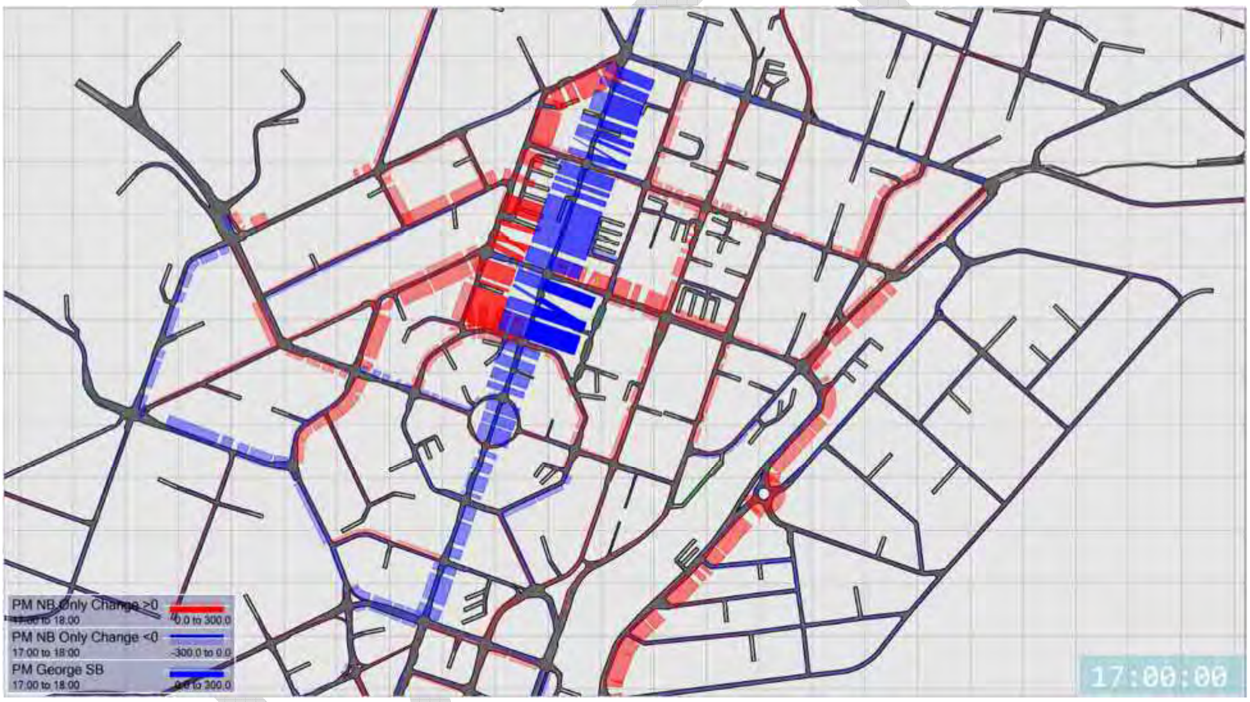

Figure 15: 2028 Northbound Only versus Do Minimum - PM Peak Hour

2038 Northbound Only

Figure 16 and Figure 17 set out the 2038 flow differences between this option and the Do Minimum, for the AM and PM peak hour periods respectively. At 2038 there is an observable increase in re-assignment across both peak periods – in the PM peak hour, the spread of "blue" links (indicating a drop in volumes) is more related to congestion resulting in less traffic reaching destinations than in the Do Minimum.

Figure 16: 2038 Northbound Only versus Do Minimum - AM Peak Hour:

Figure 17: 2038 Northbound Only versus Do Minimum - PM Peak Hour

2028 Southbound Only

Figure 18and Figure 19 set out the 2028 flow differences between this option and the Do Minimum, for the AM and PM peak hour periods respectively. As might be expected due to the higher congestion levels, there is considerably more re-assignment in the PM peak compared to the AM peak period.

Figure 18: 2028 Southbound Only versus Do Minimum - AM Peak Hour:

Figure 19: 2028 Southbound Only versus Do Minimum - PM Peak Hour

2038 Southbound Only

Figure 20 and Figure 21 set out the 2038 flow differences between this option and the Do Minimum, for the AM and PM peak hour periods respectively.

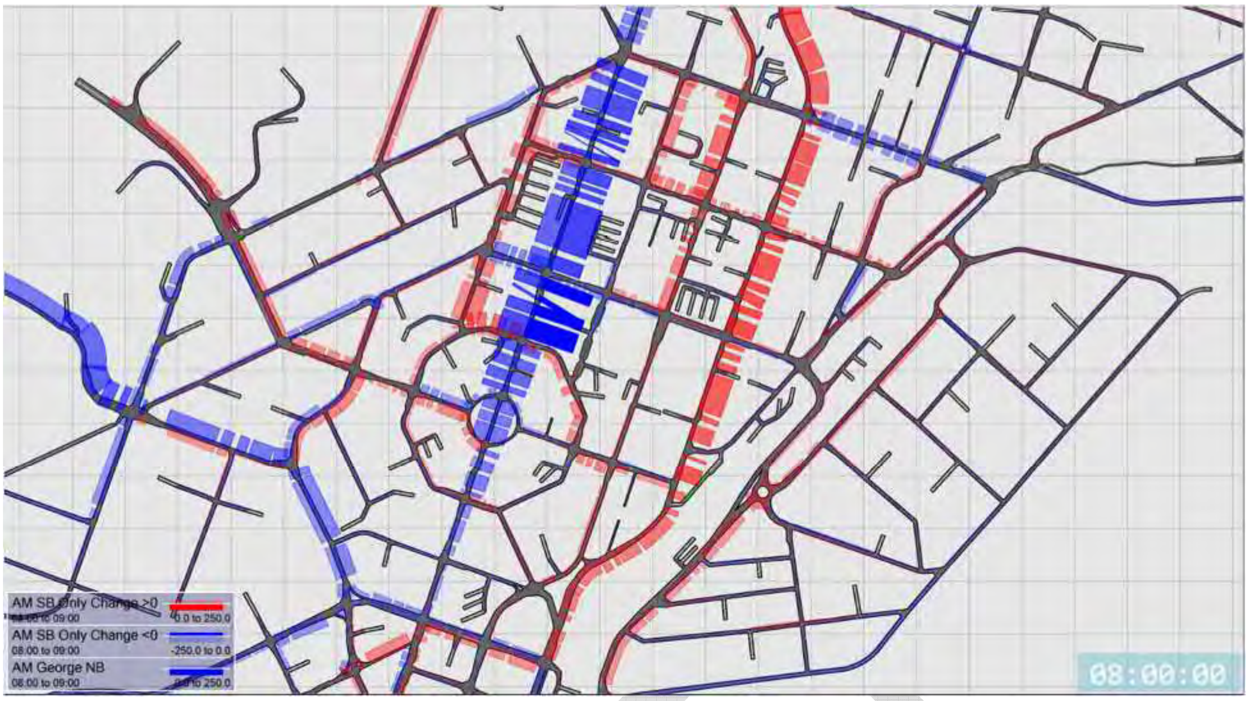

Figure 20: 2038 Southbound Only versus Do Minimum - AM Peak Hour:

Figure 21: 2038 Southbound Only versus Do Minimum - PM Peak Hour

Summary

The plots show a relatively consistent picture across all periods between the various options. Re-assignment due to the changes on George Street are generally focussed on Filleul Street rather than Great King Street. In a wider perspective, particularly at 2038 when the demand sets are higher, re-assignment tends to be pushed outwards towards Thomas Burns Street, the Western Corridor and the SH1 pairs – but the re-assignment becomes complicated as congestion increases, as traffic starts to carry out more convoluted routes to avoid congestion.

Intersection and Network Performance – Level of Service

2028 Future Year

Table 7 shows the Level of Service (LOS) at all intersections in the vicinity of George Street within the study area, for the 2028 AM peak period, across each scenario.

Table 7: Intersection Level of Service – 2028 AM Peak Hour

Intersection	Base		Do-Min		10kmh 2 way		10kmh NB Only		10kmh SB Only	
	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
George St / London St / Frederick St	86.7	F	66.7	E	70.4	E	74.6	E	74.8	E
Hanover St / George St	28.6	C	26.2	C	26.5	C	21.2	C	18.1	B
St Andrews St / George St	28.8	C	28.8	C	28.6	C	23.0	C	23.8	C
George St / Moray Pl (north)	25.6	C	24.4	C	34.6	C	20.9	C	23.1	C
Frederick St / Great King St	42.4	D	21.6	C	22.9	C	25.7	C	21.6	C
Hanover St / Great King St	21.4	C	24.6	C	28.1	C	24.8	C	24.9	C
St Andrews St / Great King St	27.9	C	26.4	C	28.7	C	28.6	C	29.1	C
Filleul St / London St	24.1	C	19.8	C	25.0	C	18.3	C	26.0	D
Filleul St / Cargill St	6.6	A	6.2	A	5.9	A	6.4	A	5.8	A
St Andrews St / Filleul St	13.6	B	15.4	B	14.0	B	14.1	B	14.7	B
Filleul St / Meridian Access	9.6	A	10.1	B	10.7	B	10.2	B	8.9	A
Moray Pl / Filleul St	3.1	A	3.3	A	3.4	A	4.1	A	3.8	A
Stuart St / London St	17.9	B	17.1	B	17.6	B	17.5	B	17.9	B
Smith St / Stuart St	37.6	D	36.1	D	34.4	C	36.9	D	35.8	D

The results show little change between scenarios – a minor improvement is forecast at the George Street/Frederick Street intersection compared to the Base scenario, likely due to the re-assignment away from the intersection linked to the less traffic to the south on George Street in the other options. Across the wider network, there is little impact on traffic operation.

Table 8 shows the Level of Service (LOS) at all intersections in the vicinity of George Street within the study area, for the 2028 Interpeak period, across each scenario.

Table 8: Intersection Level of Service – 2028 Interpeak Hour

Intersection	Base		Do-Min		10kmh 2 way		10kmh NB Only		10kmh SB Only	
	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
George St / London St / Frederick St	59.7	E	54.1	D	54.4	D	49.1	D	59.1	E
Hanover St / George St	27.4	C	25.2	C	21.9	C	19.4	B	17.4	B
St Andrews St / George St	28.8	C	28.9	C	27.0	C	24.1	C	22.8	C
George St / Moray Pl (north)	23.5	C	24.0	C	31.7	C	19.9	B	20.6	C
Frederick St / Great King St	26.1	C	22.3	C	23.7	C	32.2	C	27.5	C
Hanover St / Great King St	23.0	C	33.5	C	27.9	C	27.5	C	29.4	C
St Andrews St / Great King St	26.8	C	28.6	C	31.9	C	29.8	C	33.7	C
Filleul St / London St	3.1	A	4.3	A	4.1	A	4.3	A	6.6	A
Filleul St / Cargill St	7.5	A	5.5	A	5.2	A	5.4	A	4.9	A
St Andrews St / Filleul St	10.4	B	12.5	B	12.9	B	14.3	B	14.2	B
Filleul St / Meridian Access	8.7	A	11.1	B	10.4	B	10.2	B	10.4	B
Moray Pl / Filleul St	2.7	A	3.0	A	3.9	A	3.5	A	3.7	A
Stuart St / London St	31.0	C	23.0	C	25.4	C	27.7	C	31.5	C
Smith St / Stuart St	25.3	C	27.5	C	24.7	C	26.2	C	27.6	C

As for the AM peak period, the results show little change between scenarios with only modest re-assignment across the wider network, and little impact on traffic operation.

Table 9 shows the Level of Service (LOS) at all intersections in the vicinity of George Street within the study area, for the 2028 PM peak period, across each scenario.

Table 9: Intersection Level of Service – 2028 PM Peak Hour

Intersection	Base		Do-Min		10kmh 2 way		10kmh NB Only		10kmh SB Only	
	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
George St / London St / Frederick St	85.3	F	66.6	E	77.9	E	69.0	E	79.1	E
Hanover St / George St	33.7	C	33.9	C	28.7	C	19.3	B	21.6	C
St Andrews St / George St	41.5	D	63.6	E	30.6	C	21.9	C	22.9	C
George St / Moray Pl (north)	62.2	E	63.4	E	29.8	C	22.9	C	21.2	C
Frederick St / Great King St	40.1	D	24.1	C	32.8	C	35.3	D	36.3	D
Hanover St / Great King St	28.6	C	37.2	D	33.1	C	33.6	C	35.8	D
St Andrews St / Great King St	39.5	D	34.6	C	39.5	D	44.7	D	50.4	D
Filleul St / London St	8.5	A	6.8	A	12.1	B	12.5	B	14.9	B
Filleul St / Cargill St	19.0	C	14.4	B	17.7	C	17.2	C	18.8	C
St Andrews St / Filleul St	34.4	C	26.4	C	21.6	C	21.3	C	20.6	C
Filleul St / Meridian Access	21.6	C	23.5	C	18.3	C	19.2	C	19.5	C
Moray Pl / Filleul St	32.5	D	5.6	A	11.9	B	12.4	B	13.2	B
Stuart St / London St	36.3	D	32.9	C	35.4	D	36.4	D	35.3	D
Smith St / Stuart St	53.5	D	54.8	D	57.3	E	59.0	E	56.8	E

The results clearly demonstrate the PM peak to be the critical period, with more intersections operating in the LOS D to LOS E range. As for the AM peak, a minor improvement is forecast at the George Street/Frederick Street intersection compared to the Base scenario, albeit with still a poor level of operation (LOS E across all other scenarios). As might be expected, the lower volumes on George Street in the three main options result in less overall delay along this corridor, and there is also little change to the operational results along Filleul Street, despite the additional volumes carried – although this has implications for the safety and efficiency for pedestrians crossing this corridor, given the lack of (controlled) crossing facilities. Across the wider network, there is also little impact on traffic operation, on the key north-south alternative routes.

2038 Future Year

Table 10 shows the Level of Service (LOS) at all intersections in the vicinity of George Street within the study area, for the 2038 AM peak period, across each scenario.

Table 10: Intersection Level of Service – 2038 AM Peak Hour

Intersection	Base		Do-Min		10kmh 2 way		10kmh NB Only		10kmh SB Only	
	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
George St / London St / Frederick St	93.1	F	73.1	E	78.0	E	86.8	F	86.4	F
Hanover St / George St	28.6	C	27.8	C	27.9	C	21.7	C	19.9	B
St Andrews St / George St	28.6	C	30.7	C	30.9	C	24.3	C	23.5	C
George St / Moray Pl (north)	26.0	C	27.9	C	33.7	C	23.0	C	21.5	C
Frederick St / Great King St	49.2	D	27.2	C	26.1	C	26.2	C	25.0	C
Hanover St / Great King St	20.3	C	23.9	C	25.8	C	26.8	C	23.8	C
St Andrews St / Great King St	29.1	C	28.5	C	33.1	C	35.1	D	28.3	C
Filleul St / London St	41.3	E	26.1	D	27.4	D	31.0	D	40.5	E
Filleul St / Cargill St	7.5	A	6.1	A	8.3	A	7.2	A	6.6	A
St Andrews St / Filleul St	15.5	B	13.9	B	17.0	B	15.3	B	16.5	B
Filleul St / Meridian Access	11.1	B	10.9	B	10.0	B	9.9	A	9.4	A
Moray Pl / Filleul St	3.3	A	3.7	A	5.1	A	4.3	A	4.7	A
Stuart St / London St	20.6	C	20.9	C	20.8	C	19.2	B	21.0	C
Smith St / Stuart St	37.6	D	45.1	D	46.2	D	42.2	D	43.5	D

The results show little change between scenarios, demonstrating that the AM peak is still not a critical time period at 2038 forecast demand levels. However, the George Street/Frederick Street intersection remains the critical constraint in the local network, and the poor operation in the Northbound only and Southbound only scenarios at this intersection suggests that the restriction in moves to the south on George Street is resulting in some issues in balancing capacity to demand at this location.

Across the wider network, as per the 2028 AM peak, there is little impact on traffic operation although the Western Corridor is of concern with LOS F at the key Princes Street/Jetty

Street/Manse Street 5-arm intersection in the three main option scenarios – due to increased volumes seeking to re-assign away from the George Street restrictions.

Table 11 shows the Level of Service (LOS) at all intersections in the vicinity of George Street within the study area, for the 2038 Interpeak period, across each scenario.

Table 11: Intersection Level of Service – 2038 Interpeak Hour

Intersection	Base		Do-Min		10kmh 2 way		10kmh NB Only		10kmh SB Only	
	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
George St / London St / Frederick St	65.9	E	55.9	E	56.2	E	55.8	E	65.1	E
Hanover St / George St	27.3	C	25.8	C	27.2	C	20.0	C	17.7	B
St Andrews St / George St	30.3	C	29.6	C	26.8	C	24.1	C	23.2	C
George St / Moray Pl (north)	25.6	C	23.8	C	33.8	C	19.4	B	19.8	B
Frederick St / Great King St	29.6	C	23.9	C	26.4	C	29.0	C	33.3	C
Hanover St / Great King St	23.4	C	28.7	C	27.8	C	28.4	C	30.7	C
St Andrews St / Great King St	32.1	C	30.7	C	32.9	C	32.4	C	33.5	C
Filleul St / London St	3.2	A	3.8	A	4.9	A	5.5	A	12.4	B
Filleul St / Cargill St	7.6	A	5.3	A	5.4	A	5.6	A	6.1	A
St Andrews St / Filleul St	11.1	B	12.0	B	13.0	B	13.2	B	14.2	B
Filleul St / Meridian Access	10.2	B	9.4	A	10.8	B	10.9	B	9.5	A
Moray Pl / Filleul St	2.9	A	3.1	A	3.6	A	4.0	A	3.5	A
Stuart St / London St	44.5	D	58.1	E	24.2	C	25.7	C	26.8	C
Smith St / Stuart St	23.9	C	27.0	C	27.0	C	27.2	C	26.5	C

The results show little change between scenarios with only modest re-assignment across the wider network, and little impact on traffic operation – demonstrating that the changes have George Street have only a modest impact on operation in this period at 2038 forecast demand levels.

Table 12 shows the Level of Service (LOS) at all intersections in the vicinity of George Street within the study area, for the 2038 PM peak period, across each scenario.

Table 12: Intersection Level of Service – 2038 PM Peak Hour

Intersection	Base		Do-Min		10kmh 2 way		10kmh NB Only		10kmh SB Only	
	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
George St / London St / Frederick St	110.0	F	76.8	E	102.5	F	85.9	F	87.8	F
Hanover St / George St	47.1	D	53.7	D	39.3	D	20.5	C	30.1	C
St Andrews St / George St	80.7	F	118.3	F	31.1	C	22.4	C	22.7	C
George St / Moray Pl (north)	118.9	F	134.6	F	27.8	C	25.1	C	25.6	C
Frederick St / Great King St	52.1	D	29.3	C	37.7	D	50.5	D	37.1	D
Hanover St / Great King St	36.0	D	37.4	D	40.2	D	38.8	D	39.0	D
St Andrews St / Great King St	42.3	D	53.7	D	45.2	D	54.1	D	45.6	D
Filleul St / London St	31.6	D	11.6	B	87.9	F	30.6	D	47.0	E
Filleul St / Cargill St	42.6	E	39.7	E	27.6	D	29.8	D	19.4	C
St Andrews St / Filleul St	33.8	C	44.9	D	36.3	D	25.9	C	29.5	C
Filleul St / Meridian Access	23.0	C	28.6	D	24.9	C	20.5	C	19.6	C
Moray Pl / Filleul St	8.1	A	58.0	F	26.5	D	21.2	C	26.9	D
Stuart St / London St	37.4	D	50.7	D	45.7	D	42.4	D	34.6	C
Smith St / Stuart St	53.6	D	62.8	E	77.0	E	65.7	E	63.1	E

At 2038, the results show that operation is predicted to be poor in the PM peak period. Several more intersections are operating in the LOS E to LOS F range compared to the 2028 demand set.

The main points of congestion are moved between the Base/Do Minimum and the three options, with George Street being more congested in the Base and Do Minimum as traffic seeks to use the corridor, whereas poor operation is predicted on the alternative corridors in the three proposed options.

It is important to note that in all five model scenarios (at 2038, PM peak) the model is unstable, with around 25% of models failing to run the full period (due to locking up issues). Several features have been added to the model parameters to minimise the change of this occurring, but the demand levels are such that queues are extending back through several intersections across several corridors – and this also leads to some questionable re-assignment in the model as traffic increasingly seeks to assign away from these areas.

As a result, the 2038 PM peak results should be viewed with some caution, as there is a significant variation between model runs, and the subsequent analytical output. Effort has been made to minimise the impact of "outlier" runs by removing these from the analysis, but significant variations are still present.

Intersection and Network Performance – Model Screenshots

2028 Future Year – AM Peak

At 2028 in the AM peak period, the above section has shown that there are no critical issues in terms of performance of the network, or at specific intersections. In all options, the only intersections with LOS E or F (see Appendix B) are at:

- George Street/Frederick Street/London Street
- Princes Street/Jetty Street/Manse Street
- Crawford Street/Jervois Street

Figure 22 shows a screenshot of the operation of the AM peak period under the 2028 Southbound-only, but is typical of operation under all scenarios in this period and year. The "hotspots" within this image show the location of queues within the network. It should be noted that this is a single point in time in a single model run, so should be viewed as a means for relative comparison of option performance – the analytic output provided for LOS and traffic volumes is a more detailed comparison of operation over a compilation of many model runs.

Figure 22: 2028 AM Peak Southbound only Option - model snapshot

2028 Future Year – Interpeak Period

At 2028 in the Interpeak period, the above section has shown that there are no critical issues in terms of performance of the network, or at specific intersections in this period. As per the AM peak, the worst operating intersections in terms of LOS (see Appendix C) are at the two main five-arm intersections:

- George Street/Frederick Street/London Street
- Princes Street/Jetty Street/Manse Street

2028 Future Year – PM Peak

At 2028 in the PM peak period, the network performs much closer to the practical capacity compared to the other two modelled periods, with a number of intersections operating at LOS D to F in all options (see Appendix D).

Figure 23 to Figure 27 show snapshots of model operation of all five scenarios at 2028.

Figure 23: 2028 PM Peak Base Option - model snapshot

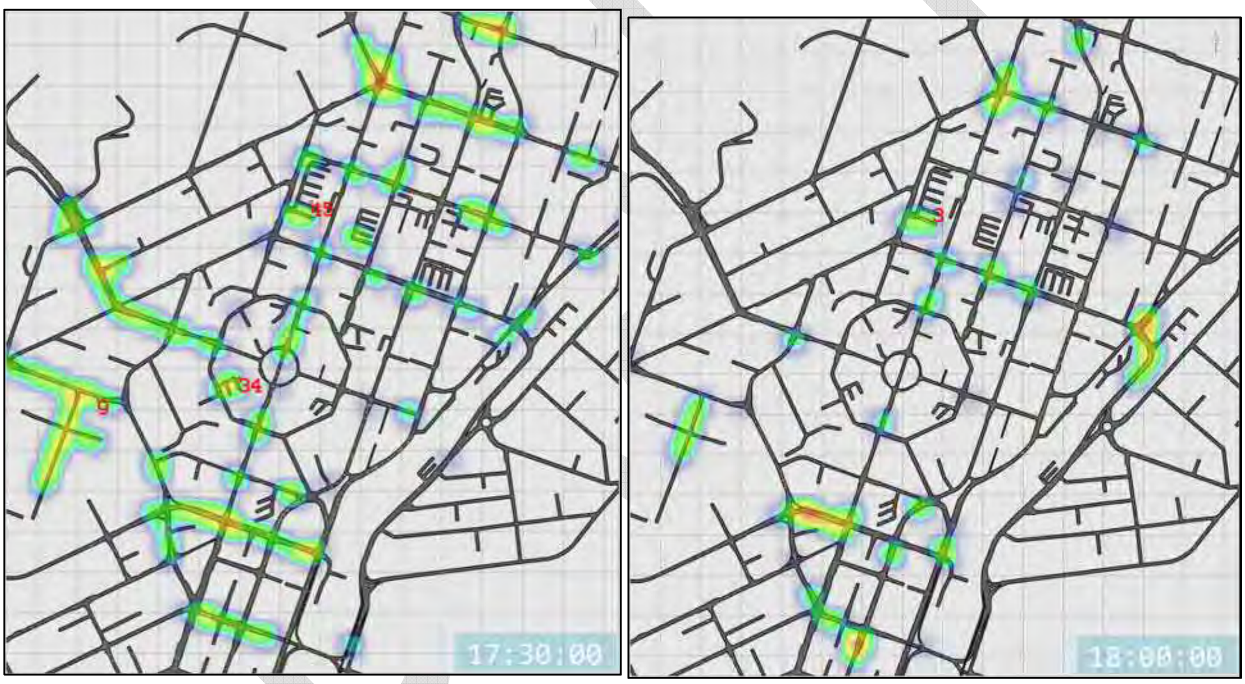

Figure 24: 2028 PM Peak Do Minimum Option - model snapshot

Figure 25: 2028 PM Peak Two-way Slow Option - model snapshot

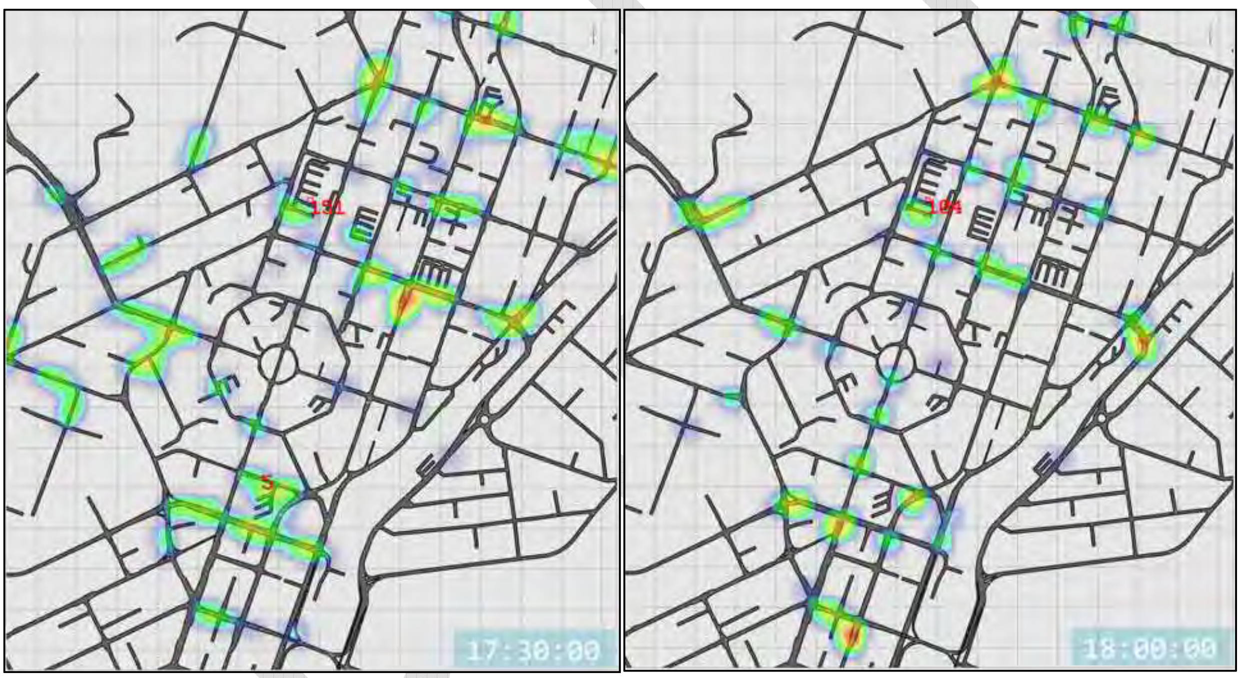

Figure 26: 2028 PM Peak Northbound Only Option - model snapshot

Figure 27: 2028 PM Peak Southbound Only Option - model snapshot

Noting that the above figures are representative of a single model run (and therefore only provide an indication of comparative performance), the differences between operation are largely minor.

One key difference is the egress from the Meridian Mall car park onto Filleul Street, which becomes more difficult in the three options (Two-way Slow, Northbound-only and Southbound-only) compared to the Do Minimum, and particularly, the Base scenarios. This is predominantly linked to the operation of the Filleul Street/St Andrew Street intersection, and the additional southbound volumes on Filleul Street due to changes made on both George Street (in the three options) and at London Street/Filleul Street in respect of the banned uphill right turn (in the three options and the Do Minimum). Queues are shown to intermittently stretch back to the car park egress from this intersection, which provides an impediment to vehicles exiting the car park.

In practice, there is scope to further optimise the operation of the Filleul Street/St Andrew Street intersection (which operates at LOS C in all options, see Appendix D), so as to reduce these unreleased vehicles from the car park. In addition, the Meridian Mall car park zone also represents other smaller on-street and off-street car parks within the vicinity of Filleul Street in the model, and therefore in practice, it is considered that these vehicles will be able to disperse onto the network more easily that the model shows.

2038 Future Year – AM Peak

At 2038 in the AM peak period, there is a general deterioration in network performance from 2028 – particularly in the vicinity of the Western Corridor (Rattray Street, Broadway, Manse Street, Jetty Street) due to increased volumes to and from the communities to the west (i.e. up the hill via Rattray Street and Stuart Street).

However, between options, there is little difference in operational performance. As an example, Figure 28 shows a screenshot of the operation of the AM peak period under the 2038 Base scenario, and Figure 29 shows a screenshot of the operation under the 2038 Two-way Slow scenario – and this is also shown in Appendix E, with little difference in LOS performance over the wider network between options.

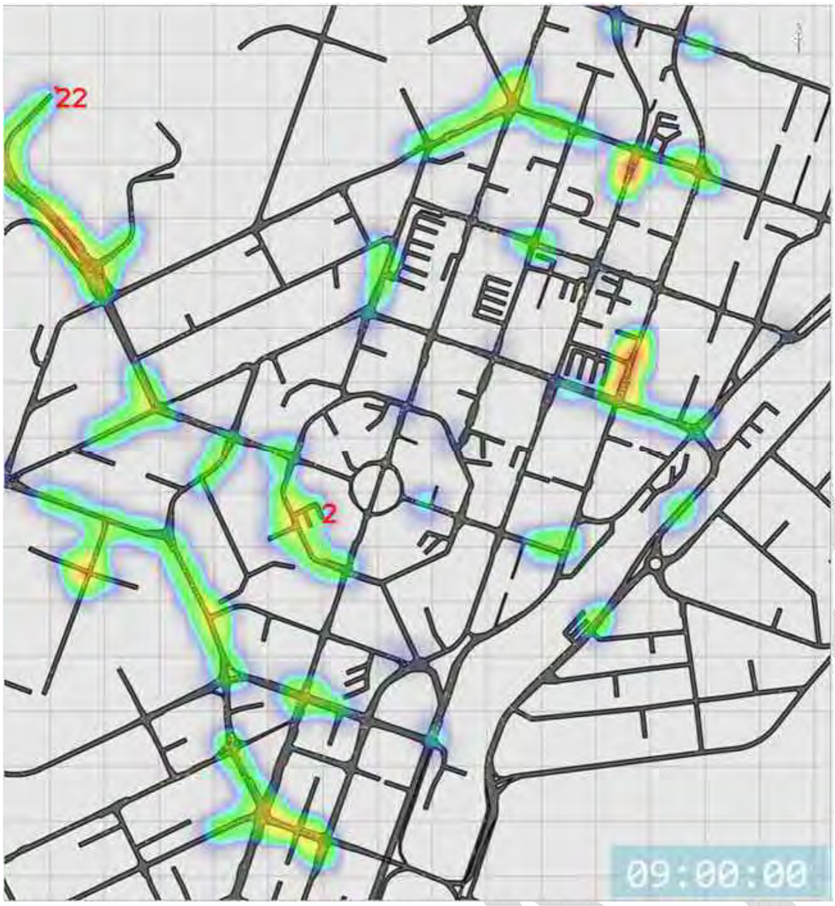

Figure 28: 2038 AM Peak Base Option - model snapshot

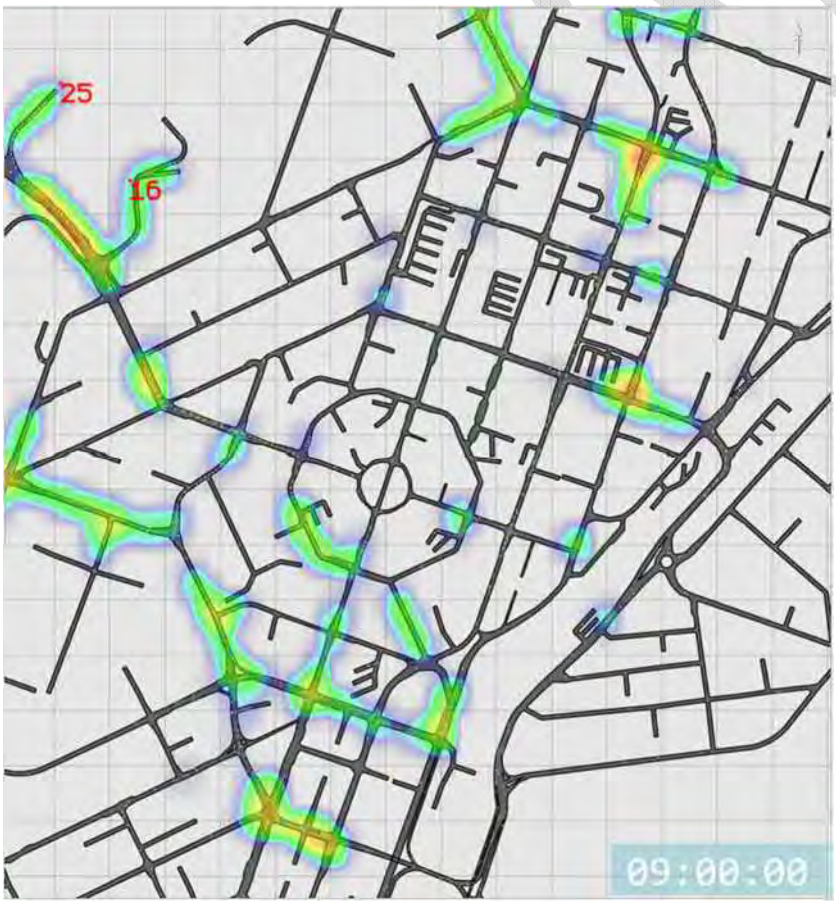

Figure 29: 2038 AM Peak Two-way Slow Option - model snapshot

2038 Future Year – Interpeak Period

At 2038 in the Interpeak period, there are no critical issues in terms of performance of the network, or at specific intersections in this period – with little deterioration in performance from the 2028 results, and little difference in network performance between the options (see Appendix F).

2038 Future Year – PM Peak

At 2038 in the PM peak period, the network performance deteriorates from 2028, with more intersections operating at LOS D to F in all options (see Appendix G), particularly around the following areas:

- The Octagon – in the Base and Do Minimum, there are significant southbound delays along George Street and Princes Street around the 1700-1720 period. Due to the restrictions to George Street in the three options, these delays are reduced as traffic re-assigns away from this north-south route
- Western Corridor – busy, but not as critical as in the AM peak period
- London/George/Filleul – more congested in the three options, which leads to queues on the London Street approach stretching back to the London/Filleul intersection on occasions in the three options

Figure 30 to Figure 34 show snapshots of model operation of all five scenarios at 2038.

Figure 30: 2038 PM Peak Base Option - model snapshot

Figure 31: 2038 PM Peak Do Minimum Option - model snapshot

Figure 32: 2038 PM Peak Two-way Slow Option - model snapshot

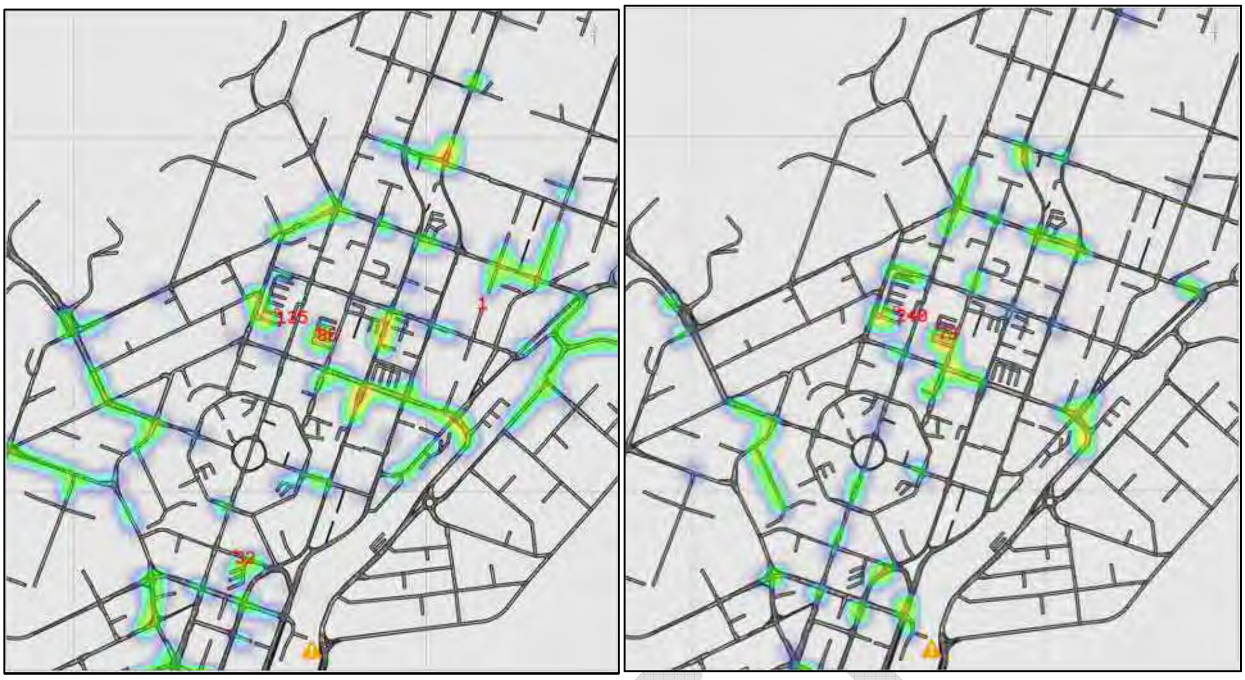

Figure 33: 2038 PM Peak Northbound Only Option - model snapshot

Figure 34: 2038 PM Peak Southbound Only Option - model snapshot

As for the 2028 results, a key difference in performance between the options is the egress from the Meridian Mall car park onto Filleul Street, which becomes more difficult in the three options (Two-way Slow, Northbound-only and Southbound-only) and the Do Minimum, compared to the Base scenario. This is predominantly linked to the operation of the Filleul Street/St Andrew Street intersection, and the additional southbound volumes on Filleul Street due to changes made on both George Street (in the three options) and at London Street/Filleul Street in respect of the banned uphill right turn (in the three options and the Do Minimum). Queues are shown to intermittently stretch back to the car park egress from this intersection, which provides an impediment to vehicles exiting the car park.

As for the 2028 scenario, there is scope to further optimise the operation of the Filleul Street/St Andrew Street intersection (which operates at LOS C or D in all options, see Appendix G), so as to reduce these unreleased vehicles from the car park. However, it does indicate that any additional changes to the Filleul Street/St Andrew Street intersection – such as Barnes Dance introduction – could have a major impact on the operation of this part of the network.

Summary

The above section has shown the relative performance of each of the three options for George Street versus the Base and Do Minimum scenario at both 2028 and 2038.

The previous assessment of the options (WSP technical note "George Street Option Testing in DMM Future Models" dated 30 April 2021) suggested that the re-assignment of traffic due to the southbound closure of George Street was predicted to have a more significant impact than the other options. This was mitigated in these latest tests through the introduction of the right turn into the Meridian Mall car park on Filleul Street, which improved movement in this area of the model, for both Do Minimum and the three George Street options.

In terms of the relative operation of each scenario:

- Generally, traffic volume increases are seen on Filleul Street in particular as a result of the changes in operation of George Street
- At both 2028 and 2038, in the AM peak and Interpeak, model results show little difference between the operation of each scenario, either within the study area or the wider network
- At 2028, the PM peak period models operate satisfactorily in the most part, albeit with near-capacity operation – the PM peak is the critical period at 2028
- At 2038, the PM peak period models show several issues with network performance. This is principally due to the general level of capacity in the network to accommodate the forecast demand set, rather than the specific network changes included within each option. However, the additional southbound volumes on Filleul Street are predicted to introduce a greater impediment for vehicles egressing the Meridian Mall car park

In conclusion, it would appear that the proposed changes to George Street have only a minor impact on network operation, in either of the three main options investigated. Of more concern is the general level of traffic in the wider network in the 2038 PM peak period, which is causing a number of areas of the network to breakdown, again regardless of the George Street option. Such areas are principally the Western Corridor, and the operation of the SH1 pairs between St Andrew Street and Frederick Street.

For context, it should be noted that these model tests **do not** include:

- Hospital changes – changes in traffic patterns in relation to the new hospital and any associated network changes (e.g. reduction in lanes on St Andrew Street)
- Harbour Arterial upgrade – improvement of the Harbour Arterial route (via Strathallan, Wharf, Thomas Burns, Ward) to provide better efficiency (and alternatives) for north-south traffic
- SH88 – changes to Anzac Avenue or Frederick Street related to the revocation of the western end of SH88 (or re-classification to Frederick Street)

Disclaimer

This technical note ('Report) has been prepared by WSP New Zealand Limited ('WSP') exclusively for Dunedin City Council ('Client') in relation to the modelling of CCG options within the DMM ('Purpose') and in accordance with DCC Project reference 9479 and WSP LTES Panel Scope of Works dated 8 March 2021). The findings in this Report are based on and are subject to the assumptions specified in the Report. WSP accepts no liability whatsoever for any use or reliance on this Report, in whole or in part, for any purpose other than the Purpose or for any use or reliance on this Report by any third party.

Appendix A – Assumptions Matrix

On-line Assumptions

Scenario	Intersection	SCN	Lane Allocations - George Street: North Kerbside	North Middle	North Offside	East Kerbside	East Offside	South Kerbside	South Middle	South Offside	West Kerbside	West Offside	West2 Kerbside	West2 Offside	Comment	Signal Phase Changes	Bus Routes	Demand
2028/2038 Base	Moray/George	29	SBL, SBT	-	SBR	WBL, WBT	WBR	NBL, NBT	-	NBR	EBL, EBT	EBR	-	-	-	-	No change	2028 Future Baseline Demand (not including SFDT TDM measures)
	St Andrew/George	30	SBL, SBT	-	SBR	WBL, WBT	WBR	NBL, NBT	-	NBR	EBL, EBT	EBR	-	-	-	-		
	Hanover/George	31	SBL, SBT	-	SBR	WBL, WBT	WBR	NBL, NBT	-	NBR	EBL, EBT	EBR	-	-	-	-		
	Frederick/George	32	SBL	SBT	SBR1, SBR2	WBL, WBT1	WBT2, WBR	NBL1, NBL2	NBT	NBR	EBL1, EBL2	EBT, EBR	EBL	EBT, EBR1, EBR2	-	-		
2028/2038 Do Minimum	Moray/George	29	SBL, SBT	-	SBR	WBL, WBT	WBR	NBL, NBT	-	NBR	EBL, EBT	EBR	-	-	-	-	NB and SB buses on George Street re-route to Great King Street between Frederick and Moray	
	St Andrew/George	30	SBL, SBT	-	SBR	WBL, WBT	WBR	NBL, NBT	-	NBR	EBL, EBT	EBR	-	-	-	-		
	Hanover/George	31	SBL, SBT	-	SBR	WBL, WBT	WBR	NBL, NBT	-	NBR	EBL, EBT	EBR	-	-	-	-		
	Frederick/George	32	SBL	SBT	SBR1, SBR2	WBL, WBT1	WBT2, WBR	NBL1, NBL2	NBT	NBR	EBL1, EBL2	EBT, EBR	EBL	EBT, EBR1, EBR2	-	-		
2028/2038 NB Only	Moray/George	29	Closed	-	Closed	WBL, WBT	WBR	NBL, NBT	-	NBR	EBL, EBT	EBR	-	-	As Existing, but speed reduced to 10kph on the three sections of George Street in NB direction Single lane in NB direction along George Street	No change	NB and SB buses on George Street re-route to Great King Street between Frederick and Moray	
	St Andrew/George	30	Closed	-	Closed	WBT	WBR	NBL, NBT, NBR	-	-	EBL	EBT	-	-		No change		
	Hanover/George	31	Closed	-	Closed	WBT	WBR	NBL, NBT, NBR	-	-	EBL	EBT	-	-		No change		
	Frederick/George	32	SBL	SBR1, SBR2	-	WBT1	WBT2, WBR	NBL1, NBL2, NBT	NBR	-	EBL1, EBL2	EBT	EBL	EBT, EBR2		No change		
2028/2038 SB Only	Moray/George	29	SBL, SBT, SBR	-	-	WBL	WBT	NBL	-	NBR	EBT	EBR	-	-	As Existing, but speed reduced to 10kph on the three sections of George Street in SB direction Single lane in SB direction along George Street	No change	NB and SB buses on George Street re-route to Great King Street between Frederick and Moray	
	St Andrew/George	30	SBL, SBT, SBR	-	-	WBL	WBT	Closed	-	Closed	EBT	EBR	-	-		Phase C no longer required; delete phase and reduce cyde time accordingly		
	Hanover/George	31	SBL, SBT, SBR	-	-	WBL	WBT	Closed	-	Closed	EBT	EBR	-	-		No change		
	Frederick/George	32	SBL	SBT	SBR1, SBR2	WBL, WBT1	WBT2, WBR	Closed	Closed	Closed	EBL1, EBL2	EBT, EBR	EBL	EBT, EBR1, EBR2		Phase A still required to run ped across London; but can run minimum time for ped+clearance (22 seconds). Any leftover can be re-allocated to phase B		
2028/2038 Slow Speed	Moray/George	29	SBL, SBT, SBR	-	-	WBL, WBT	WBR	NBL, NBT	-	NBR	EBL, EBT	EBR	-	-	As Existing, but speed reduced to 10kph on the three sections of George Street in both directions Single lane in each direction along George Street	No change	NB and SB buses on George Street re-route to Great King Street between Frederick and Moray	
	St Andrew/George	30	SBL, SBT, SBR	-	-	WBL, WBT	WBR	NBL, NBT, NBR	-	-	EBL, EBT	EBR	-	-		No change		
	Hanover/George	31	SBL, SBT, SBR	-	-	WBL, WBT	WBR	NBL, NBT, NBR	-	-	EBL, EBT	EBR	-	-		No change		
	Frederick/George	32	SBL	SBT	SBR1, SBR2	WBL, WBT1	WBT2, WBR	NBL1, NBL2, NBT	NBR	-	EBL1, EBL2	EBT, EBR	EBL	EBT, EBR1, EBR2		No change		

Closed	Lane/Movement now not possible
WBL	Lane allocation/movement changed from existing
Not Used	Lane now not used (redundant road space)

Off-line Assumptions

Type	Location	SCN	2028/2038 Base	2028/2038 Do Minimum	2028/2038 NB Only	2028/2038 SB Only	2028/2038 Slow Speed
Intersection	Wharf/Kitchener		3-phase Signalised intersection				
	Wharf/Roberts		SBLT and EBRT banned				
	Wharf/Birch		NBLT banned				
	Filleul/Hanover		No change				
	Filleul/Cargill		No change				
	Filleul/Moray		No change				
	Filleul/Meridian Access		No change	Introduce NBRT (access into Meridian Mall car park building)			
	Filleul/York/St Andrew	36	No change	Reallocate lanes on North and South approach to LT+A; RT			
	London/Filleul		No change	Banned turn from uphill London Road to London Road; Banned right turn from downhill London Road to Filleul			
	Hanover/Great King	7	No change	Introduce Barnes Dance. Remove EBLT and WBLT lanes			

Appendix B – Full LOS Results – AM Peak 2028

Intersection	Base		Do-Min		10kmh 2 way		10kmh NB Only		10kmh SB Only	
	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
North Rd / Great King St / Opoho Rd	36.6	D	33.7	C	36.2	D	36.9	D	36.3	D
Great King St / SH1	10.8	B	10.8	B	9.7	A	11.4	B	11.3	B
Duke St / George St	14.5	B	14.6	B	14.5	B	14.5	B	15.2	B
Duke St / Great King St	15.2	B	14.9	B	15.2	B	15.5	B	14.9	B
George St / Warrender St / Howe St	21.0	C	21.0	C	20.9	C	20.9	C	20.4	C
Howe St / Great King St	18.5	B	17.2	B	16.8	B	16.3	B	17.6	B
Howe St / Cumberland St	23.4	C	22.0	C	21.6	C	21.7	C	23.1	C
Dundas St / Great King St	15.6	B	15.4	B	15.6	B	14.9	B	14.8	B
Dundas St / Cumberland St	20.6	C	20.2	C	20.5	C	20.5	C	20.1	C
George St / Park St / Regent Rd	13.3	B	9.6	A	10.2	B	11.1	B	8.6	A
St David St / Great King St	12.3	B	12.7	B	12.2	B	12.4	B	12.4	B
St David St / Cumberland St	14.6	B	15.3	B	14.6	B	14.9	B	15.1	B
Union St W / Great King St	7.8	A	7.3	A	7.5	A	7.8	A	7.7	A
Union St W / Cumberland St	15.8	B	14.6	B	14.5	B	18.6	B	12.4	B
Ravensbourne Rd / SH88	10.6	B	11.0	B	10.6	B	10.7	B	10.9	B
George St / London St / Frederick St	86.7	F	66.7	E	70.4	E	74.6	E	74.8	E
Cumberland St / Frederick St	35.2	D	23.3	C	24.3	C	25.8	C	23.7	C
Castle St / Frederick St	19.4	B	16.1	B	15.4	B	17.2	B	16.4	B
SH88 / Frederick St	26.5	C	26.4	C	27.4	C	25.3	C	26.7	C
Hanover St / George St	28.6	C	26.2	C	26.5	C	21.2	C	18.1	B
Hanover St / Great King St	21.4	C	24.6	C	28.1	C	24.8	C	24.9	C
Hanover St / Cumberland St	25.4	C	15.2	B	15.7	B	17.0	B	17.5	B
Hanover St / Castle St	18.1	B	16.2	B	16.5	B	17.0	B	16.7	B
Ward St / Halsey St	2.1	A	2.1	A	2.3	A	2.1	A	2.2	A
Stuart St / Queens Dr	44.9	D	46.0	D	45.9	D	47.9	D	46.3	D
Stuart St / London St	17.9	B	17.1	B	17.6	B	17.5	B	17.9	B
St Andrews St / Filleul St	13.6	B	15.4	B	14.0	B	14.1	B	14.7	B
St Andrews St / George St	28.8	C	28.8	C	28.6	C	23.0	C	23.8	C
St Andrews St / Great King St	27.9	C	26.4	C	28.7	C	28.6	C	29.1	C
St Andrews St / Cumberland St	27.2	C	20.9	C	21.3	C	21.4	C	26.0	C
St Andrews St / Castle St	30.1	C	26.2	C	26.3	C	24.9	C	26.1	C
St Andrews St / SH88	42.4	D	42.2	D	40.2	D	39.2	D	39.7	D
George St / Moray Pl (north)	25.6	C	24.4	C	34.6	C	20.9	C	23.1	C
Moray Pl / Filleul St	3.1	A	3.3	A	3.4	A	4.1	A	3.8	A
Smith St / Stuart St	37.6	D	36.1	D	34.4	C	36.9	D	35.8	D
Moray Pl / Stuart St (west)	21.4	C	20.7	C	20.7	C	21.0	C	20.9	C
George St / The Octagon (north)	22.3	C	22.5	C	21.3	C	20.9	C	20.9	C
George St / The Octagon (south)	22.7	C	22.4	C	22.3	C	21.5	C	21.4	C
Moray Pl / Stuart St	31.8	C	30.4	C	34.4	C	34.9	C	36.0	D
Cumberland St / Stuart St	12.1	B	9.6	A	10.4	B	11.8	B	12.0	B
Castle St / Stuart St	8.8	A	9.5	A	9.7	A	9.5	A	10.2	B
Thomas Ward St / Ward St / St Andrews St	12.2	B	11.2	B	13.1	B	11.5	B	11.8	B
Rattray St / Arthur St / York Pl	27.9	C	29.4	C	29.3	C	28.1	C	27.2	C
George St / Moray Pl (south)	36.0	D	37.3	D	35.5	D	35.1	D	33.3	C
Dowling St / Princes St	23.0	C	16.2	B	13.9	B	12.0	B	15.5	B
Queens Garden / Dowling St / Burlington St	17.1	B	17.2	B	18.0	B	17.3	B	17.6	B
Dowling St / SH1	9.1	A	10.9	B	13.7	B	13.3	B	13.2	B
Rattray St / Broadway / Maclaggan St	33.9	C	41.5	D	37.5	D	34.5	C	39.4	D
Rattray St / Princes St	47.4	D	45.2	D	44.0	D	44.0	D	45.1	D
Queens Gardens / Crawford St	31.0	C	31.6	C	33.5	C	34.3	C	32.8	C
Queens Gardens / Cumberland St	22.2	C	24.6	C	27.1	C	27.4	C	27.1	C
Thomas Burns St / Wharf St / Fryatt St	6.4	A	6.4	A	6.5	A	6.0	A	6.8	A
Broadway / High St / Manse St	15.4	B	18.1	B	19.4	B	16.9	B	18.1	B
Princes St / Jetty St / Manse St	61.8	E	65.6	E	70.3	E	66.9	E	64.7	E
Jetty St / Crawford St	42.7	D	43.1	D	43.2	D	42.1	D	42.0	D
Princes St / Carroll St	4.0	A	6.4	A	9.2	A	10.4	B	8.3	A
Jervois St / SH1	37.3	E	44.7	E	45.2	E	40.9	E	46.6	E
Gordon St / Crawford St / Andersons Bay Rd	10.4	B	11.4	B	9.7	A	11.1	B	11.0	B
Andersons Bay Rd / SH1	26.7	C	27.1	C	26.6	C	26.2	C	26.3	C
Andersons Bay Rd / Strathallan St	25.0	C	25.1	C	24.7	C	25.4	C	24.6	C
Wharf St / Strathallan St / Portsmouth Dr	19.3	B	21.3	C	20.9	C	20.9	C	20.9	C
Hillside Rd / King Edward St	27.8	C	28.0	C	27.6	C	27.6	C	28.1	C
Hillside Rd / Andersons Bay Rd / Orari St	23.8	C	23.7	C	23.7	C	23.8	C	23.9	C
Portsmouth Dr / Orari St	13.3	B	14.5	B	14.2	B	13.4	B	14.7	B
King Edward St / Macandrew Rd	23.8	C	23.8	C	24.0	C	24.1	C	23.6	C
Andersons Bay Rd / Macandrew Rd / Midland St	30.6	C	30.9	C	30.2	C	30.8	C	30.5	C
Portsmouth Dr / Midland St	14.7	B	14.3	B	14.6	B	15.0	B	14.6	B
Bay View Rd / King Edward St / Prince Albert Rd	11.5	B	11.8	B	11.4	B	11.6	B	11.8	B
Bay View Rd / Portobello Rd / Andersons Bay Rd	8.0	A	7.7	A	7.5	A	7.7	A	7.9	A
Filleul St / London St	24.1	C	19.8	C	25.0	C	18.3	C	26.0	D
Filleul St / Cargill St	6.6	A	6.2	A	5.9	A	6.4	A	5.8	A
Filleul St / Meridian Access	9.6	A	10.1	B	10.7	B	10.2	B	8.9	A
Frederick St / Great King St	42.4	D	21.6	C	22.9	C	25.7	C	21.6	C

Appendix C – Full LOS Results – Interpeak 2028

Intersection	Base		Do-Min		10kmh 2 way		10kmh NB Only		10kmh SB Only	
	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
North Rd / Great King St / Opoho Rd	30.3	C	31.1	C	30.3	C	32.1	C	31.1	C
Great King St / SH1	9.1	A	8.1	A	8.8	A	8.9	A	8.8	A
Duke St / George St	9.4	A	9.6	A	9.6	A	9.5	A	9.5	A
Duke St / Great King St	8.6	A	8.5	A	8.1	A	8.6	A	8.3	A
George St / Warrender St / Howe St	14.9	B	14.8	B	14.7	B	14.8	B	15.1	B
Howe St / Great King St	16.7	B	16.9	B	16.7	B	16.8	B	16.9	B
Howe St / Cumberland St	16.8	B	17.0	B	17.0	B	16.6	B	16.8	B
Dundas St / Great King St	11.1	B	11.4	B	11.2	B	11.1	B	11.1	B
Dundas St / Cumberland St	22.5	C	22.4	C	22.1	C	22.2	C	22.9	C
George St / Park St / Regent Rd	4.0	A	4.5	A	3.6	A	3.2	A	3.6	A
St David St / Great King St	8.1	A	8.6	A	8.2	A	8.8	A	8.7	A
St David St / Cumberland St	14.5	B	15.4	B	14.4	B	14.9	B	15.4	B
Union St W / Great King St	8.3	A	7.7	A	7.3	A	7.7	A	8.1	A
Union St W / Cumberland St	13.2	B	13.4	B	13.4	B	17.0	B	15.8	B
Ravensbourne Rd / SH88	6.3	A	6.1	A	6.1	A	6.1	A	5.9	A
George St / London St / Frederick St	59.7	E	54.1	D	54.4	D	49.1	D	59.1	E
Cumberland St / Frederick St	18.4	B	18.6	B	20.2	C	21.6	C	24.1	C
Castle St / Frederick St	13.1	B	12.8	B	12.6	B	12.2	B	13.2	B
SH88 / Frederick St	16.6	B	16.9	B	15.5	B	16.2	B	16.0	B
Hanover St / George St	27.4	C	25.2	C	21.9	C	19.4	B	17.4	B
Hanover St / Great King St	23.0	C	33.5	C	27.9	C	27.5	C	29.4	C
Hanover St / Cumberland St	15.6	B	15.2	B	17.0	B	16.6	B	20.5	C
Hanover St / Castle St	18.9	B	18.5	B	18.7	B	18.7	B	19.0	B
Ward St / Halsey St	1.5	A	1.5	A	1.6	A	1.3	A	1.5	A
Stuart St / Queens Dr	20.3	C	18.8	B	20.0	C	21.7	C	21.9	C
Stuart St / London St	31.0	C	23.0	C	25.4	C	27.7	C	31.5	C
St Andrews St / Filleul St	10.4	B	12.5	B	12.9	B	14.3	B	14.2	B
St Andrews St / George St	28.8	C	28.9	C	27.0	C	24.1	C	22.8	C
St Andrews St / Great King St	26.8	C	28.6	C	31.9	C	29.8	C	33.7	C
St Andrews St / Cumberland St	18.7	B	18.9	B	19.2	B	19.8	B	23.9	C
St Andrews St / Castle St	24.4	C	24.0	C	23.4	C	23.5	C	24.7	C
St Andrews St / SH88	26.0	C	25.3	C	23.2	C	24.6	C	26.8	C
George St / Moray Pl (north)	23.5	C	24.0	C	31.7	C	19.9	B	20.6	C
Moray Pl / Filleul St	2.7	A	3.0	A	3.9	A	3.5	A	3.7	A
Smith St / Stuart St	25.3	C	27.5	C	24.7	C	26.2	C	27.6	C
Moray Pl / Stuart St (west)	12.5	B	12.5	B	13.1	B	13.1	B	13.1	B
George St / The Octagon (north)	23.1	C	22.9	C	21.0	C	21.6	C	20.9	C
George St / The Octagon (south)	22.9	C	22.2	C	21.5	C	21.5	C	20.3	C
Moray Pl / Stuart St	27.3	C	27.2	C	29.2	C	30.3	C	29.9	C
Cumberland St / Stuart St	8.9	A	9.4	A	9.5	A	9.8	A	10.3	B
Castle St / Stuart St	9.8	A	9.7	A	10.1	B	10.5	B	11.0	B
Thomas Ward St / Ward St / St Andrews St	5.4	A	5.5	A	5.5	A	5.6	A	5.7	A
Rattray St / Arthur St / York Pl	12.6	B	12.4	B	12.7	B	12.9	B	13.1	B
George St / Moray Pl (south)	30.5	C	31.2	C	28.5	C	28.7	C	27.9	C
Dowling St / Princes St	8.8	A	8.7	A	8.5	A	8.5	A	8.0	A
Queens Garden / Dowling St / Burlington St	14.9	B	14.8	B	14.9	B	15.6	B	15.5	B
Dowling St / SH1	19.9	B	19.9	B	22.8	C	24.5	C	24.0	C
Rattray St / Broadway / Maclaggan St	19.9	B	21.1	C	19.0	B	21.2	C	19.6	B
Rattray St / Princes St	28.7	C	27.4	C	25.8	C	26.4	C	28.0	C
Queens Gardens / Crawford St	24.5	C	22.6	C	24.2	C	24.1	C	24.3	C
Queens Gardens / Cumberland St	19.8	B	20.1	C	21.5	C	22.8	C	21.9	C
Thomas Burns St / Wharf St / Fryatt St	7.8	A	7.4	A	8.1	A	7.2	A	7.6	A
Broadway / High St / Manse St	11.8	B	11.7	B	11.7	B	12.0	B	11.9	B
Princes St / Jetty St / Manse St	49.3	D	48.6	D	49.7	D	48.4	D	48.6	D
Jetty St / Crawford St	23.3	C	23.3	C	22.9	C	22.9	C	22.8	C
Princes St / Carroll St	2.3	A	2.4	A	1.9	A	2.0	A	2.1	A
Jervois St / SH1	29.6	D	27.2	D	30.9	D	27.6	D	29.3	D
Gordon St / Crawford St / Andersons Bay Rd	9.7	A	9.7	A	9.6	A	9.7	A	9.9	A
Andersons Bay Rd / SH1	22.2	C	21.5	C	21.5	C	21.7	C	21.6	C
Andersons Bay Rd / Strathallan St	24.3	C	24.7	C	25.0	C	24.3	C	25.1	C
Wharf St / Strathallan St / Portsmouth Dr	10.5	B	11.9	B	11.1	B	10.8	B	10.1	B
Hillside Rd / King Edward St	31.0	C	30.5	C	30.3	C	31.4	C	30.0	C
Hillside Rd / Andersons Bay Rd / Orari St	31.0	C	31.0	C	32.4	C	31.0	C	32.0	C
Portsmouth Dr / Orari St	16.5	B	12.1	B	19.3	B	14.3	B	13.1	B
King Edward St / Macandrew Rd	24.6	C	24.8	C	24.5	C	24.8	C	24.4	C
Andersons Bay Rd / Macandrew Rd / Midland St	28.1	C	28.3	C	28.2	C	28.4	C	28.4	C
Portsmouth Dr / Midland St	19.9	B	22.8	C	23.7	C	21.3	C	20.5	C
Bay View Rd / King Edward St / Prince Albert Rd	8.7	A	8.8	A	8.7	A	8.3	A	8.9	A
Bay View Rd / Portobello Rd / Andersons Bay Rd	6.1	A	6.3	A	6.1	A	6.0	A	6.3	A
Filleul St / London St	3.1	A	4.3	A	4.1	A	4.3	A	6.6	A
Filleul St / Cargill St	7.5	A	5.5	A	5.2	A	5.4	A	4.9	A
Filleul St / Meridian Access	8.7	A	11.1	B	10.4	B	10.2	B	10.4	B
Frederick St / Great King St	26.1	C	22.3	C	23.7	C	32.2	C	27.5	C

Appendix D – Full LOS Results – PM Peak 2028

Intersection	Base		Do-Min		10kmh 2 way		10kmh NB Only		10kmh SB Only	
	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
North Rd / Great King St / Opoho Rd	52.1	D	54.1	D	49.1	D	54.9	D	59.3	E
Great King St / SH1	25.4	D	25.4	D	28.5	D	26.9	D	25.5	D
Duke St / George St	17.1	B	18.3	B	17.6	B	17.0	B	18.1	B
Duke St / Great King St	12.8	B	12.5	B	14.2	B	15.2	B	13.8	B
George St / Warrender St / Howe St	25.8	C	25.7	C	27.3	C	28.7	C	29.2	C
Howe St / Great King St	17.9	B	18.4	B	18.2	B	19.1	B	18.5	B
Howe St / Cumberland St	19.4	B	19.1	B	19.5	B	19.6	B	20.2	C
Dundas St / Great King St	17.9	B	20.0	C	18.7	B	17.8	B	17.6	B
Dundas St / Cumberland St	35.9	D	37.1	D	39.1	D	37.2	D	36.1	D
George St / Park St / Regent Rd	14.9	B	12.0	B	13.1	B	15.2	C	11.9	B
St David St / Great King St	10.2	B	10.5	B	10.6	B	10.4	B	10.5	B
St David St / Cumberland St	14.9	B	15.6	B	15.6	B	15.8	B	16.1	B
Union St W / Great King St	10.5	B	10.9	B	11.9	B	11.2	B	11.1	B
Union St W / Cumberland St	28.2	C	23.8	C	27.2	C	25.3	C	26.8	C
Ravensbourne Rd / SH88	8.2	A	7.7	A	7.9	A	8.1	A	7.8	A
George St / London St / Frederick St	85.3	F	66.6	E	77.9	E	69.0	E	79.1	E
Cumberland St / Frederick St	23.4	C	21.7	C	27.9	C	29.0	C	28.1	C
Castle St / Frederick St	22.4	C	22.5	C	25.1	C	24.1	C	25.3	C
SH88 / Frederick St	26.6	C	26.0	C	27.0	C	26.1	C	26.6	C
Hanover St / George St	33.7	C	33.9	C	28.7	C	19.3	B	21.6	C
Hanover St / Great King St	28.6	C	37.2	D	33.1	C	33.6	C	35.8	D
Hanover St / Cumberland St	21.7	C	21.2	C	26.4	C	26.8	C	26.8	C
Hanover St / Castle St	28.0	C	24.9	C	27.8	C	27.0	C	27.2	C
Ward St / Halsey St	1.6	A	1.8	A	1.6	A	1.6	A	1.8	A
Stuart St / Queens Dr	24.1	C	20.3	C	21.7	C	20.3	C	20.5	C
Stuart St / London St	36.3	D	32.9	C	35.4	D	36.4	D	35.3	D
St Andrews St / Filleul St	34.4	C	26.4	C	21.6	C	21.3	C	20.6	C
St Andrews St / George St	41.5	D	63.6	E	30.6	C	21.9	C	22.9	C
St Andrews St / Great King St	39.5	D	34.6	C	39.5	D	44.7	D	50.4	D
St Andrews St / Cumberland St	28.4	C	27.5	C	32.9	C	34.4	C	34.0	C
St Andrews St / Castle St	35.6	D	32.0	C	34.0	C	31.6	C	34.5	C
St Andrews St / SH88	35.5	D	33.5	C	33.2	C	33.9	C	35.8	D
George St / Moray Pl (north)	62.2	E	63.4	E	29.8	C	22.9	C	21.2	C
Moray Pl / Filleul St	32.5	D	5.6	A	11.9	B	12.4	B	13.2	B
Smith St / Stuart St	53.5	D	54.8	D	57.3	E	59.0	E	56.8	E
Moray Pl / Stuart St (west)	22.8	C	26.5	C	25.5	C	25.7	C	25.3	C
George St / The Octagon (north)	45.5	D	65.8	E	21.6	C	20.8	C	20.0	C
George St / The Octagon (south)	56.9	E	70.0	E	28.4	C	29.6	C	27.4	C
Moray Pl / Stuart St	32.3	C	32.0	C	36.3	D	36.1	D	36.1	D
Cumberland St / Stuart St	9.5	A	10.6	B	11.2	B	13.6	B	10.6	B
Castle St / Stuart St	15.1	B	15.6	B	17.0	B	17.8	B	18.4	B
Thomas Ward St / Ward St / St Andrews St	8.0	A	7.4	A	9.9	A	8.9	A	7.7	A
Rattray St / Arthur St / York Pl	25.3	C	26.5	C	34.7	C	28.0	C	30.2	C
George St / Moray Pl (south)	48.5	D	57.5	E	44.5	D	43.9	D	46.0	D
Dowling St / Princes St	22.2	C	21.1	C	16.1	B	26.0	C	19.2	B
Queens Garden / Dowling St / Burlington St	18.4	B	18.3	B	17.8	B	19.7	B	19.9	B
Dowling St / SH1	8.4	A	8.3	A	11.2	B	10.3	B	12.7	B
Rattray St / Broadway / Maclaggan St	36.6	D	43.2	D	41.3	D	44.0	D	42.6	D
Rattray St / Princes St	35.8	D	38.2	D	33.1	C	39.6	D	36.7	D
Queens Gardens / Crawford St	26.7	C	28.5	C	28.9	C	31.4	C	30.8	C
Queens Gardens / Cumberland St	16.7	B	17.9	B	20.1	C	20.2	C	21.3	C
Thomas Burns St / Wharf St / Fryatt St	28.0	D	19.0	C	48.7	E	25.9	D	19.7	C
Broadway / High St / Manse St	17.4	B	21.8	C	20.7	C	21.8	C	21.3	C
Princes St / Jetty St / Manse St	59.3	E	63.3	E	59.4	E	59.7	E	61.7	E
Jetty St / Crawford St	37.5	D	41.3	D	35.3	D	35.0	D	37.7	D
Princes St / Carroll St	3.5	A	3.3	A	2.9	A	3.1	A	3.1	A
Jervois St / SH1	28.8	D	33.8	D	31.7	D	31.0	D	33.6	D
Gordon St / Crawford St / Andersons Bay Rd	13.3	B	13.1	B	12.8	B	12.1	B	13.7	B
Andersons Bay Rd / SH1	39.0	D	40.0	D	38.9	D	45.5	D	36.3	D
Andersons Bay Rd / Strathallan St	42.3	D	50.9	D	47.9	D	47.0	D	47.6	D
Wharf St / Strathallan St / Portsmouth Dr	10.8	B	10.9	B	10.4	B	10.6	B	10.8	B
Hillside Rd / King Edward St	45.5	D	48.2	D	44.9	D	46.1	D	46.5	D
Hillside Rd / Andersons Bay Rd / Orari St	49.1	D	61.9	E	54.4	D	53.6	D	52.4	D
Portsmouth Dr / Orari St	6.9	A	7.5	A	7.0	A	7.2	A	7.6	A
King Edward St / Macandrew Rd	38.2	D	36.1	D	38.1	D	37.2	D	37.1	D
Andersons Bay Rd / Macandrew Rd / Midland St	41.2	D	43.8	D	44.2	D	43.0	D	42.6	D
Portsmouth Dr / Midland St	14.8	B	15.2	B	15.0	B	15.1	B	15.8	B
Bay View Rd / King Edward St / Prince Albert Rd	11.5	B	11.9	B	11.7	B	11.2	B	11.5	B
Bay View Rd / Portobello Rd / Andersons Bay Rd	9.6	A	9.9	A	9.2	A	8.9	A	9.7	A
Filleul St / London St	8.5	A	6.8	A	12.1	B	12.5	B	14.9	B
Filleul St / Cargill St	19.0	C	14.4	B	17.7	C	17.2	C	18.8	C
Filleul St / Meridian Access	21.6	C	23.5	C	18.3	C	19.2	C	19.5	C
Frederick St / Great King St	40.1	D	24.1	C	32.8	C	35.3	D	36.3	D

Appendix E – Full LOS Results – AM Peak 2038

Intersection	Base		Do-Min		10kmh 2 way		10kmh NB Only		10kmh SB Only	
	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
North Rd / Great King St / Opoho Rd	37.3	D	36.8	D	37.0	D	38.2	D	37.2	D
Great King St / SH1	10.6	B	10.9	B	10.7	B	11.1	B	10.6	B
Duke St / George St	14.7	B	15.6	B	15.1	B	14.8	B	15.3	B
Duke St / Great King St	15.6	B	14.6	B	15.6	B	15.1	B	14.8	B
George St / Warrender St / Howe St	21.7	C	22.6	C	22.8	C	22.4	C	22.4	C
Howe St / Great King St	17.9	B	18.9	B	17.2	B	17.4	B	19.1	B
Howe St / Cumberland St	23.1	C	23.2	C	23.4	C	23.8	C	24.6	C
Dundas St / Great King St	15.8	B	14.9	B	15.3	B	15.7	B	15.3	B
Dundas St / Cumberland St	21.0	C	20.3	C	21.3	C	20.7	C	20.6	C
George St / Park St / Regent Rd	12.2	B	13.6	B	12.3	B	13.7	B	11.1	B
St David St / Great King St	12.6	B	12.6	B	12.0	B	12.5	B	11.8	B
St David St / Cumberland St	15.0	B	15.0	B	14.7	B	15.4	B	15.0	B
Union St W / Great King St	8.4	A	7.5	A	8.1	A	8.0	A	7.8	A
Union St W / Cumberland St	12.2	B	21.2	C	26.6	C	23.6	C	18.5	B
Ravensbourne Rd / SH88	11.0	B	11.4	B	10.7	B	11.1	B	11.6	B
George St / London St / Frederick St	93.1	F	73.1	E	78.0	E	86.8	F	86.4	F
Cumberland St / Frederick St	32.4	C	26.9	C	27.6	C	31.2	C	26.5	C
Castle St / Frederick St	17.9	B	19.2	B	18.3	B	21.6	C	17.2	B
SH88 / Frederick St	28.0	C	27.4	C	27.8	C	27.9	C	26.7	C
Hanover St / George St	28.6	C	27.8	C	27.9	C	21.7	C	19.9	B
Hanover St / Great King St	20.3	C	23.9	C	25.8	C	26.8	C	23.8	C
Hanover St / Cumberland St	20.7	C	16.6	B	17.8	B	19.1	B	18.0	B
Hanover St / Castle St	20.9	C	22.4	C	21.4	C	23.1	C	18.3	B
Ward St / Halsey St	2.2	A	2.3	A	2.5	A	2.6	A	2.7	A
Stuart St / Queens Dr	46.8	D	49.8	D	52.5	D	48.1	D	46.8	D
Stuart St / London St	20.6	C	20.9	C	20.8	C	19.2	B	21.0	C
St Andrews St / Filleul St	15.5	B	13.9	B	17.0	B	15.3	B	16.5	B
St Andrews St / George St	28.6	C	30.7	C	30.9	C	24.3	C	23.5	C
St Andrews St / Great King St	29.1	C	28.5	C	33.1	C	35.1	D	28.3	C
St Andrews St / Cumberland St	27.7	C	25.0	C	28.3	C	26.9	C	29.5	C
St Andrews St / Castle St	35.8	D	39.5	D	37.5	D	35.2	D	35.5	D
St Andrews St / SH88	43.8	D	44.6	D	45.3	D	46.0	D	47.0	D
George St / Moray Pl (north)	26.0	C	27.9	C	33.7	C	23.0	C	21.5	C
Moray Pl / Filleul St	3.3	A	3.7	A	5.1	A	4.3	A	4.7	A
Smith St / Stuart St	37.6	D	45.1	D	46.2	D	42.2	D	43.5	D
Moray Pl / Stuart St (west)	21.1	C	24.6	C	22.9	C	21.5	C	22.0	C
George St / The Octagon (north)	22.7	C	27.5	C	21.1	C	22.0	C	21.6	C
George St / The Octagon (south)	22.4	C	32.7	C	23.1	C	22.3	C	22.2	C
Moray Pl / Stuart St	33.1	C	36.6	D	35.2	D	35.4	D	32.0	C
Cumberland St / Stuart St	12.9	B	10.2	B	11.3	B	13.0	B	11.7	B
Castle St / Stuart St	9.6	A	10.5	B	11.5	B	10.0	A	10.7	B
Thomas Ward St / Ward St / St Andrews St	12.6	B	13.0	B	13.8	B	14.7	B	13.4	B
Rattray St / Arthur St / York Pl	37.1	D	34.1	C	66.0	E	52.6	D	67.6	E
George St / Moray Pl (south)	38.2	D	50.8	D	39.3	D	36.9	D	36.3	D
Dowling St / Princes St	20.7	C	35.7	D	21.0	C	15.3	B	16.2	B
Queens Garden / Dowling St / Burlington St	19.3	B	19.3	B	19.2	B	19.1	B	18.9	B
Dowling St / SH1	12.6	B	12.9	B	17.1	B	15.4	B	15.8	B
Rattray St / Broadway / Maclaggan St	45.3	D	48.4	D	62.1	E	50.3	D	55.5	E
Rattray St / Princes St	53.2	D	60.1	E	55.4	E	48.9	D	54.2	D
Queens Gardens / Crawford St	34.5	C	35.5	D	35.2	D	35.2	D	36.2	D
Queens Gardens / Cumberland St	23.4	C	26.1	C	27.4	C	27.5	C	28.0	C
Thomas Burns St / Wharf St / Fryatt St	6.6	A	6.5	A	6.7	A	6.9	A	7.0	A
Broadway / High St / Manse St	22.2	C	23.5	C	31.9	C	29.5	C	28.5	C
Princes St / Jetty St / Manse St	79.2	E	78.9	E	82.9	F	92.8	F	94.7	F
Jetty St / Crawford St	51.0	D	49.4	D	51.1	D	48.9	D	51.6	D
Princes St / Carroll St	21.9	C	22.5	C	18.9	B	47.7	D	46.6	D
Jervois St / SH1	67.7	F	63.5	F	79.4	F	82.0	F	87.2	F
Gordon St / Crawford St / Andersons Bay Rd	11.4	B	11.2	B	12.1	B	12.6	B	13.5	B
Andersons Bay Rd / SH1	27.4	C	27.8	C	29.8	C	28.2	C	28.6	C
Andersons Bay Rd / Strathallan St	24.9	C	25.5	C	27.4	C	26.6	C	28.2	C
Wharf St / Strathallan St / Portsmouth Dr	23.0	C	23.8	C	26.1	C	24.9	C	29.3	C
Hillside Rd / King Edward St	29.6	C	30.0	C	30.0	C	28.5	C	30.4	C
Hillside Rd / Andersons Bay Rd / Orari St	25.5	C	25.7	C	25.4	C	26.3	C	25.6	C
Portsmouth Dr / Orari St	16.1	B	15.4	B	15.5	B	17.6	B	18.0	B
King Edward St / Macandrew Rd	25.5	C	24.3	C	24.6	C	25.0	C	24.6	C
Andersons Bay Rd / Macandrew Rd / Midland St	30.7	C	30.8	C	30.8	C	30.7	C	30.2	C
Portsmouth Dr / Midland St	15.4	B	15.0	B	14.7	B	15.5	B	15.4	B
Bay View Rd / King Edward St / Prince Albert Rd	11.6	B	11.8	B	11.9	B	11.9	B	11.9	B
Bay View Rd / Portobello Rd / Andersons Bay Rd	9.2	A	8.9	A	9.2	A	7.9	A	7.8	A
Filleul St / London St	41.3	E	26.1	D	27.4	D	31.0	D	40.5	E
Filleul St / Cargill St	7.5	A	6.1	A	8.3	A	7.2	A	6.6	A
Filleul St / Meridian Access	11.1	B	10.9	B	10.0	B	9.9	A	9.4	A
Frederick St / Great King St	49.2	D	27.2	C	26.1	C	26.2	C	25.0	C

Appendix F – Full LOS Results – Interpeak 2038

Intersection	Base		Do-Min		10kmh 2 way		10kmh NB Only		10kmh SB Only	
	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
North Rd / Great King St / Opoho Rd	32.1	C	32.1	C	30.1	C	29.8	C	30.8	C
Great King St / SH1	8.5	A	8.6	A	8.9	A	9.0	A	9.2	A
Duke St / George St	9.8	A	9.4	A	9.9	A	9.8	A	9.9	A
Duke St / Great King St	7.9	A	9.0	A	8.7	A	8.1	A	8.1	A
George St / Warrender St / Howe St	14.6	B	15.3	B	15.5	B	15.1	B	15.2	B
Howe St / Great King St	16.5	B	17.2	B	16.5	B	16.9	B	16.5	B
Howe St / Cumberland St	16.9	B	17.0	B	17.7	B	16.9	B	17.2	B
Dundas St / Great King St	10.9	B	11.7	B	11.1	B	11.7	B	11.0	B
Dundas St / Cumberland St	22.7	C	22.0	C	21.5	C	23.1	C	24.0	C
George St / Park St / Regent Rd	4.9	A	4.9	A	4.6	A	6.1	A	4.1	A
St David St / Great King St	8.4	A	9.0	A	8.3	A	8.8	A	8.7	A
St David St / Cumberland St	15.3	B	15.0	B	15.0	B	15.6	B	14.6	B
Union St W / Great King St	8.8	A	8.1	A	8.4	A	8.2	A	8.3	A
Union St W / Cumberland St	15.7	B	16.9	B	16.2	B	20.6	C	16.0	B
Ravensbourne Rd / SH88	6.5	A	6.4	A	6.2	A	6.1	A	6.2	A
George St / London St / Frederick St	65.9	E	55.9	E	56.2	E	55.8	E	65.1	E
Cumberland St / Frederick St	21.6	C	22.4	C	21.3	C	22.6	C	28.2	C
Castle St / Frederick St	13.6	B	13.1	B	12.8	B	12.7	B	13.0	B
SH88 / Frederick St	16.7	B	16.0	B	16.6	B	16.1	B	17.1	B
Hanover St / George St	27.3	C	25.8	C	27.2	C	20.0	C	17.7	B
Hanover St / Great King St	23.4	C	28.7	C	27.8	C	28.4	C	30.7	C
Hanover St / Cumberland St	17.4	B	17.7	B	17.4	B	16.8	B	22.7	C
Hanover St / Castle St	18.6	B	18.0	B	19.7	B	19.2	B	20.8	C
Ward St / Halsey St	1.6	A	1.6	A	1.8	A	1.7	A	1.8	A
Stuart St / Queens Dr	20.9	C	23.0	C	19.1	B	18.5	B	19.4	B
Stuart St / London St	44.5	D	58.1	E	24.2	C	25.7	C	26.8	C
St Andrews St / Filleul St	11.1	B	12.0	B	13.0	B	13.2	B	14.2	B
St Andrews St / George St	30.3	C	29.6	C	26.8	C	24.1	C	23.2	C
St Andrews St / Great King St	32.1	C	30.7	C	32.9	C	32.4	C	33.5	C
St Andrews St / Cumberland St	19.3	B	21.3	C	20.5	C	21.4	C	25.1	C
St Andrews St / Castle St	24.6	C	24.0	C	24.5	C	24.6	C	25.4	C
St Andrews St / SH88	25.3	C	24.8	C	26.2	C	27.1	C	28.2	C
George St / Moray Pl (north)	25.6	C	23.8	C	33.8	C	19.4	B	19.8	B
Moray Pl / Filleul St	2.9	A	3.1	A	3.6	A	4.0	A	3.5	A
Smith St / Stuart St	23.9	C	27.0	C	27.0	C	27.2	C	26.5	C
Moray Pl / Stuart St (west)	12.3	B	13.1	B	13.1	B	12.9	B	12.5	B
George St / The Octagon (north)	22.8	C	22.9	C	20.5	C	21.7	C	22.9	C
George St / The Octagon (south)	23.1	C	22.5	C	20.5	C	21.4	C	20.0	C
Moray Pl / Stuart St	26.5	C	29.4	C	31.2	C	29.7	C	31.1	C
Cumberland St / Stuart St	9.2	A	9.7	A	10.2	B	10.5	B	10.6	B
Castle St / Stuart St	9.7	A	10.1	B	11.0	B	10.7	B	11.1	B
Thomas Ward St / Ward St / St Andrews St	5.8	A	6.2	A	6.3	A	6.1	A	6.6	A
Rattray St / Arthur St / York Pl	12.7	B	20.1	C	12.9	B	13.3	B	13.3	B
George St / Moray Pl (south)	30.6	C	32.1	C	28.5	C	29.8	C	27.8	C
Dowling St / Princes St	9.3	A	11.0	B	8.1	A	11.9	B	8.5	A
Queens Garden / Dowling St / Burlington St	15.5	B	15.3	B	15.3	B	16.0	B	15.3	B
Dowling St / SH1	23.5	C	24.2	C	25.5	C	26.7	C	29.9	C
Rattray St / Broadway / Maclaggan St	19.8	B	21.1	C	21.4	C	23.7	C	23.2	C
Rattray St / Princes St	30.5	C	30.9	C	29.1	C	30.6	C	28.7	C
Queens Gardens / Crawford St	24.5	C	24.3	C	26.6	C	28.0	C	26.3	C
Queens Gardens / Cumberland St	20.7	C	21.3	C	23.1	C	22.6	C	23.4	C
Thomas Burns St / Wharf St / Fryatt St	8.0	A	7.8	A	8.3	A	7.7	A	8.9	A
Broadway / High St / Manse St	12.5	B	12.0	B	12.7	B	12.2	B	12.6	B
Princes St / Jetty St / Manse St	51.1	D	51.7	D	50.3	D	50.1	D	51.8	D
Jetty St / Crawford St	23.6	C	25.4	C	23.8	C	23.7	C	24.3	C
Princes St / Carroll St	2.3	A	2.4	A	2.1	A	1.9	A	2.1	A
Jervois St / SH1	30.4	D	29.7	D	31.4	D	31.0	D	30.6	D
Gordon St / Crawford St / Andersons Bay Rd	9.6	A	9.8	A	10.0	A	10.4	B	10.2	B
Andersons Bay Rd / SH1	22.8	C	23.4	C	23.1	C	22.1	C	22.8	C
Andersons Bay Rd / Strathallan St	25.9	C	25.8	C	25.5	C	26.0	C	26.5	C
Wharf St / Strathallan St / Portsmouth Dr	13.2	B	12.7	B	12.5	B	11.1	B	10.5	B
Hillside Rd / King Edward St	31.9	C	31.8	C	31.5	C	31.6	C	32.1	C
Hillside Rd / Andersons Bay Rd / Orari St	33.9	C	33.5	C	33.0	C	35.6	D	34.0	C
Portsmouth Dr / Orari St	23.4	C	15.7	B	14.7	B	16.6	B	24.1	C
King Edward St / Macandrew Rd	25.6	C	24.9	C	26.4	C	25.2	C	24.7	C
Andersons Bay Rd / Macandrew Rd / Midland St	28.7	C	28.0	C	28.7	C	28.4	C	27.9	C
Portsmouth Dr / Midland St	24.0	C	23.8	C	22.1	C	22.3	C	21.3	C
Bay View Rd / King Edward St / Prince Albert Rd	8.8	A	8.8	A	8.9	A	8.8	A	8.8	A
Bay View Rd / Portobello Rd / Andersons Bay Rd	6.0	A	6.2	A	6.3	A	6.3	A	6.2	A
Filleul St / London St	3.2	A	3.8	A	4.9	A	5.5	A	12.4	B
Filleul St / Cargill St	7.6	A	5.3	A	5.4	A	5.6	A	6.1	A
Filleul St / Meridian Access	10.2	B	9.4	A	10.8	B	10.9	B	9.5	A
Frederick St / Great King St	29.6	C	23.9	C	26.4	C	29.0	C	33.3	C

Appendix G – Full LOS Results – PM Peak 2038

Intersection	Base		Do-Min		10kmh 2 way		10kmh NB Only		10kmh SB Only	
	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
North Rd / Great King St / Opoho Rd	61.3	E	57.7	E	72.1	E	82.7	F	59.8	E
Great King St / SH1	29.2	D	32.1	D	30.7	D	34.3	D	30.9	D
Duke St / George St	17.9	B	17.2	B	16.7	B	23.7	C	18.8	B
Duke St / Great King St	16.7	B	19.5	B	18.4	B	21.4	C	20.6	C
George St / Warrender St / Howe St	30.1	C	33.4	C	30.8	C	38.7	D	30.7	C
Howe St / Great King St	21.2	C	20.5	C	19.6	B	23.2	C	26.8	C
Howe St / Cumberland St	19.3	B	19.4	B	21.7	C	20.7	C	20.6	C
Dundas St / Great King St	21.3	C	18.8	B	18.2	B	19.7	B	20.1	C
Dundas St / Cumberland St	44.1	D	39.6	D	39.0	D	41.2	D	38.9	D
George St / Park St / Regent Rd	23.9	C	14.4	B	24.8	C	21.7	C	39.6	E
St David St / Great King St	11.2	B	10.7	B	10.3	B	10.7	B	10.4	B
St David St / Cumberland St	15.9	B	14.9	B	16.4	B	15.5	B	15.2	B
Union St W / Great King St	13.0	B	11.3	B	13.1	B	12.0	B	10.6	B
Union St W / Cumberland St	37.2	D	24.6	C	34.2	C	33.5	C	30.5	C
Ravensbourne Rd / SH88	8.7	A	8.0	A	8.1	A	8.3	A	7.6	A
George St / London St / Frederick St	110.0	F	76.8	E	102.5	F	85.9	F	87.8	F
Cumberland St / Frederick St	37.9	D	26.7	C	31.4	C	39.1	D	34.2	C
Castle St / Frederick St	38.8	D	28.8	C	31.0	C	37.7	D	28.7	C
SH88 / Frederick St	36.7	D	30.0	C	32.0	C	29.5	C	30.9	C
Hanover St / George St	47.1	D	53.7	D	39.3	D	20.5	C	30.1	C
Hanover St / Great King St	36.0	D	37.4	D	40.2	D	38.8	D	39.0	D
Hanover St / Cumberland St	32.8	C	22.3	C	28.3	C	37.2	D	39.2	D
Hanover St / Castle St	32.3	C	26.6	C	28.8	C	37.8	D	31.3	C
Ward St / Halsey St	37.8	D	2.5	A	2.0	A	2.1	A	2.5	A
Stuart St / Queens Dr	18.0	B	48.2	D	26.1	C	20.2	C	20.8	C
Stuart St / London St	37.4	D	50.7	D	45.7	D	42.4	D	34.6	C
St Andrews St / Filleul St	33.8	C	44.9	D	36.3	D	25.9	C	29.5	C
St Andrews St / George St	80.7	F	118.3	F	31.1	C	22.4	C	22.7	C
St Andrews St / Great King St	42.3	D	53.7	D	45.2	D	54.1	D	45.6	D
St Andrews St / Cumberland St	41.5	D	32.7	C	30.4	C	46.9	D	52.0	D
St Andrews St / Castle St	43.9	D	36.2	D	39.4	D	43.3	D	45.9	D
St Andrews St / SH88	54.3	D	50.5	D	49.3	D	45.6	D	52.9	D
George St / Moray Pl (north)	118.9	F	134.6	F	27.8	C	25.1	C	25.6	C
Moray Pl / Filleul St	8.1	A	58.0	F	26.5	D	21.2	C	26.9	D
Smith St / Stuart St	53.6	D	62.8	E	77.0	E	65.7	E	63.1	E
Moray Pl / Stuart St (west)	24.0	C	26.6	C	41.7	D	33.0	C	29.7	C
George St / The Octagon (north)	80.1	F	91.9	F	24.3	C	21.5	C	24.6	C
George St / The Octagon (south)	74.5	E	83.5	F	31.8	C	34.2	C	33.9	C
Moray Pl / Stuart St	33.7	C	45.6	D	35.3	D	40.8	D	39.8	D
Cumberland St / Stuart St	11.5	B	14.3	B	11.7	B	17.1	B	26.1	C
Castle St / Stuart St	17.0	B	18.1	B	26.0	C	20.0	B	17.9	B
Thomas Ward St / Ward St / St Andrews St	17.2	B	10.6	B	19.0	B	13.7	B	22.4	C
Rattray St / Arthur St / York Pl	28.0	C	35.2	D	38.8	D	32.6	C	38.2	D
George St / Moray Pl (south)	53.4	D	65.1	E	54.5	D	49.6	D	52.1	D
Dowling St / Princes St	26.3	C	24.8	C	40.3	D	20.2	C	37.2	D
Queens Garden / Dowling St / Burlington St	20.0	B	21.9	C	21.6	C	20.7	C	22.2	C
Dowling St / SH1	10.5	B	10.4	B	30.3	C	11.6	B	17.7	B
Rattray St / Broadway / Maclaggan St	40.4	D	46.3	D	47.3	D	49.8	D	49.6	D
Rattray St / Princes St	33.3	C	43.9	D	48.5	D	40.7	D	46.9	D
Queens Gardens / Crawford St	29.5	C	30.9	C	35.1	D	29.6	C	34.2	C
Queens Gardens / Cumberland St	18.9	B	20.3	C	30.4	C	18.7	B	24.2	C
Thomas Burns St / Wharf St / Fryatt St	92.7	F	64.5	F	67.3	F	91.0	F	91.8	F
Broadway / High St / Manse St	18.8	B	24.2	C	25.4	C	30.3	C	26.0	C
Princes St / Jetty St / Manse St	56.5	E	62.8	E	67.4	E	63.5	E	62.8	E
Jetty St / Crawford St	41.9	D	46.7	D	46.1	D	42.1	D	39.4	D
Princes St / Carroll St	2.9	A	3.3	A	7.2	A	2.6	A	3.4	A
Jervois St / SH1	36.5	E	36.7	E	37.0	E	36.7	E	39.2	E
Gordon St / Crawford St / Andersons Bay Rd	13.4	B	13.6	B	12.3	B	14.7	B	13.5	B
Andersons Bay Rd / SH1	50.3	D	41.4	D	49.6	D	48.9	D	63.6	E
Andersons Bay Rd / Strathallan St	63.2	E	57.9	E	66.0	E	63.5	E	65.5	E
Wharf St / Strathallan St / Portsmouth Dr	11.9	B	12.5	B	12.1	B	12.4	B	13.7	B
Hillside Rd / King Edward St	52.0	D	48.1	D	49.3	D	50.6	D	53.9	D
Hillside Rd / Andersons Bay Rd / Orari St	66.5	E	63.7	E	63.7	E	66.2	E	66.6	E
Portsmouth Dr / Orari St	7.4	A	7.3	A	8.1	A	7.3	A	7.6	A
King Edward St / Macandrew Rd	41.7	D	41.4	D	36.0	D	40.1	D	39.0	D
Andersons Bay Rd / Macandrew Rd / Midland St	43.6	D	44.4	D	45.9	D	45.4	D	49.2	D
Portsmouth Dr / Midland St	16.8	B	16.5	B	15.4	B	16.3	B	17.2	B
Bay View Rd / King Edward St / Prince Albert Rd	11.3	B	12.0	B	11.7	B	11.7	B	12.3	B
Bay View Rd / Portobello Rd / Andersons Bay Rd	9.9	A	9.8	A	10.3	B	9.3	A	11.1	B
Filleul St / London St	31.6	D	11.6	B	87.9	F	30.6	D	47.0	E
Filleul St / Cargill St	42.6	E	39.7	E	27.6	D	29.8	D	19.4	C
Filleul St / Meridian Access	23.0	C	28.6	D	24.9	C	20.5	C	19.6	C
Frederick St / Great King St	52.1	D	29.3	C	37.7	D	50.5	D	37.1	D

DRAFT

Appendix B

Transport Model Validation Report

Dunedin City Council

MODELLING AND ANALYTICAL SERVICES - DUNEDIN MICROSIMULATION MODEL

2017 BASE MODEL UPDATE

16 SEPTEMBER 2020

CONFIDENTIAL

Question today
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MODELLING AND ANALYTICAL SERVICES - DUNEDIN MICROSIMULATION MODEL

2017 BASE MODEL UPDATE

Dunedin City Council

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REV	DATE	DETAILS
1	14/09/20	Draft
2	16/09/20	Draft v2

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150 YEARS IN AOTEAROA

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1 INTRODUCTION

1.1 PURPOSE OF MODEL UPDATE

The Dunedin City Council (Council) developed the Dunedin Transport Model (DTM), using the CUBE VOYAGER software and the Dunedin Microsimulation Model (DMM) using PARAMICS Discovery software.

WSP and Abley were commissioned to update the DMM to improve the level of detail and validation within the base model of the DMM, for the area of interest of the new hospital and George Street projects. The area of interest is defined as:

- South boundary (inclusive) – Rattray and Jetty Street
- West boundary (inclusive) – Smith Street and Filleul Street
- North boundary (inclusive) – Albany Street
- East boundary (inclusive) – Thomas Burns St, Ward Street and up to the corner of Albany/Anzac.

The validation work includes:

- Improved traffic flow validation, at a link level
- Improved traffic flow validation, at a turning level
- Improved travel time validation

The model update process is as follows:

1. Review previous validation in detail for link flows, turn flows and travel times
2. Identify demand changes (factoring of individual zone totals) where required and provide rationale for changes (with changes to be passed to others for update in DTM). Apply changes to model
3. Identify demand changes (factoring of profiles) where required, based on traffic data received, and apply changes to model
4. Identify network changes to improve accuracy of network operation, where required. Identify intersection signal operation updates, subject to summarised signal timing and phase data being made available as above. Apply changes to model.
5. Run model and refresh link flow, turn volume and travel time validation
6. Subject to results, repeat tasks 3-6
7. Report queue length analysis for key areas of the network and carry out visual operational review of model operation. No formal queue validation is undertaken due to absence of field observations

2 MODEL CHANGES

Zone changes, network changes and demand changes are the three changes made to the model as part of the model update. These are described in the following sections.

The changes should be read in conjunction with the original "City Centre Microsimulation Model Development – Technical Note 13" of February 2018 as carried out by TDG (now Stantec). Where no changes are indicated within the section below, the original assumptions within this TDG report were retained.

2.1 ZONE CHANGES

Zone changes include revise zone loading proportions and redistribute zone loading. A list of zone changes is included in Appendix A.

2.2 NETWORK CHANGES

Significant changes have been made to the model network. The main ones include:

- Offsets applied to model (none were previously entered) for SH1 (one-way pairs), Andersons Bay Road (ABR) and Portsmouth Drive – this also involved minor changes to cycle times and phase lengths in places to ensure consistency within each mini-network. Timings were adapted from the original signal data.
- Traffic lanes removed in several locations where traffic lanes in the original model did not exist on-street.
- Turning allocations amended in several locations where lane allocations in the original model did not match the marked lane allocations and/or how lanes were used in practice.
- Signal timings were amended at a few locations where the phase order had been incorrectly coded, or other phase errors were coded.
- Pedestrian protection timings also introduced and/or extended to better reflect delays to left and right turning traffic, either due to late start of red arrow signals and/or heavy pedestrian crossing volumes at some sites. A two-step process for late start of turns (for pedestrian protection) have been generally applied. Firstly, at sites where left/right turn signal delay is applied to traffic where a conflicting pedestrian signal group is activated (but where pedestrian volumes are considered low), a 4 second delay is applied. This also considers the issue that left/right turn red arrows do not appear in signal cycles when the pedestrian signal group is not requested/activated. Secondly, at sites where pedestrian volumes are more significant (generally in the city centre shopping core), left/right turns can be delayed by yielding to pedestrian volumes themselves (both with or without a red arrow signal). In these cases, a longer 8 second delay was inserted. Note, that the application of these late start timings were largely generated from local knowledge rather than measurements at every site – but are thought to be a good approximation of the impact of pedestrians on traffic movements (and capacity)
- All-red periods generally extended to better reflect actual signal timings (most were set at zero in the previous model), to 1 second at smaller intersections and 2 seconds at larger ones

- Stop line positions amended to better reflect on-street behaviour
- Link speeds – corrected in several locations, and Minor Level 2 and 3 categories reduced to 40kph (from 50kph). Minor Level 1 also reduced to 40kph (from 50kph) in city centre to reflect higher on-street friction. Speed on SH1 Southern Motorway increased to 80kph from 50kph.
- Other adjustment of some link categories from major to minor (or vice versa) to better reflect the actual usage of the road.
- Many visibility parameters removed/reduced/changed to better reflect behaviour.
- Next lanes and adherence parameters added where required to better model behaviour at intersections.

The locations of network changes are shown in Figure 2-1. The yellow dots show the locations where changes to signal phasing and signal offset have been made while the red dots show the location where other network changes have been made. A full list of the network changes is included in Appendix A.

The general result is that the model contains a lot more "friction" in the network than previously, particularly due to pedestrian protection, lower link speeds, and corrections to lane usage and allocations. This is with the exception of the SH1 one-way pairs which improved in terms of operation due to the signal offsets being applied ("green wave") and this required some rebalancing with other parameters to ensure that modelled volumes were matched against observed volumes (i.e. equilibrium between competing corridors matches observed).

2.3 DEMAND CHANGES

Changes to the model demand include:

- Total demands reduced at zones with exceptionally high adjacent inter-related demands (Zones 84/87), reallocated to upstream zones to maintain volumes. An element of this specific issue at ABR/Strathallan was due to calibration observed counts for SBRT and SBLT being transposed, it is likely this had been used in the original matrix estimation which resulted in spuriously large volumes to/from The Warehouse.
- Amended portal/zone structure around Meridian Mall car parks to reflect current entry and exit configuration.
- Adjusted activity to strengthen tidal flow effects around E industrial and wharf zones, reducing outbound in AM and inbound in PM peaks. Adjustment to promote the tidal flow required a stronger adjustment in the AM compared to the PM. The adjustments were using the modeller's judgement and then flows were factored using the Top 10 factoring to match overall directional traffic volumes in the E Industrial / Wharf area.
- Balance traffic volumes across outer screenlines using select link analysis to target matrix adjustment factors for 3-hour total volumes. Focussed on demands near model boundaries
- Shape traffic flows around key intersections and corridors using Turn Calibration counts and select link analysis to target matrix adjustment factors for 3-hour total volumes. Focussed on one-way pairs, ABR, St Andrew Street, Princes Street, George Street, Western Route area, Southern Motorway and Thomas Burns Street.

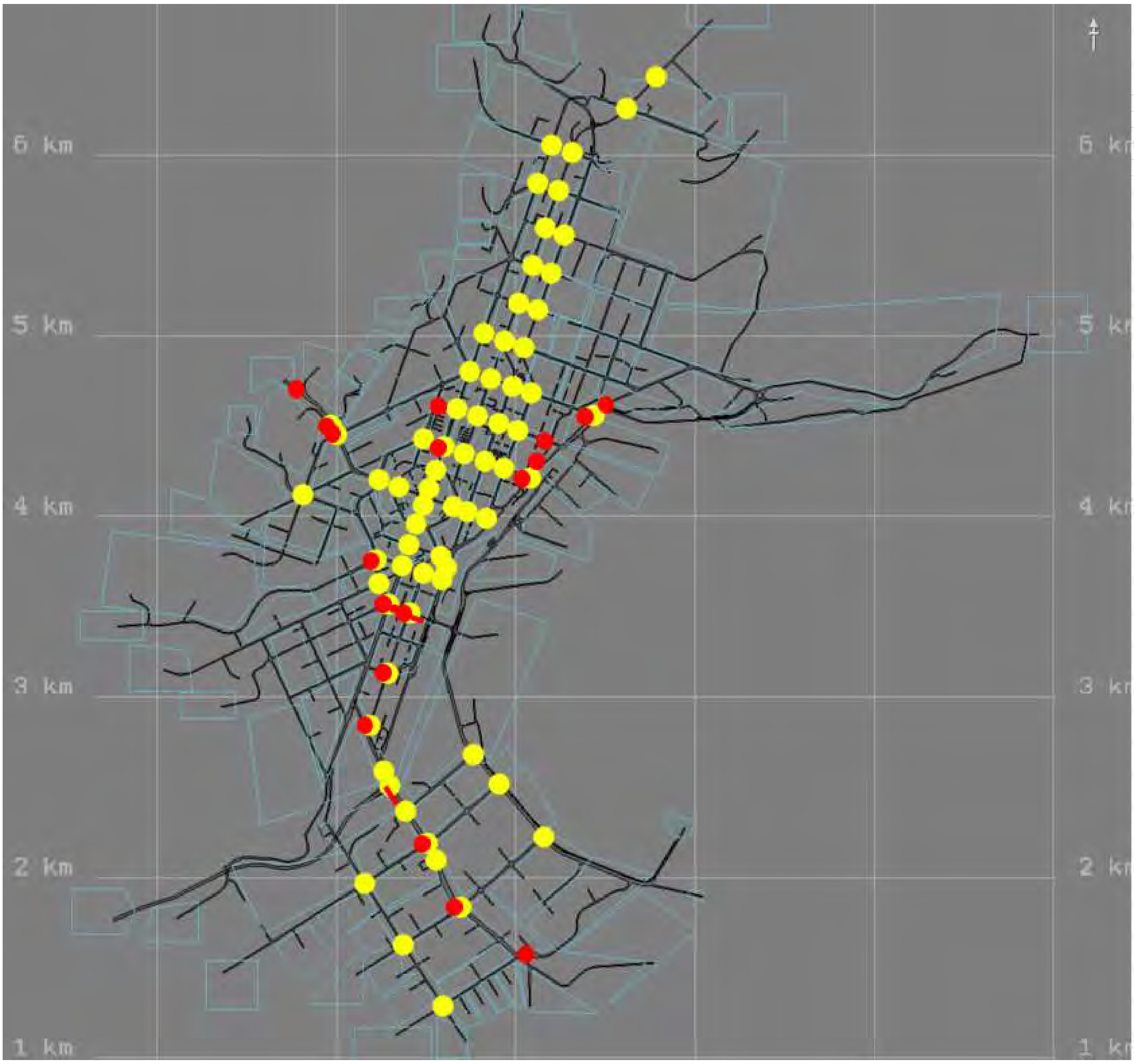


Figure 2-1: Locations of network changes

- Profiles adjusted by hour using the total turning movements across all intersections in the Turning Calibration sheet. A number of profiles in the original models were allocated to incorrect zones (especially in the interpeak period) and these were also corrected. Profile adjustments were focussed on correcting most significant outliers (mostly inbound tidal routes in the AM and outbound in the PM), the overall volume of traffic in each hour was then calibrated by factoring using the total turning movements. This tended to increase traffic loading earlier in the peak and reduce traffic loading later in the peak, the increase in the period just prior to 08:00 is an impact of this factoring rather than an indicator of the profile being derived from congested counts.
- Looped adjustments to worst performing movements using more guided select link analysis to shape demands further and identify rat running and network performance issues

The general result is that the total demand is relatively unchanged from previous, but profiles tightened to result in sharper (shorter) absolute peaks, and obvious outliers (against reality) have been amended. Many profiles, especially on external links, were directly related to/calculated from additional count data (provided by DCC, for 2017) that was not used within the previous model development.

3 MODEL CALIBRATION AND VALIDATION

Validation has been carried out on an independent set of traffic counts and the travel time data. The calibration and validation targets are based on model Category Type C: Urban Area Traffic Assignment model as described in the Waka Kotahi NZ Transport Agency's Transport Model Development Guidelines (TMDG, September 2019). Count comparisons have been carried out for each modelled hour. Travel time validation has focussed on the peak hour period.

3.1 SCREENLINE CALIBRATION

Six screenlines have been formed from available intersection turning movement counts as shown in Figure 3-1.

Screenline calibration has been carried out for the morning and evening peak periods for the six screenlines shown in Figure 3-1. Screenline calibration could not be carried out for the interpeak period due to the absence of intersection turning movement counts at several intersections during the interpeak period.

The screenline total and individual directional link counts GEH calibration comparisons for each modelled hour during the AM peak period are shown in Table 3-1 and Table 3-2 Table 3-2respectively, and in Table 3-3 and Table 3-4 respectively for the PM peak period.

Table 3-1 AM Peak Period Screenline Total GEH Comparisons

TOTAL DIRECTION COUNT ACROSS SCREENLINE	% OF COMPARISONS ACHIEVING TARGET			
	06:00 – 07:00	07:00– 08:00	08:00– 09:00	TARGET (C: Urban Area)
GEH <5.0	92%	75%	75%	>85%
GEH <7.5	92%	83%	92%	>90%
GEH <10.0	92%	100%	100%	>95%
Number of Comparisons	12	12	12	

Table 3-2 AM Peak Period Individual Movement GEH Comparisons

INDIVIDUAL DIRECTIONAL LINK COUNT ON SCREENLINE	% OF COMPARISONS ACHIEVING TARGET			
	06:00 – 07:00	07:00– 08:00	08:00– 09:00	TARGET (C: Urban Area)
GEH <5.0	78%	82%	68%	>85%
GEH <7.5	98%	88%	84%	>90%
GEH <10.0	100%	96%	90%	>95%
GEH <12.0	100%	98%	98%	100%
Number of Comparisons	50	50	50	

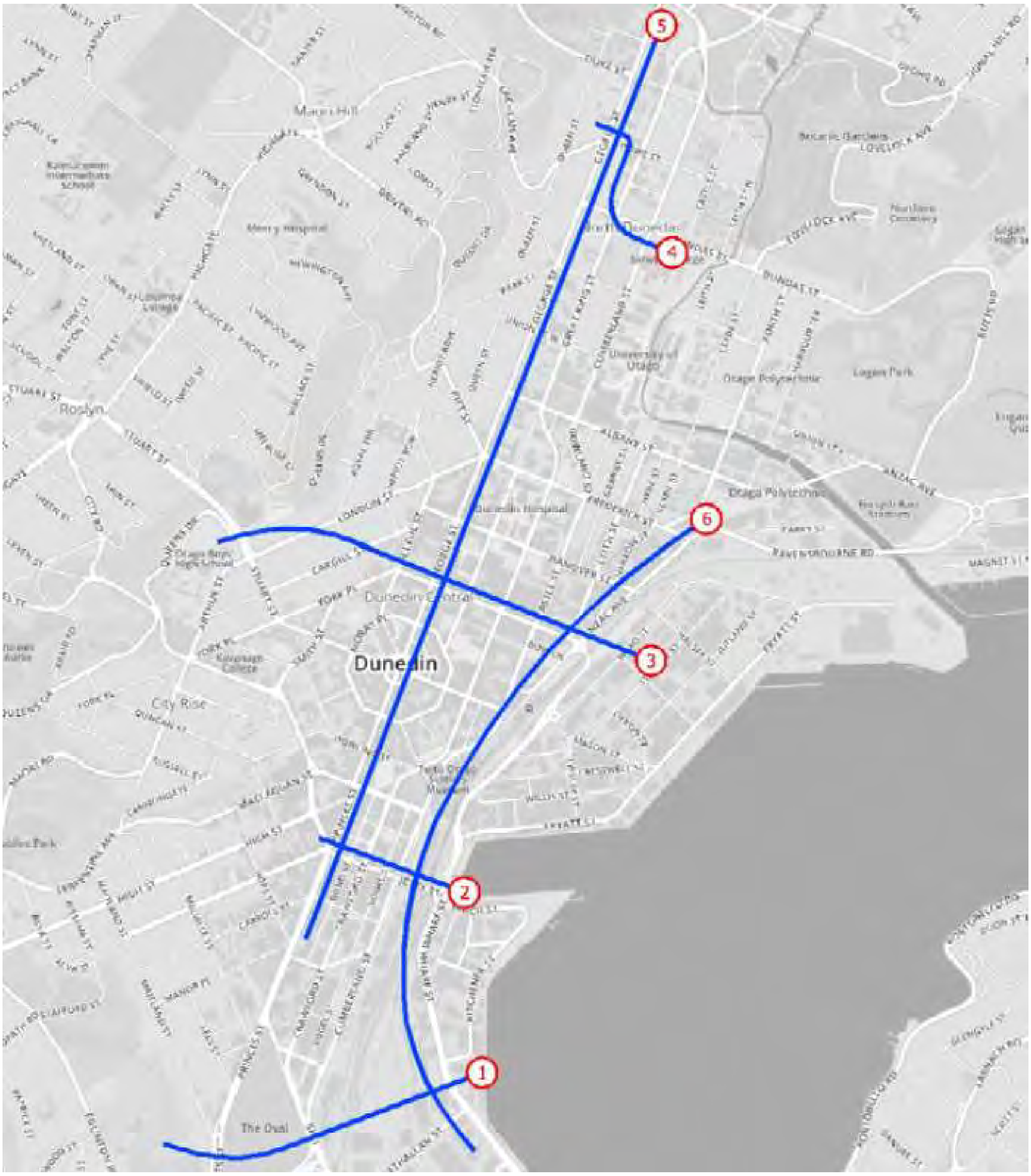


Figure 3-1 Screenline locations

Table 3-3 PM Peak Period Screenline Total GEH Comparisons

TOTAL DIRECTION COUNT ACROSS SCREENLINE	% OF COMPARISONS ACHIEVING TARGET			
	15:00 - 16:00	16:00 – 17:00	17:00 – 18:00	TARGET (C: Urban Area)
GEH <5.0	67%	75%	67%	>85%
GEH <7.5	92%	83%	83%	>90%
GEH <10.0	100%	92%	100%	>95%
Number of Comparisons	12	12	12	

Table 3-4 PM Peak Period Individual Movement GEH Comparisons

INDIVIDUAL DIRECTIONAL LINK COUNT ON SCREENLINE	% OF COMPARISONS ACHIEVING TARGET			
	15:00 - 16:00	16:00 – 17:00	17:00 – 18:00	TARGET (C: Urban Area)
GEH <5.0	80%	76%	72%	>85%
GEH <7.5	92%	90%	86%	>90%
GEH <10.0	98%	98%	98%	>95%
GEH <12.0	100%	100%	98%	100%
Number of Comparisons	50	50	50	

Table 3-1 to Table 3-4 show that the model failed to meet the GEH targets in some cases. The model failed to achieve the GEH < 5.0 criteria in all instances except for the total direction count across the screenline for the morning 6am to 7am period. The higher GEH criteria (<7.5, <10.0 and <12.0) comparisons are much stronger and pass or come close to passing the target levels indicating that there are no significant or major errors in the total demand levels and in the balance between routes through the modelled network. Although the model has failed to meet all GEH targets, the number of instances where the model has met the GEH targets have increased when compared to the 2017 results.

The XY scatter plots for the AM and PM periods are included in Appendix B. A summary of the scatter line-of-best-fit and R-squared values are summarised in Table 3-5.

The target for the line-of-best-fit is y= 0.9x to 1.1x and the target for R-squared is greater than 0.95. Table 3.5 shows that the model meets both targets for the line-of-best-fit and R-squared for all modelled AM and PM hours indicating that the modelled traffic flows are a good representation of the observed traffic flows at the screenlines. Again, the results are a significant improvement on the original 2017 model results.

Table 3-5 Screenline XY scatter line-of-best-fit and R-squared

MODELLED HOUR	XY SCATTER STATS	
	Line of best fit	R-Squared
AM Peak Period		
06:00 - 07:00	y = 1.0564x	0.9663
07:00 - 08:00	y = 1.0138x	0.9815
08:00 - 09:00	y = 1.006x	0.977
PM Peak Period		
15:00 - 16:00	y =1.0006x	0.9816
16:00 - 17:00	y = 0.9862x	0.9720
17:00 - 18:00	y = 1.0013x	0.9736

3.2 TURN COUNT CALIBRATION

The TMDG requires model validation checks for turn counts validation with criteria as follows:

- At least 80% of individual turning movements should have a GEH of less than 5.0
- At least 85% of individual turning movements should have a GEH of less than 7.5
- At least 90% of individual turning movements should have a GEH of less than 10

The results of the turning movement checks for each modelled hour in the AM, Interpeak and PM periods are shown in Table 3.6 to Table 3.8 respectively. Comparisons of absolute traffic flows are included in Appendix C.

Table 3-6 AM peak period turning movement GEH comparisons

TURNING MOVEMENT	% OF COMPARISONS ACHIEVING TARGET			
	06:00 – 07:00	07:00– 08:00	08:00– 09:00	TARGET (C: Urban Area)
GEH <5.0	92%	79%	72%	>80%
GEH <7.5	98%	93%	88%	>85%
GEH <10.0	99%	99%	97%	>90%
Number of Comparisons	424	431	451	

Table 3-7 Interpeak period turning movement GEH comparisons

TURNING MOVEMENT	% OF COMPARISONS ACHIEVING TARGET		
	11:00 – 12:00	12:00– 13:00	TARGET (C: Urban Area)
GEH <5.0	85%	83%	>80%
GEH <7.5	95%	95%	>85%
GEH <10.0	99%	99%	>90%
Number of Comparisons	310	311	

Table 3-8 PM peak period turning movement GEH comparisons

TURNING MOVEMENT	% OF COMPARISONS ACHIEVING TARGET			
	15:00 - 16:00	16:00 – 17:00	17:00 – 18:00	TARGET (C: Urban Area)
GEH <5.0	75%	72%	74%	>80%
GEH <7.5	92%	88%	85%	>85%
GEH <10.0	98%	96%	96%	>90%
Number of Comparisons	439	439	439	

Table 3-6 to Table 3-8 show that the GEH targets are met in most cases. All GEH targets were achieved for the interpeak period. The GEH <5.0 target is not achieved for the whole PM peak period and between 7am and 9am for the morning peak period. The GEH <7.5 target is satisfied in the morning period and in most of the evening period indicating that there are a large proportion of GEHs between 5.0 and 7.5 in the morning and evening periods. This may be due to the mixed sources of traffic count data from surveys carried out on different dates resulting in some minor differences in observed volumes between intersections.

The results are at a similar level to the original 2017 model results – however, the model re-validation has concentrated on improving the accuracy in the key areas of the model network, and therefore a general improvement has been achieved in these areas.

The XY scatter plots for the AM, interpeak and PM periods are included in Appendix B. A summary of the scatter line-of-best-fit and R-squared values are summarised in Table 3-9.

Table 3-9 Turn Count XY scatter line-of-best-fit and R-squared

MODELLED HOUR	XY SCATTER STATS	
	Line of best fit	R-Squared
AM Peak Period		
06:00 - 07:00	y = 1.012x	0.8868
07:00 - 08:00	y = 0.9615x	0.9399
08:00 - 09:00	y = 0.978x	0.9518
Interpeak Period		
11:00 - 12:00	y = 0.9555x	0.9688
12:00 - 13:00	y = 0.9581x	0.9675
PM Peak Period		
15:00 - 16:00	y = 0.9937x	0.9606
16:00 - 17:00	y = 0.982x	0.9602
17:00 - 18:00	y = 0.9687x	0.9582

Table 3-9 shows that the model meets the target for the line-of-best-fit is y= 0.9x to 1.1x in all instances. The target for R-squared of greater than 0.95 is met in most cases except for the morning 6am to 8am period. This is due to the range or spread of observed data. Again, the line-of best fit and R-squared results are an improvement on the original 2017 model results.

3.3 LINK COUNT CALIBRATION

The GEH comparison for each modelled hour during the AM, interpeak and PM periods are provided in Table 3.10 to Table 3.12 respectively. Comparisons of absolute traffic flows are included in Appendix C

Table 3-10 AM peak period link count GEH comparisons

TURNING MOVEMENT	% OF COMPARISONS ACHIEVING TARGET			
	06:00 – 07:00	07:00– 08:00	08:00– 09:00	TARGET (C: Urban Area)
GEH <5.0	86%	61%	61%	>85%
GEH <7.5	97%	89%	85%	>90%
GEH <10.0	100%	97%	95%	>95%
GEH < 12.0	100%	98%	98%	100%
Number of Comparisons	66	66	66	

Table 3-11 Interpeak period link count GEH comparisons

TURNING MOVEMENT	% OF COMPARISONS ACHIEVING TARGET		
	11:00 – 12:00	12:00– 13:00	TARGET (C: Urban Area)
GEH <5.0	68%	71%	>85%
GEH <7.5	89%	86%	>90%
GEH <10.0	100%	97%	>95%
GEH < 12.0	100%	100%	100%
Number of Comparisons	66	66	

Table 3-12 PM peak period link count GEH comparisons

TURNING MOVEMENT	% OF COMPARISONS ACHIEVING TARGET			
	15:00 - 16:00	16:00 – 17:00	17:00 – 18:00	TARGET (C: Urban Area)
GEH <5.0	67%	68%	58%	>85%
GEH <7.5	83%	85%	77%	>90%
GEH <10.0	97%	95%	94%	>95%
GEH < 12.0	98%	98%	97%	100%
Number of Comparisons	66	66	66	

Table 3-10 to Table 3-12 show that the GEH < 5.0 criteria is not achieved in almost all instances except for the morning 6am to 7am period. Table 3.10 and Table 3.12 show that most of the higher GEH targets (GEH < 10.0 and <12.0) are met or come close to being met (3-5% difference) in the AM and PM periods. Table 3.11 shows that the interpeak period meets the higher GEH targets (GEH < 10.0 and <12.0) and come close to meeting the GEH target of <7.5 with 1-4% difference.

As for the link count validation, the results are at a similar level to the original 2017 model results – however, the model re-validation has concentrated on improving the accuracy in the key areas of the model network, and therefore a general improvement has been achieved in these areas. In addition, the original 2017 flow validation was generally of a reasonable level, considering the complexity of the network and availability of numerous alternative routes (due to the grid network structure of the network) – and therefore the improvement of the model is more based on improving the network coding than the demand side (save for profile adjustments and some localised zone demand adjustments).

It should also be noted that the development of the original 2017 model did not re-balance any observed counts on the basis of seasonality – and in a few cases there are large discrepancies between counts at adjacent sites (so therefore it was difficult to calibrate well against both without introducing significant sink/feed volumes in/out of intermediate zones).

3.4 TRAVEL TIME CALIBRATION

The sectional and route observed travel times have been compared with the modelled travel times for six routes within the City Centre model area for the core two-hour period in each peak. The routes include:

1 Waverley to the Octagon
2 St Clair to the Octagon
3 Normanby to the Octagon
4 Brockville to the Octagon
5 Mosgiel to the Octagon
6 Bus hub routes

The TMDG states that the acceptability levels for comparing the total observed and modelled direction route travel times for an Urban Area model should have:

— More than 85% of routes within 15% or 1 minute (if higher)

— More than 90% of routes within 25% or 1.5 minutes (if higher)

The comparison between the full route travel times for the AM, interpeak and PM periods are summarised in Table 3.13 to Table 3.15 respectively. The time versus distance graphs for each route are included in Appendix D.

Table 3-13 and Table 3-15 show that three to four routes did not pass the target difference of 15% or one minute (if higher) in the AM and PM periods. In the AM period 64% of the routes pass the criteria while in the PM period 73% of routes pass the criteria which is below the target of 85%.

Table 3-14 shows that the interpeak period meets the criteria of more than 85% of routes within 15% or 1 minute (if higher).

Although the AM and PM periods did not achieve the target difference of 15% or one minute (if higher), Table 3-13 to Table 3-15 show that all periods meet the criteria of more than 90% of routes within 25% or 1.5 minutes (if higher).

As discussed through the peer review process, there are some misgivings about the quality of the observed data (and/or the interpretation of the data) in the original validation – essentially around the issue of double counting link travel times at the start of each section. Reluctantly – due to time constraints, inability to collect data on current conditions as a proxy (due to COVID), and inability to collect data from the original model validation time period – we have had to accept the original observed data as the validation set. Travel time validation is generally good, and in most cases, model travel times are longer than observed, which errs on the side of being conservative. There are a few individual travel time sections that have "odd" observed times, and this is commented on below:

- AM Peak – Route 2 Inbound - Section 2 (Dowling to Rattray is only 14 seconds (average) in observed. This seems unlikely for 150m distance to cross 2 signal stoplines. If this section ignored, % Diff for full route is around 10%
- AM Peak – Route 3 Outbound - Section 7 (Albany to Frederick) is much quicker in observed (across all 3 periods). Delays (in reality) at the downstream (second) stopline at the 5-arm intersection (Frederick) are generally significant. If this section ignored, % Diff for full route is around 6%
- AM Peak – Route 5 Inbound - Model quicker in section of SH1 between Gordon and Jetty. Likely to be due to lower model NB flow (but within 5%). Note that this happens for this section in all three periods (which is not common in reality), so could be due to roadworks or other incident on this section during the (unidentified) day of the surveys
- AM Peak – Bus Hub Route - Model significantly slower. As volumes are a lot lower before 7:30, signal timings in the AM peak vary more significantly than in other periods, due to adaptive signal timings in reality (Model has average timings for peak hour period) - so results to be expected
- PM Peak – Section 3 Inbound - Section 7 (Albany to Frederick) is much quicker in observed (across all 3 periods). Delays (in reality) at the downstream (second) stopline at the 5-arm intersection (Frederick) are generally significant. If this section ignored, % Diff for full route is around -4%
- PM Peak – Section 4 Inbound – no known issues (POST RE-VALIDATION NOTE: During the next stage of the modelling work to develop 2019 models, phasing errors were discovered at Smith/Upper Stuart, which when corrected, lead to more green time being afforded to the inbound approach – and resulted to a 0.9 minute quicker journey in the 2019 model, which included a 4% uplift in demand. Consequently, it is considered that this change if applied in the 2017 model would also significantly improve the validation, and bring the difference between model and observed travel time below the 1-minute criteria)
- PM Peak – Section 5 Inbound - Model quicker in section of SH1 between Gordon and Jetty. Note that this happens for this section in all three periods (which is not common in reality), so could be due to roadworks or other incident on this section during the (unidentified) day of the surveys

Table 3-13 AM peak period travel time comparisons

ROUTE	DIRECTION	ROUTE TRAVEL TIMES (MINS)									
		AM Peak						Travel Time Comparison			
		Observed			Modelled			Abs. Diff (min	% Diff	Criteria (within 15% or 1 min)	Criteria (within 25% or 1.5 mins)
		Avg	Max	Min	Avg	Max	Min				
1 Waverley - Octagon	INBOUND	5.7	9.7	3.2	5.2	11.6	2.7	0.5	8.3%	Yes	Yes
	OUTBOUND	5.3	10.1	3.2	6.0	13.4	3.2	0.7	12.2%	Yes	Yes
2 St Clair - Octagon	INBOUND	6.4	13.5	3.6	6.4	13.7	3.4	0.0	0.7%	Yes	Yes
	OUTBOUND	6.1	9.3	3.9	7.3	14.4	3.6	1.3	20.7%	No	Yes
3 Normanby - Octagon	INBOUND	6.7	12.6	4.0	7.7	16.3	3.7	1.1	15.9%	No	Yes
	OUTBOUND	7.1	13.0	4.0	8.1	14.6	3.7	1.1	15.0%	Yes	Yes
4 Brockville - Octagon	INBOUND	1.6	3.6	0.9	1.6	4.7	0.7	0.0	2.6%	Yes	Yes
	OUTBOUND	1.5	2.6	0.8	2.2	5.5	0.8	0.7	44.0%	Yes	Yes
5 Mosgiel - Octagon	INBOUND	7.3	13.3	4.4	6.0	13.1	3.4	1.3	17.6%	No	Yes
	OUTBOUND	7.0	10.0	4.9	7.6	15.3	3.8	0.6	8.6%	Yes	Yes
6 Bus Hub Route	Anti-Clockwise	8.4	14.4	5.0	10.3	20.8	4.4	2.0	23.8%	No	No

Table 3-14 Interpeak period travel time comparisons

ROUTE	DIRECTION	ROUTE TRAVEL TIMES (MINS)									
		Interpeak						Travel Time Comparison			
		Observed			Modelled			Abs. Diff (min	% Diff	Criteria (within 15% or 1 min)	Criteria (within 25% or 1.5 mins)
		Avg	Max	Min	Avg	Max	Min				
1 Waverley - Octagon	INBOUND	5.2	9.2	3.2	5.1	11.2	2.8	0.1	2.4%	Yes	Yes
	OUTBOUND	5.4	8.4	3.2	5.4	10.1	3.1	0.0	0.8%	Yes	Yes
2 St Clair - Octagon	INBOUND	6.5	10.2	3.8	6.6	12.2	3.4	0.2	2.4%	Yes	Yes
	OUTBOUND	7.7	9.8	4.6	7.3	13.7	3.6	0.4	5.4%	Yes	Yes
3 Normanby - Octagon	INBOUND	6.9	10.6	4.0	7.1	13.8	3.7	0.2	3.3%	Yes	Yes
	OUTBOUND	7.3	11.0	4.3	6.8	12.6	3.6	0.5	6.7%	Yes	Yes
4 Brockville - Octagon	INBOUND	1.6	2.7	0.9	1.5	3.2	0.7	0.0	1.6%	Yes	Yes
	OUTBOUND	1.8	3.3	0.9	1.7	4.1	0.8	0.1	5.6%	Yes	Yes
5 Mosgiel - Octagon	INBOUND	6.6	9.6	4.4	5.9	13.6	3.4	0.7	10.3%	Yes	Yes
	OUTBOUND	6.7	9.6	4.6	7.0	14.1	3.6	0.4	5.6%	Yes	Yes
6 Bus Hub Route	Anti-Clockwise	9.3	15.8	5.3	10.2	19.3	4.5	0.9	9.5%	Yes	Yes

Table 3-15 PM peak period travel time comparisons

ROUTE	DIRECTION	ROUTE TRAVEL TIMES (MINS)									
		PM Peak						Travel Time Comparison			
		Observed			Modelled			Abs. Diff (min	% Diff	Criteria (within 15% or 1 min)	Criteria (within 25% or 1.5 mins)
		Avg	Max	Min	Avg	Max	Min				
1 Waverley - Octagon	INBOUND	6.1	11.1	3.4	6.0	15.3	2.8	0.1	2.1%	Yes	Yes
	OUTBOUND	5.9	9.6	3.1	6.3	12.2	3.6	0.4	7.5%	Yes	Yes
2 St Clair - Octagon	INBOUND	6.9	10.8	3.8	6.8	17.7	3.3	0.1	1.4%	Yes	Yes
	OUTBOUND	8.4	14.6	4.6	8.7	18.5	3.6	0.3	3.6%	Yes	Yes
3 Normanby - Octagon	INBOUND	8.5	16.9	4.6	9.9	21.7	3.8	1.4	16.7%	No	Yes
	OUTBOUND	8.3	14.5	4.6	7.9	16.8	3.6	0.4	4.8%	Yes	Yes
4 Brockville - Octagon	INBOUND	1.9	3.8	0.9	3.3	9.8	0.7	1.4	76.2%	No	Yes
	OUTBOUND	2.5	4.5	1.0	2.1	5.2	0.8	0.4	16.1%	Yes	Yes
5 Mosgiel - Octagon	INBOUND	7.4	14.5	4.3	6.3	15.0	3.4	1.1	15.2%	No	Yes
	OUTBOUND	8.2	13.9	4.7	8.0	16.1	4.2	0.1	1.6%	Yes	Yes
6 Bus Hub Route	Anti-Clockwise	11.8	23.7	6.0	11.1	24.8	4.5	0.7	6.3%	Yes	Yes

Travel times in the model appear reasonable, given that it is difficult to compare with the original validation due to the combination of "no offsets" and "over supply of capacity". These effects cancel each other out on some routes but not others. As above, we have applied a number of measures within the model to slow the network operation down to more realistic performance. The time versus distance graphs included in Appendix D for each route show that there is good correlation between the observed and modelled travelled times. Overall, the results of the travel time comparisons demonstrate that the model is fit for predicting and measuring delays and travel times.

3.5 QUEUE LENGTHS

As no queue length validation data was available from the original 2017 model development, queue length validation has also not been possible in this update. However, the network changes to the model have generally resulted in an increased level of queueing in the network (due to additional network friction), which are more representative of on-street conditions (particularly in the busiest PM peak period). In addition, the models were presented to DCC (Hjarne Poulsen) who confirmed that the models did better reflect the network operation than the original version.

3.6 PEER REVIEW

A peer review of the model was carried out by Ian Clark and Qing Li of Flow Transportation Specialists Ltd. A record of the peer review is included as Appendix E, with the models accepted as a reasonable reflection of the operation of the 2017 network.

4 SUMMARY AND CONCLUSION

The Dunedin City Centre microsimulation model has been updated to improve the level of detail and validation within the base model. The model update involves changes to the model zone, network, and demand.

The model was checked against screenlines (calibration), calibrated to turning counts, validated to an independent set of link counts and validated to travel time data. The key results were:

— The screenline validation and link count validation show that the model failed to achieve the GEH < 5.0 criteria in almost all instances. However, the higher GEH criteria (<7.5, <10.0 and <12.0) comparisons are much stronger and pass or come close to passing the target levels. Overall, the higher GEH target checks indicate that there are no significant or major errors in the modelled flows across the screenlines and the model generally represents observed traffic levels.

— Turn count validation shows that all GEH targets are met in most cases or close to being achieved

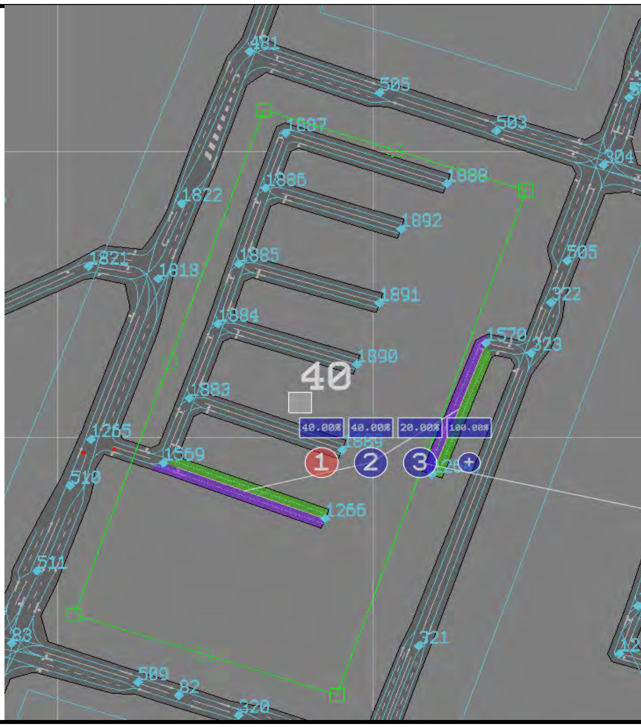
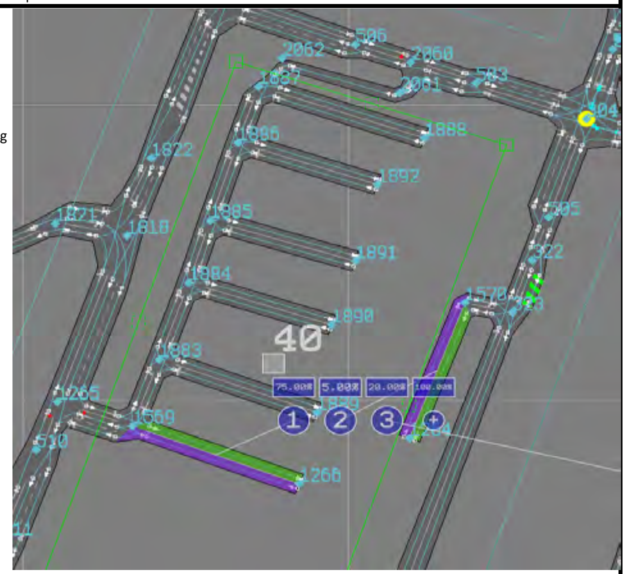
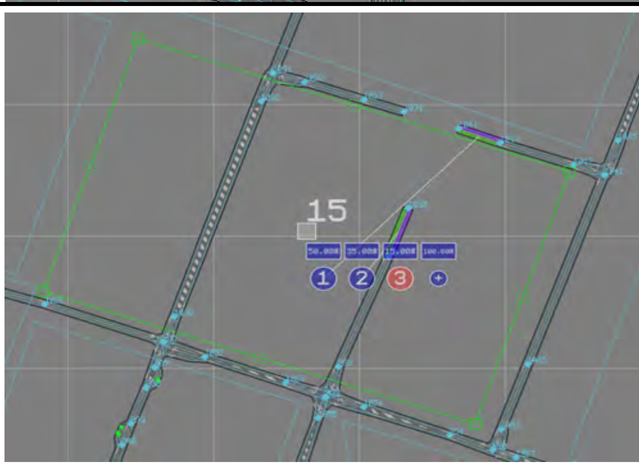
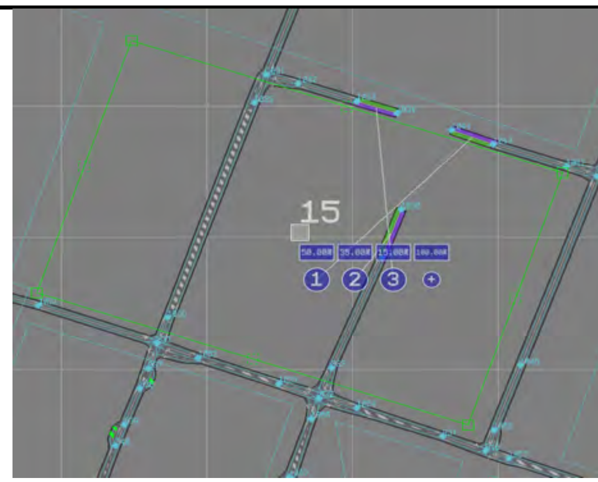
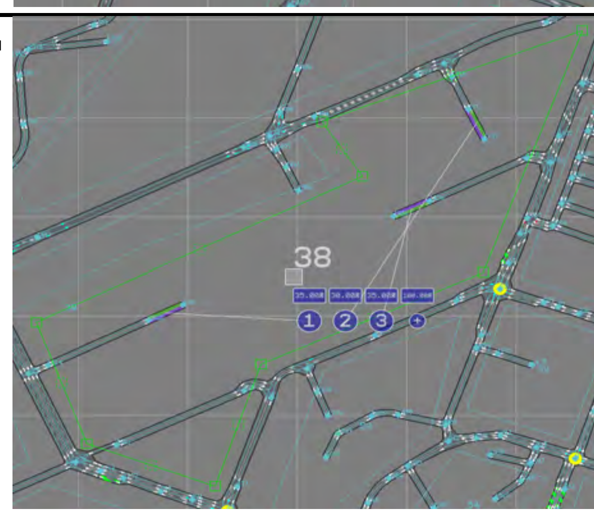
— There is good correlation between the observed and modelled travelled times.

Overall, the updated model shows improved validation against the observed traffic flow at link level and turning level and good validation against observed travel time. Each of the checks have demonstrated that the model is validated to an acceptable level, it is stable and representative of traffic behaviour in the model study area.

Of equal importance, the update removed a significant amount of coding errors within the original model (incorrect lane allocation, additional spurious lanes, no signal offsets applied throughout the model, for example), and applied a higher level of “friction” particularly within the city centre core to reflect the slower speeds experienced by traffic moving round the network, due to pedestrian conflicts, parking manoeuvres and other kerbside activity. The model is now considered to be a better reflection of the operation of the city centre network, with a limited amount of space capacity (particularly in the peak 30 minutes of the evening peak period) to accommodate additional growth in traffic volumes.

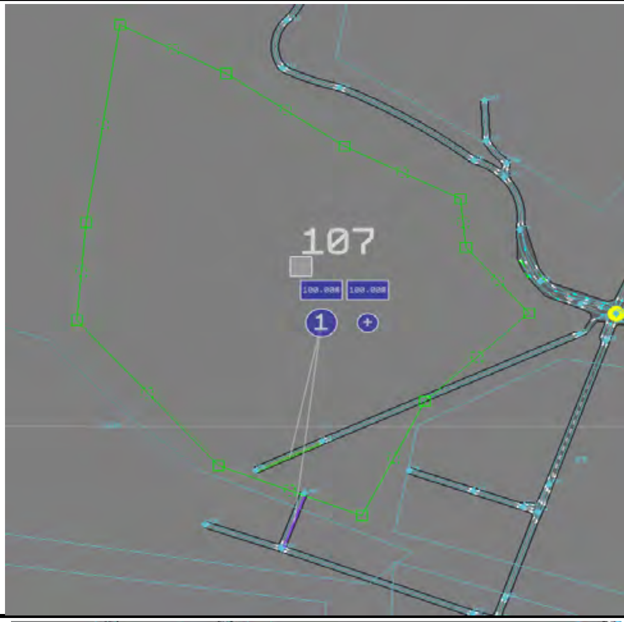
The model is considered fit-for-purpose for the city centre although local area validation checks are recommended for individual projects as required.

APPENDIX A - MODEL CHANGES

Zone	Initial State	Changes / Updates	Updates State
40		Create carpark entry from Hanover St Add exit lane on Filleul St (test and remove if needed) Reduce demand to George St to 5% to represent on-street parking Balance remaining 75% demand to internal carpark	
15		Portal 3 not linked - missing 15% zone activity Connected to 1033::1034, check and test	
38		Additional link selected on Portal 2 which will redirect some traffic	

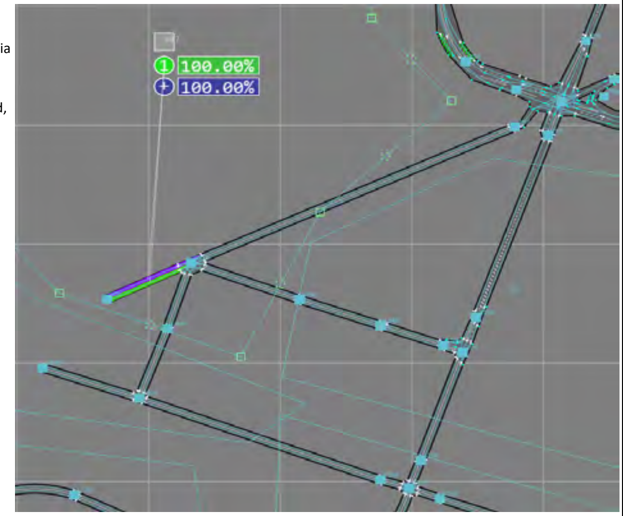
Zone changes

107

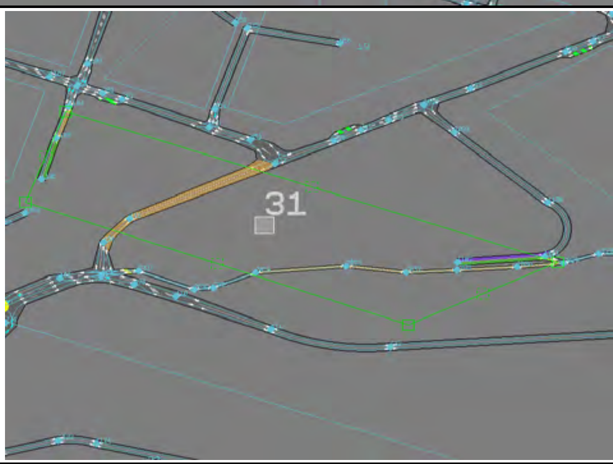


All traffic is forced to enter zone via northern link
All traffic is forced to exit zone via southern link

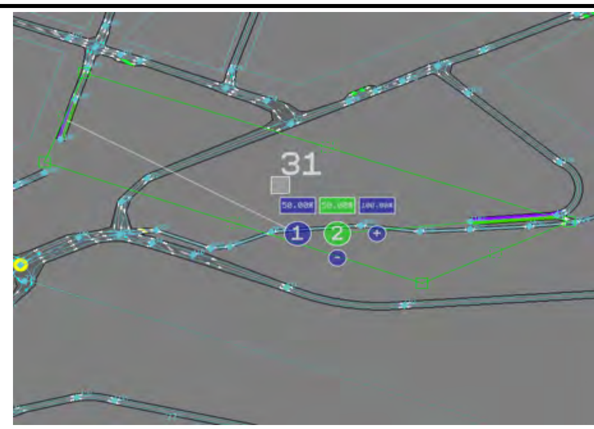
All links in vicinity are connected, should have route choice



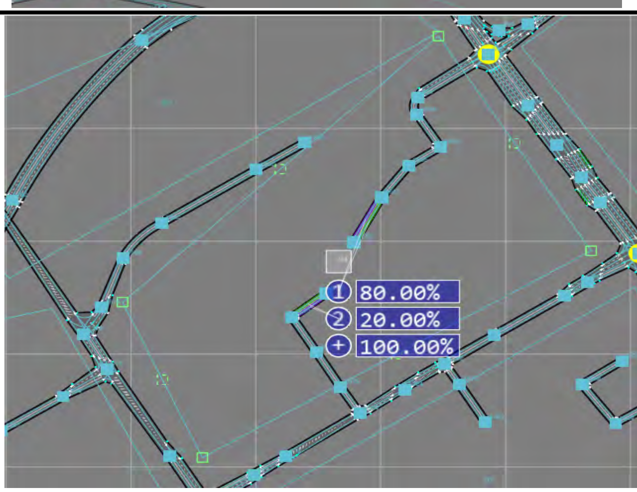
31



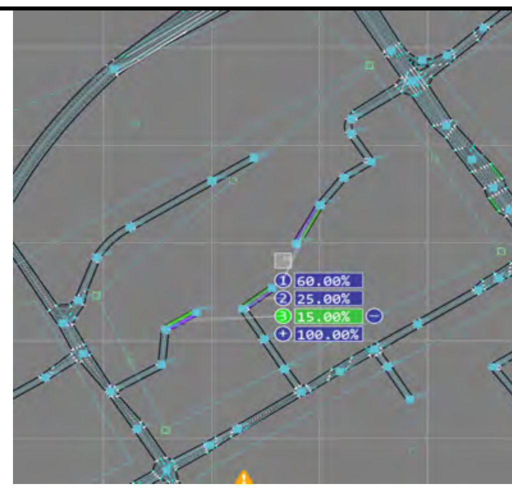
Link loading spread across main road segment
Western link only for destination, not origin
Split assumed 50/50, test and check

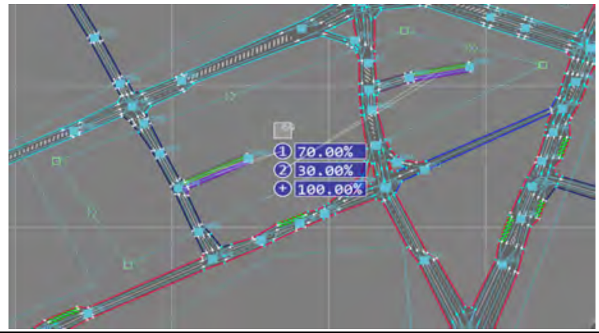
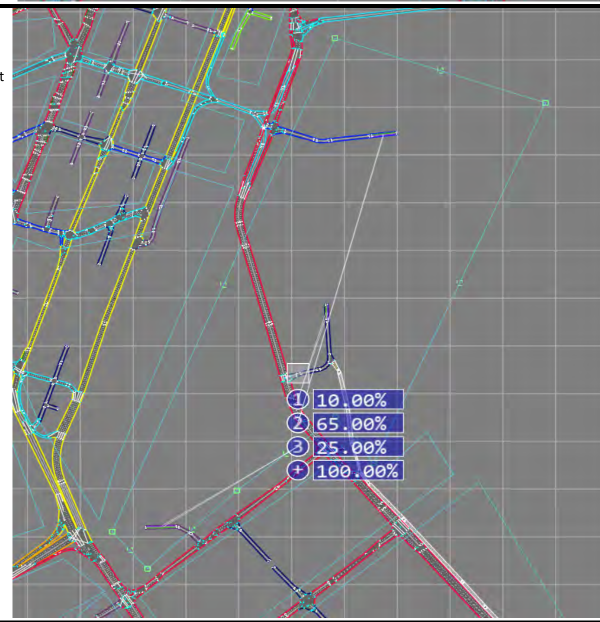
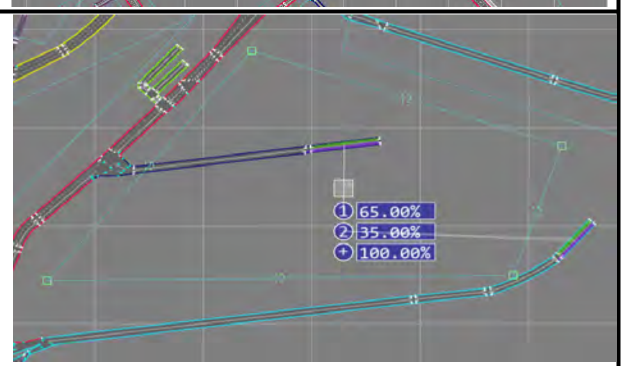
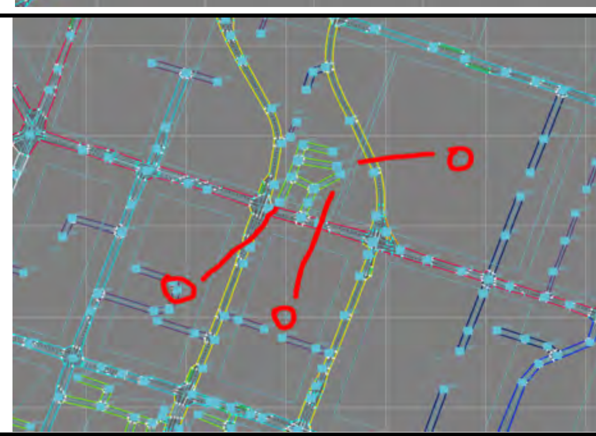


84

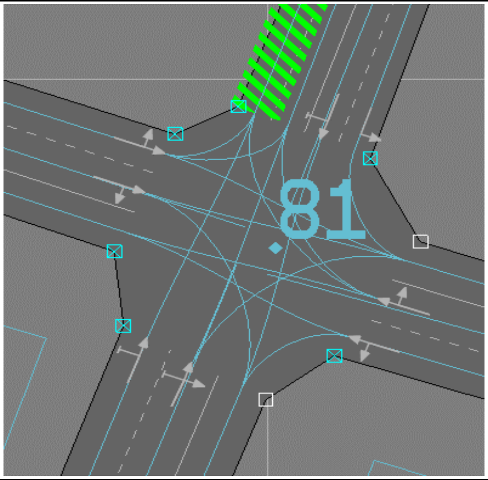
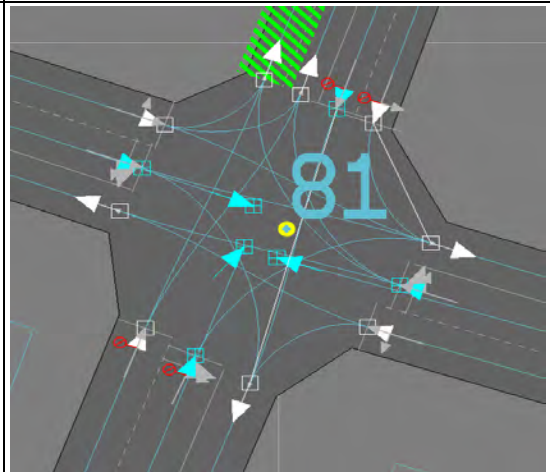
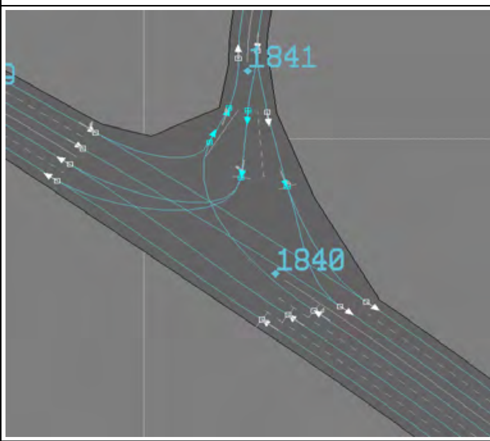
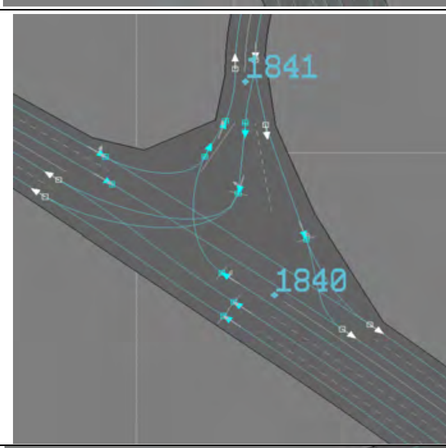
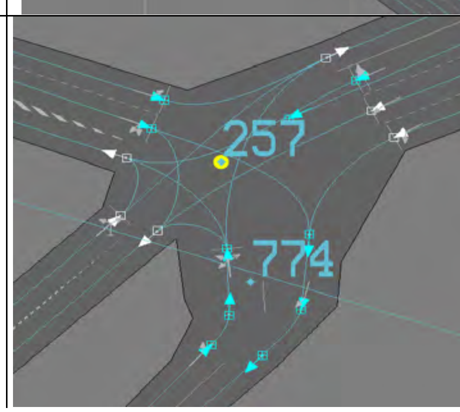


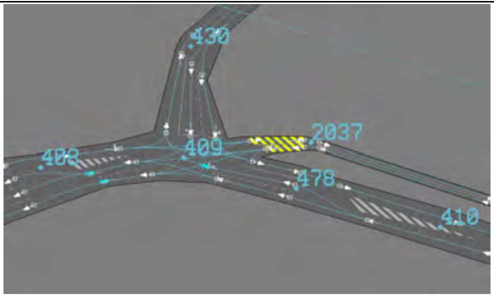
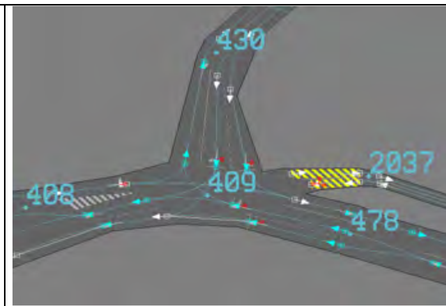
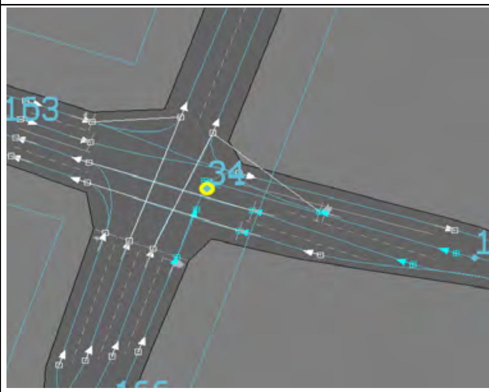
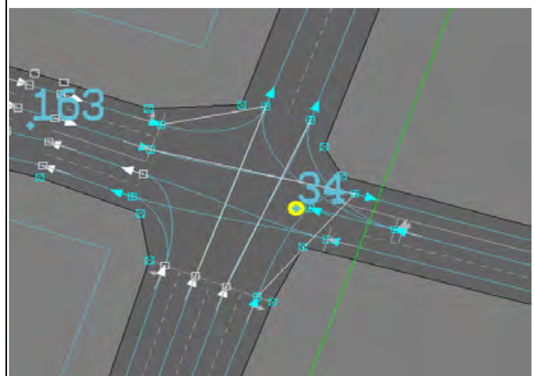
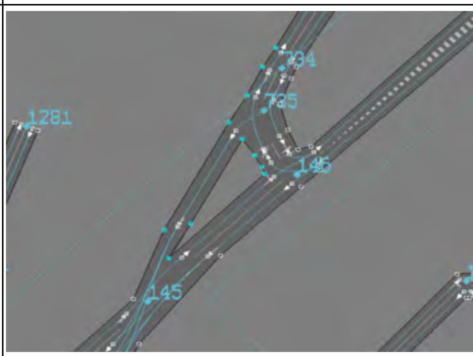
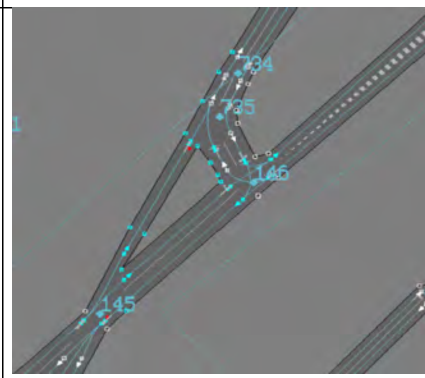
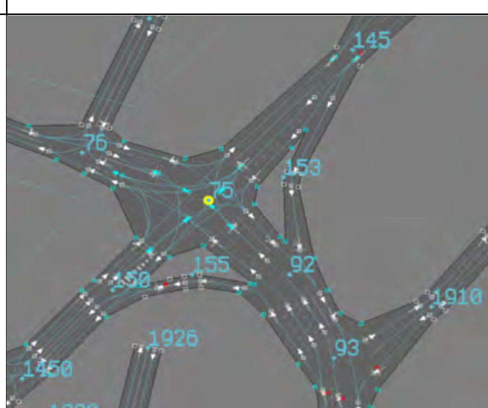
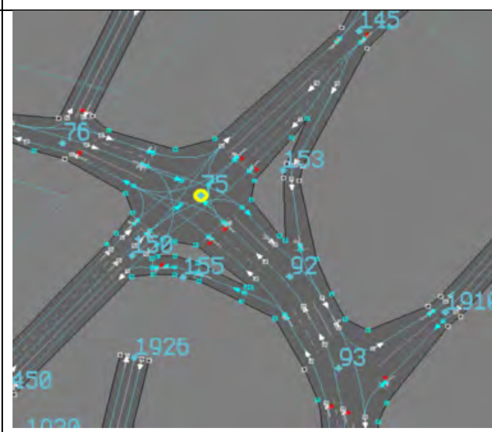
Link added for minor western access
Loading modified to reduce load to AB/Strathallan

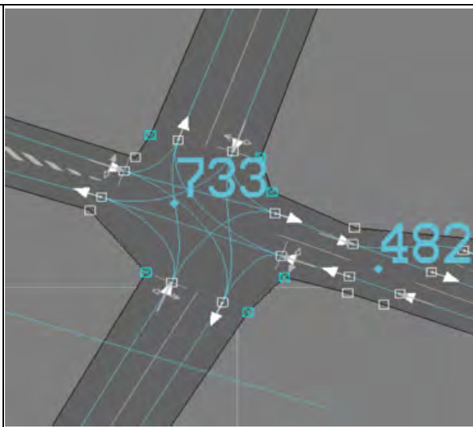
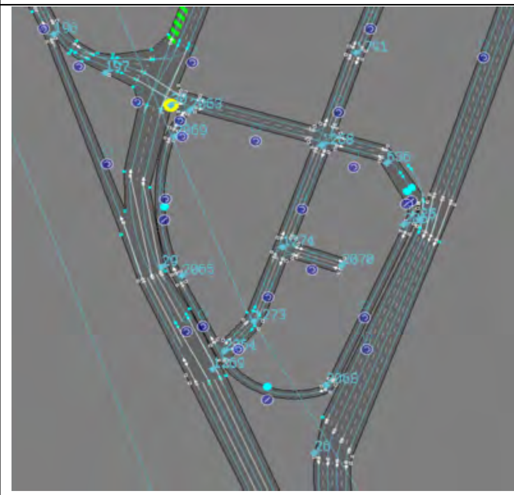
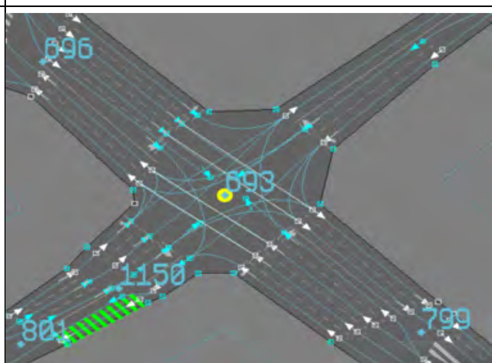
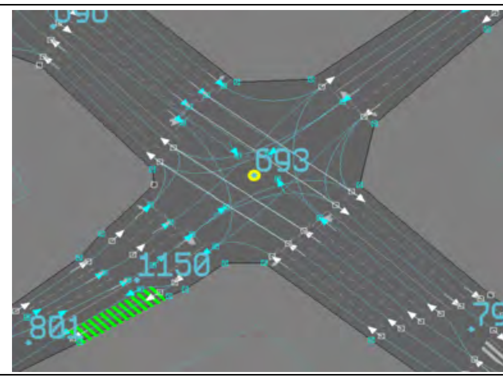
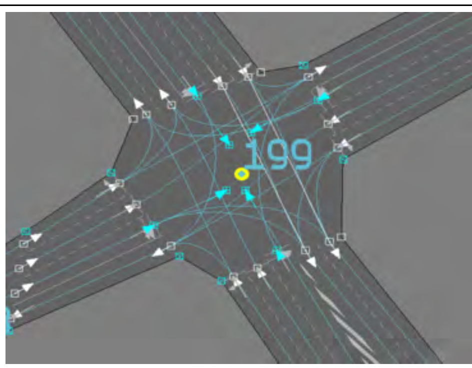
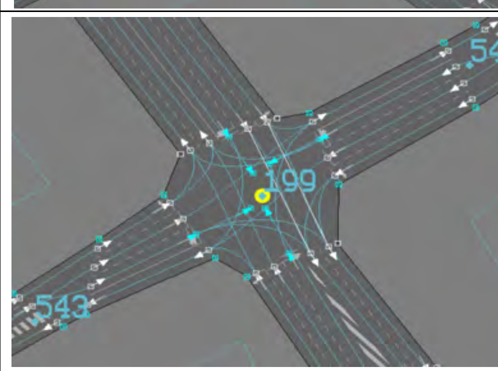


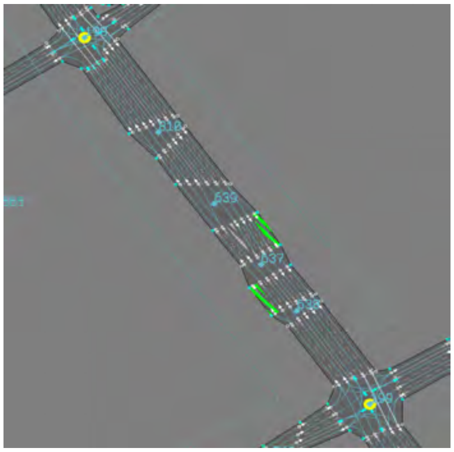
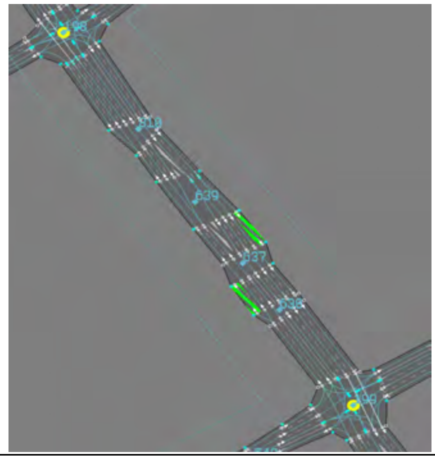
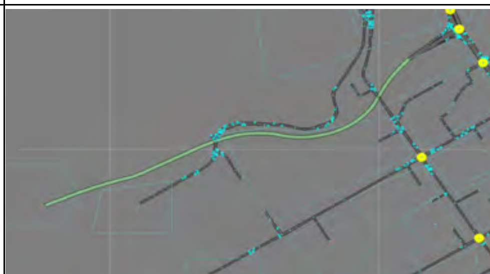
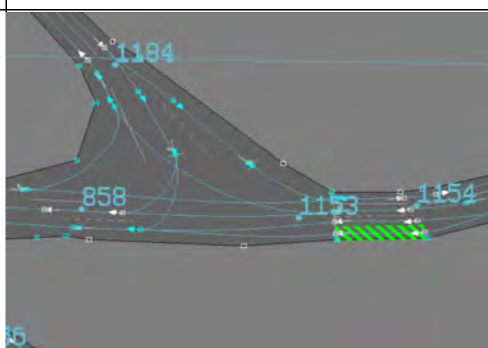
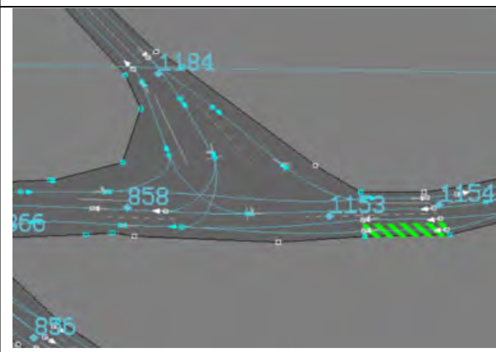
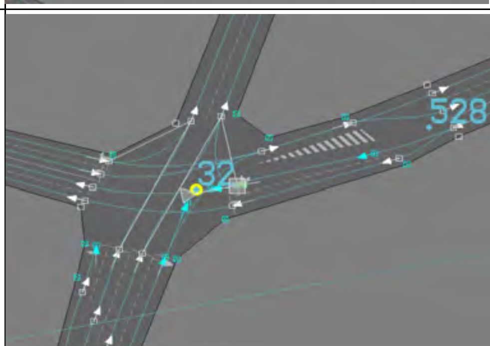
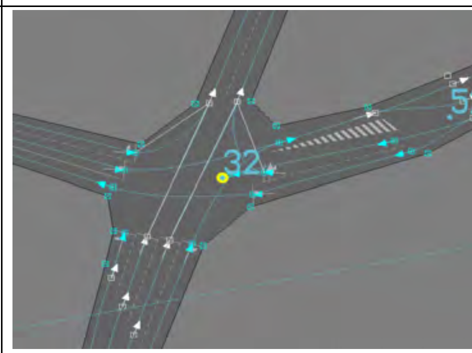
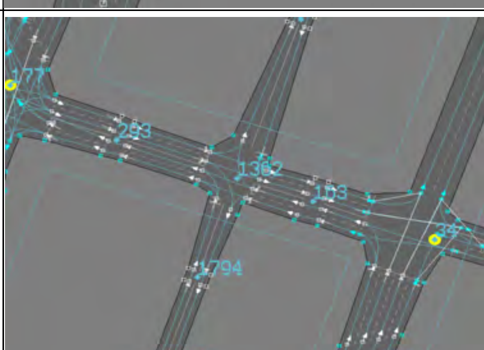
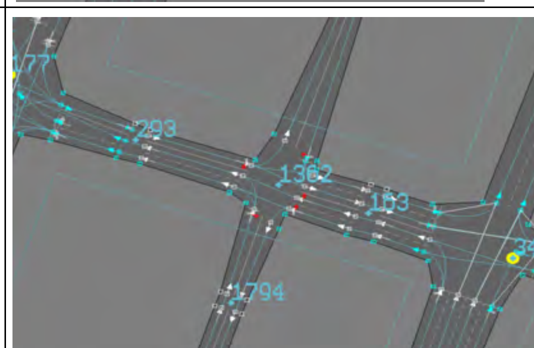
<table>
<tr><td>69</td><td></td><td>Connect through street, balance demands to new access road</td><td>
</td></tr>
<tr><td>75</td><td></td><td>Revise loading proportions to reduce demand at Kitchener RT
Review need for additional link at Wharf/Roberts</td><td>
</td></tr>
<tr><td>50</td><td></td><td>Revise zone loading to higher capacity intersection</td><td>
</td></tr>
<tr><td>34, 35</td><td></td><td>Redistribute loading to reduce volume from Frederick Carpark</td><td></td></tr>
</table>

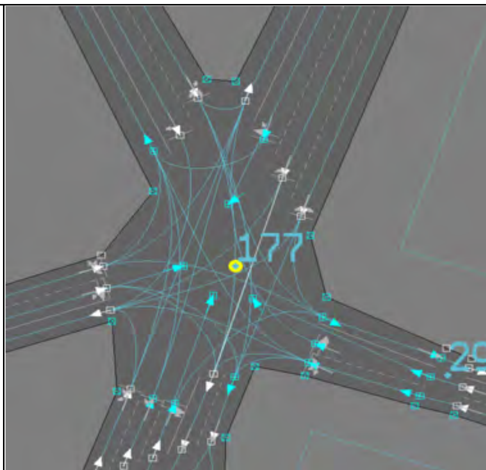
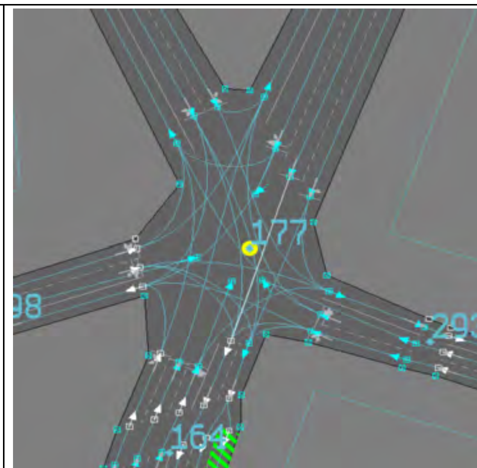
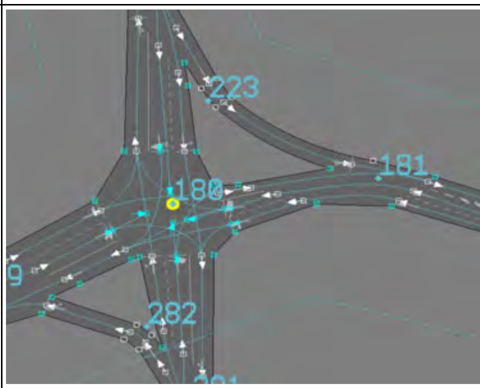
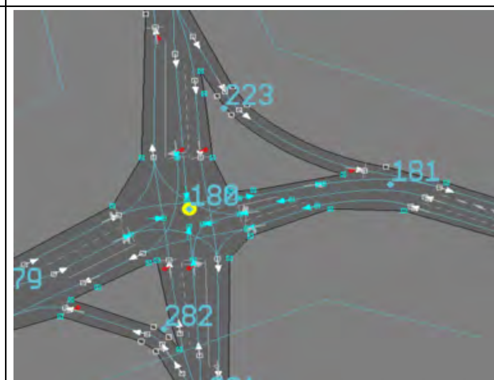
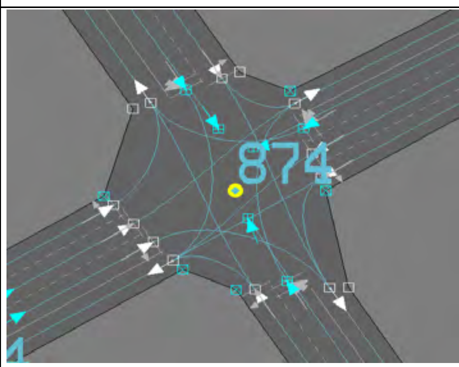
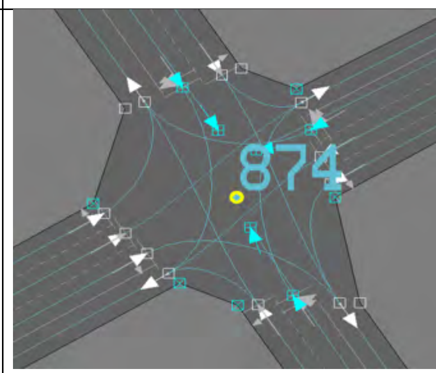
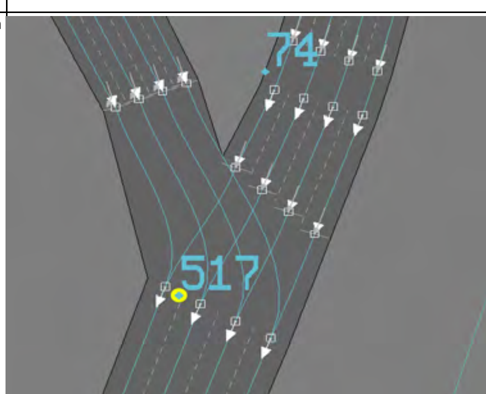
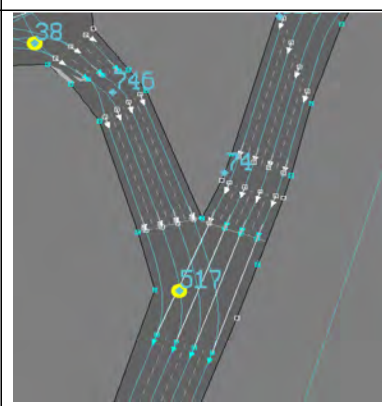
Zone changes

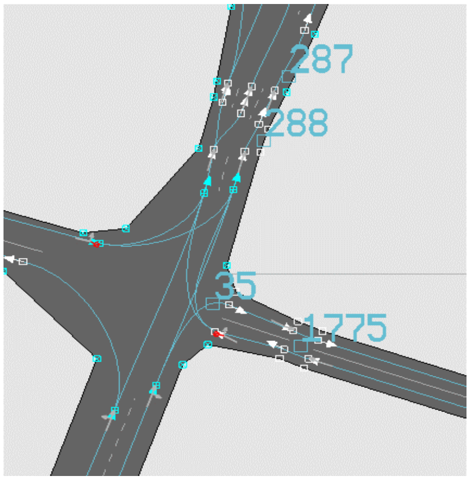
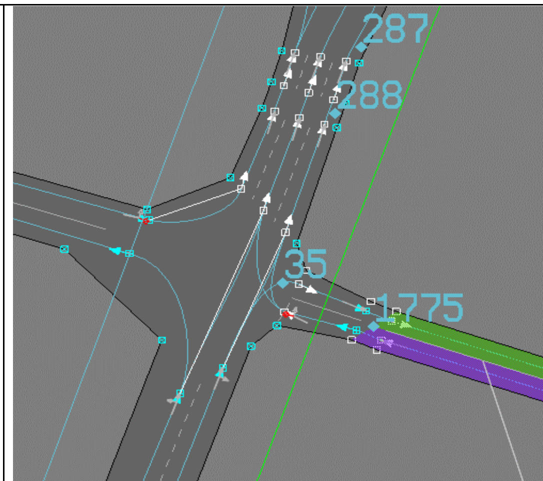
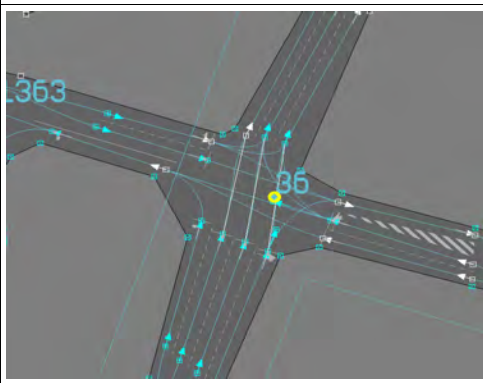
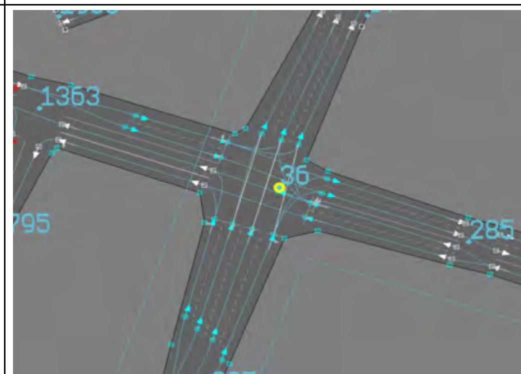
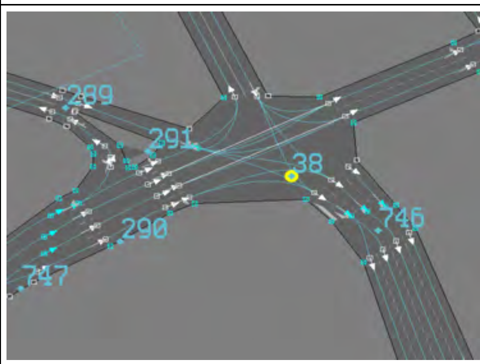
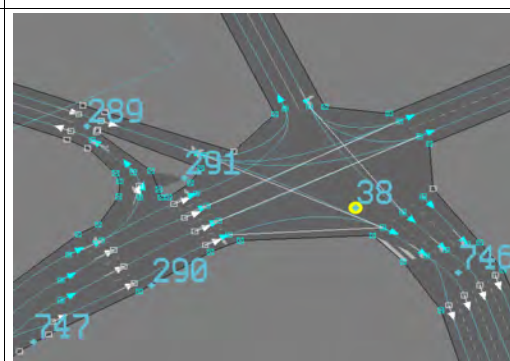
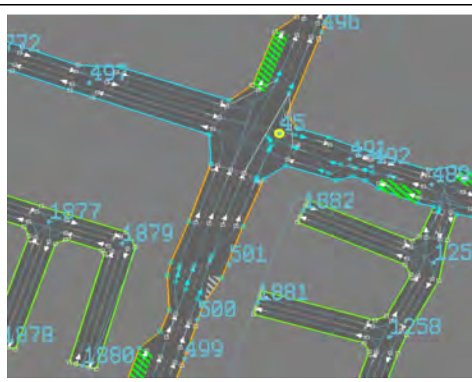
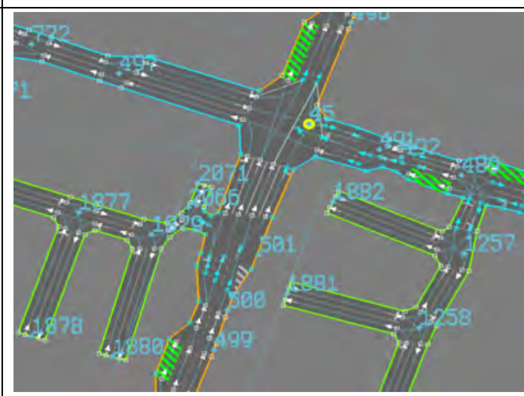
Node	Intersection	Before	Action	Updated
81	George - St Andrew		From Google Maps July 2017 date Ban NB Left Ban SB Right Correct NB Lane Allocation Remove stacking on SB Lane 2 Remove next lane on NB lane 1	
226	Stuart - London		Adjust NB next lane Also added to node 227 to reduce weaving	
1840	Stuart - Littlebourne		Adjust stoplines to reflect intersection geometry Add look through to SB Stuart approach	
257	ANZAC - Frederick		Southern approach traffic vehicle paths incorrect Remove stacking from NW approach Push back NW stoplines Push back NE stacking RT	

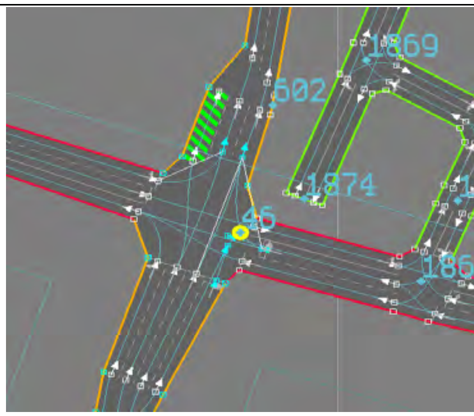
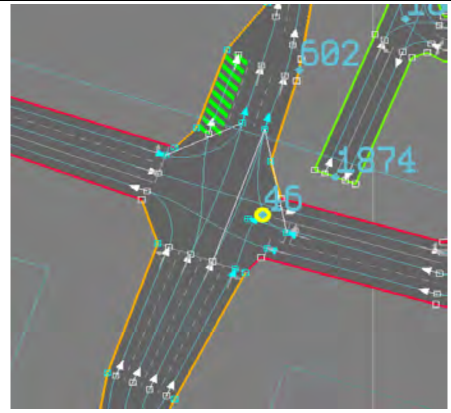
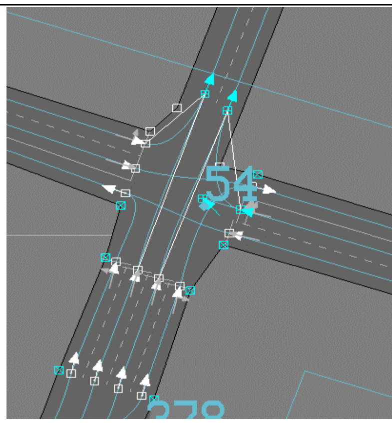
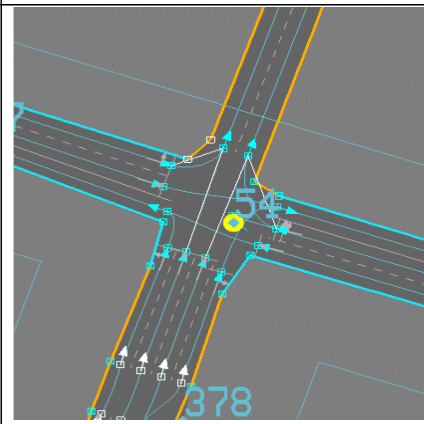
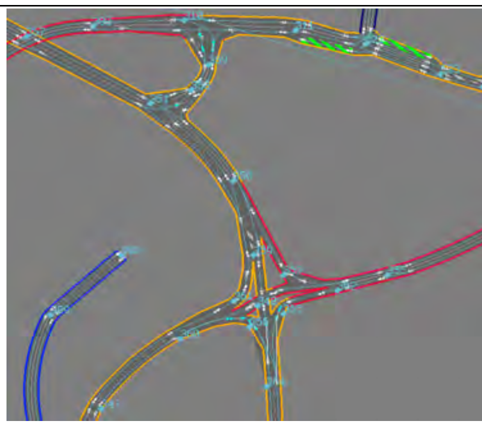
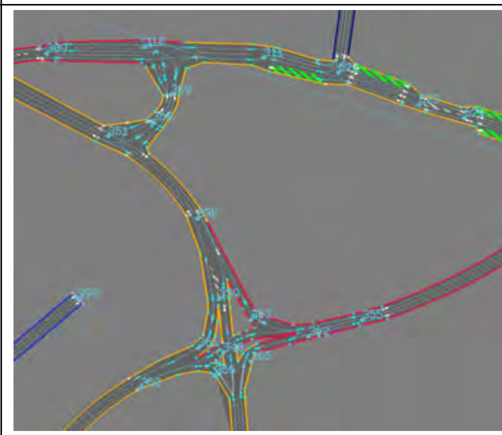
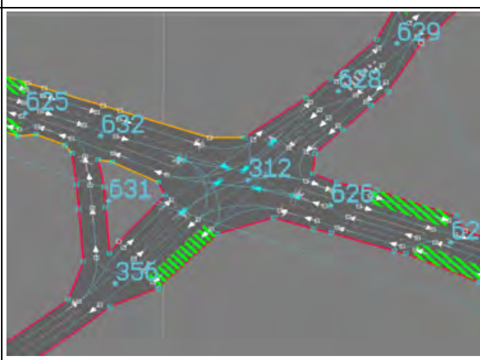
409	ANZAC - SH88		Remove wide end on 410::478 SE approach update lanes to correct movements Ban movements to cycle network for clarity Add look through on W approach Stay in lanes between intersection and west signals	
34	Crawford - Jetty		Remove through on EB lane 1 Correct lane count and allocation on WB approach Remove stacking on NB RT Align stoplines on WB and EB approaches	
145	ANZAC - Harrow		Harrow St one way section reversed Harrow app RT reinstated Give way NB at one way - two way merge	
75	ANZAC - St Andrews		Revise lane count on SE approach Revise lane allocation on SW approach Revise exit lane count on NW approach Ban RTs at node 76 Revise lane allocation on NE approach Realign lane points on NW exit Revise lane count and movements SW at node 1450 Revise lane allocation on NW approach CHECK OVERALL DIMENSIONS + STOPLINES CHECK SETBACK ON NODE 150	

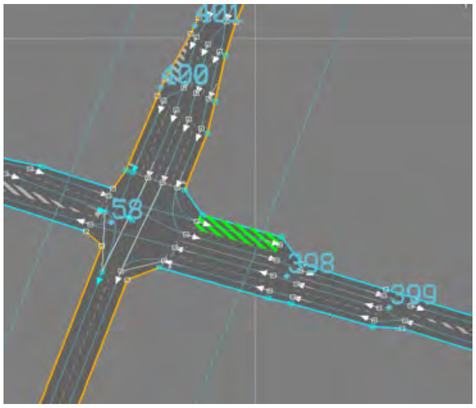
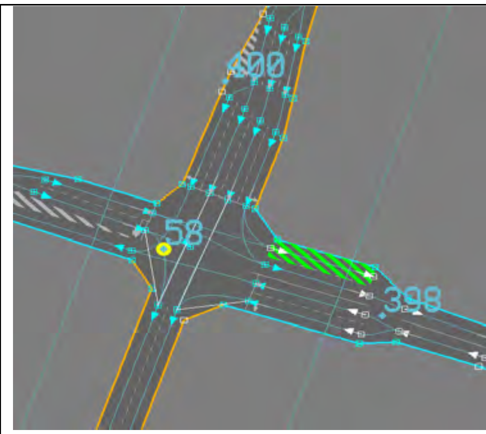
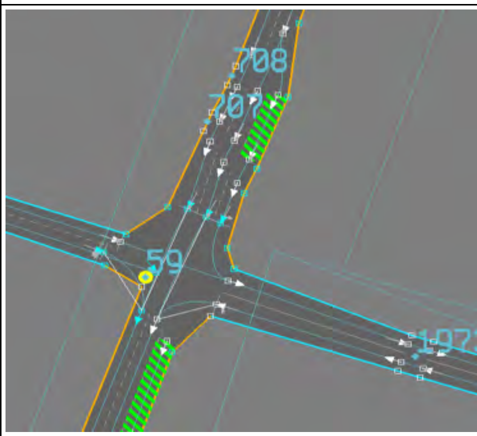
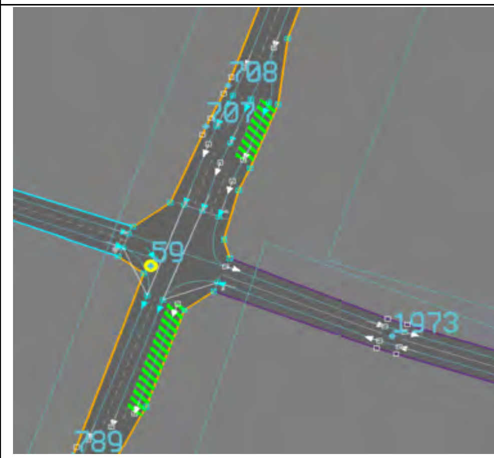
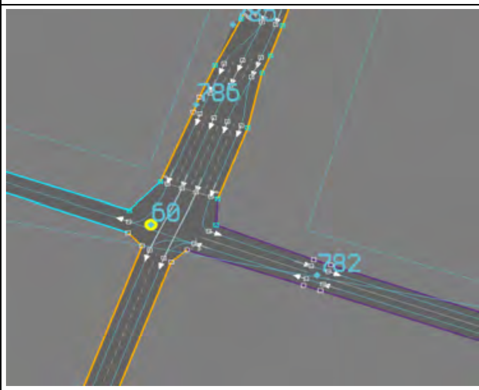
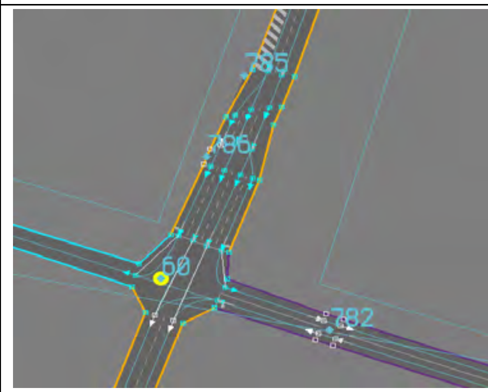
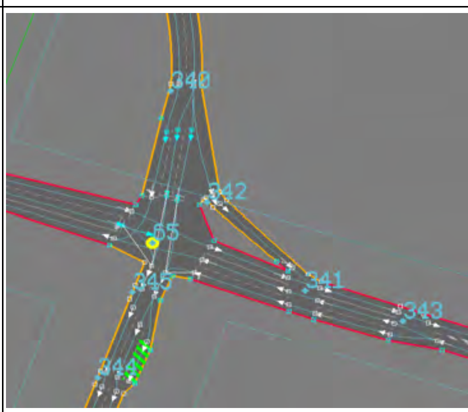
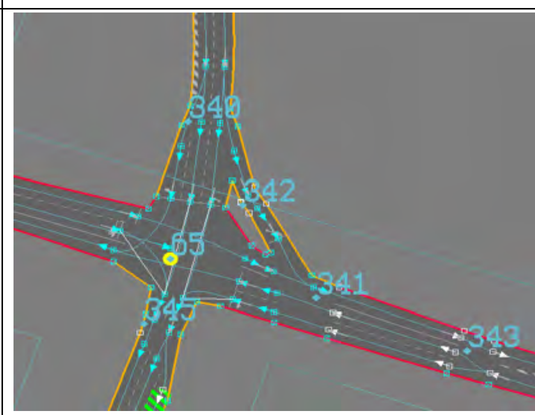
733	Harrow - Hanover		Realign approaches Move stoplines closer to reality remove visibility on minor approaches	
273	Vogel - ABR		Remove Vogel St link to ABR Add circulating one way links for frontage road Link Vogel St to north Complete second Gordon St lane and link to frontage	
693	ABR - Macandrew		Revise lane allocation on SW approach Lane lengths on SW and SE approaches need to be reviewed Stopline positions need to be reviewed	
199	ABR - Hillside		Revise thru lane allocation on SW and NE approaches Add look thru to all approaches for RT behaviour Lane lengths on approaches need to be reviewed Stopline positions need to be reviewed	

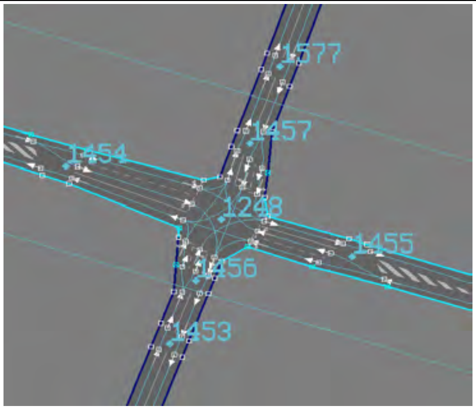
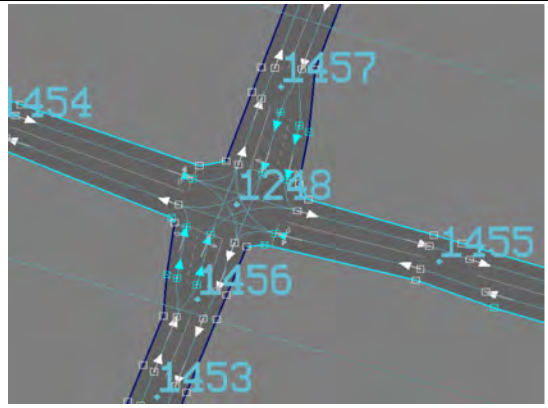
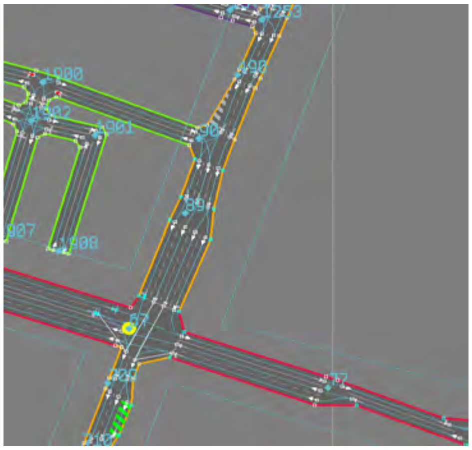
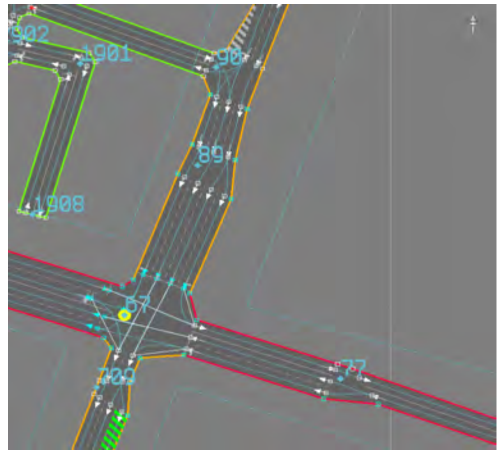
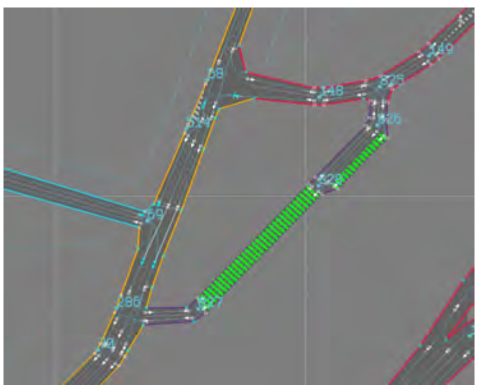
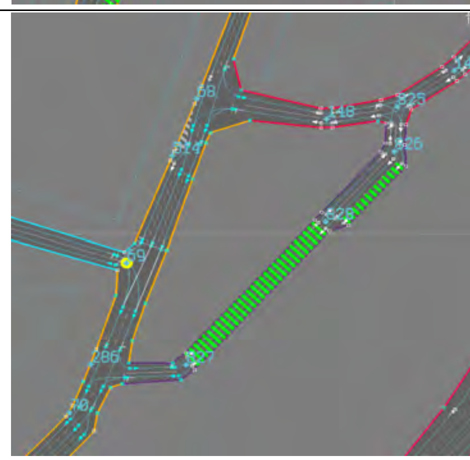
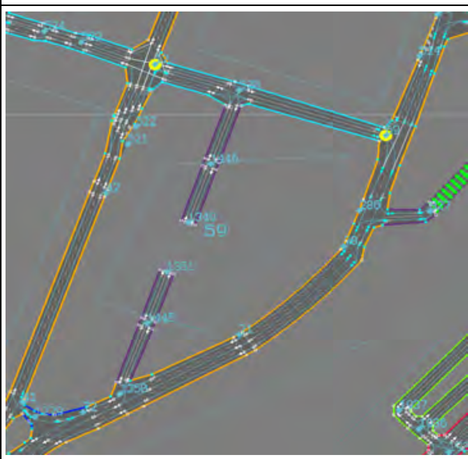
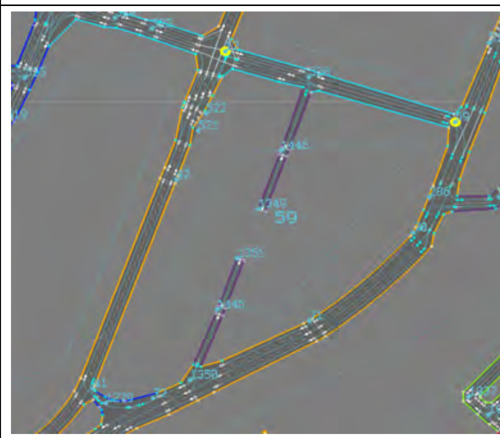
198 to 199	ABR		SB too many lanes, mainly 2 increasing to 3 at Hillside	
28 to 1684	SH1 South		Operating speed increased from 50km/h to 80km/h	
1153	Portobello - Timaru		Realign E approach RT to correct angle Realign N exit and W approach CHECK DATE OF PORTOBELLO RD WORKS 4 TO 2 LANE Potentially too many lanes on E approach	
32	Crawford - Jervois		Revise WB lane allocation Reduce E exit to 1 lane Lane lengths on approaches need to be reviewed Stopline positions need to be reviewed	
1362	Jetty - Bond		Ban RTs over median Reduce EB lanes to one until Crawford	

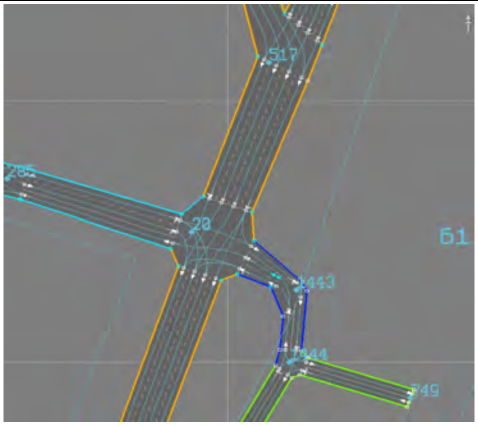
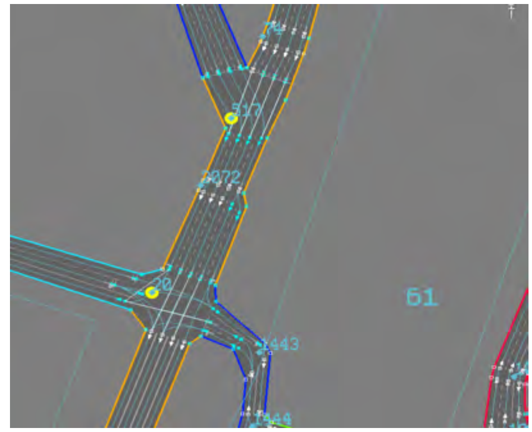
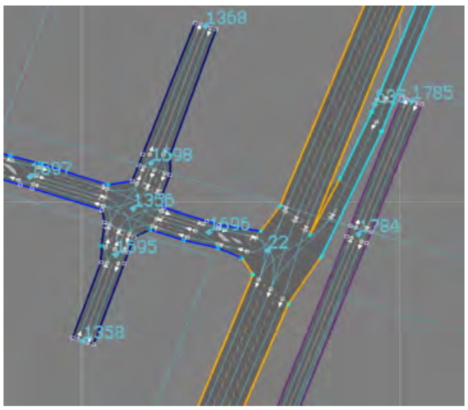
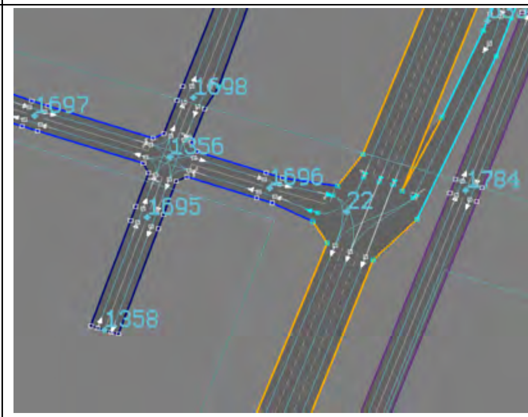
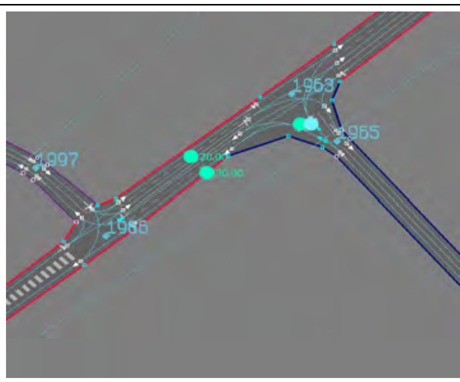
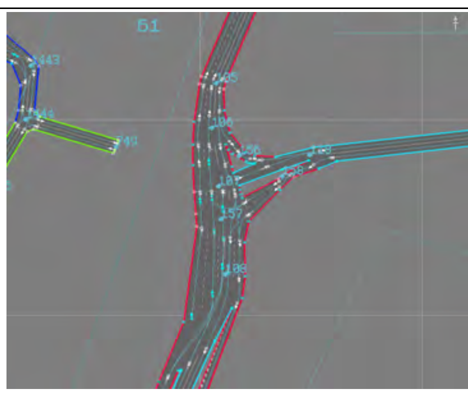
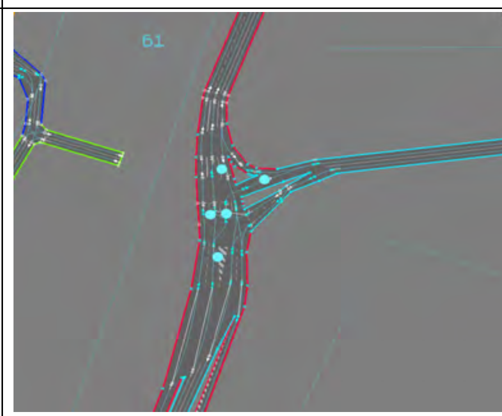
177	Princes - Jetty		Revise lane allocation for all approaches Align stoplines on all approaches MODEL MISSING LIVERPOOL ST AT NORTHERN EXIT	
180	Rattray - Maclaggan		Revise WB lane allocation CHECK LINK 223:181 LENGTH / ANGLE	
874	Hillside - King Edward		Revise WB lane allocation	
517	Queens Garden - Dowling		Revise stop lines / trajectories	

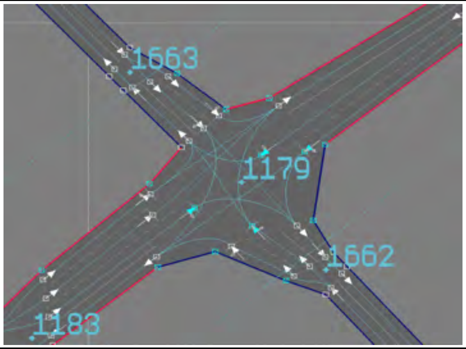
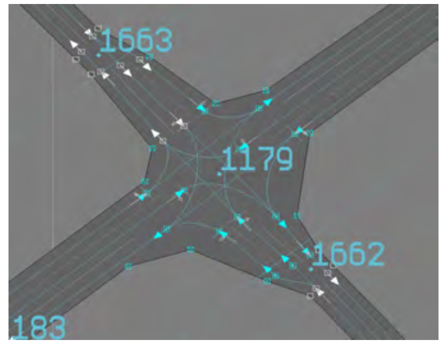
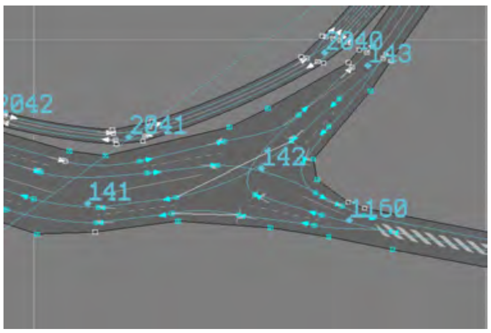
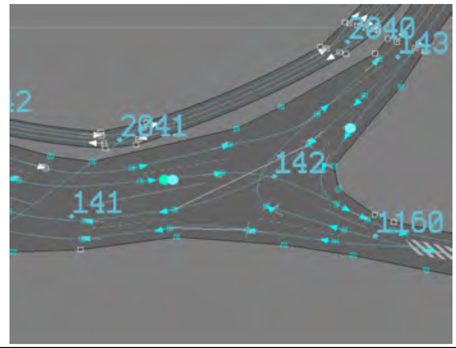
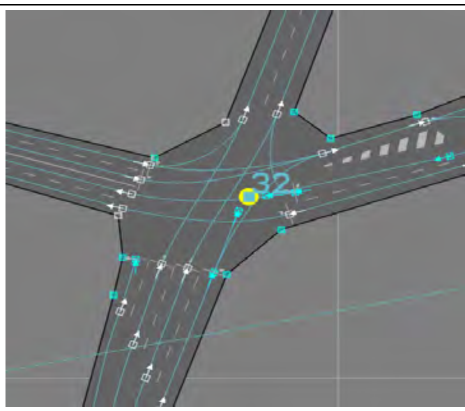
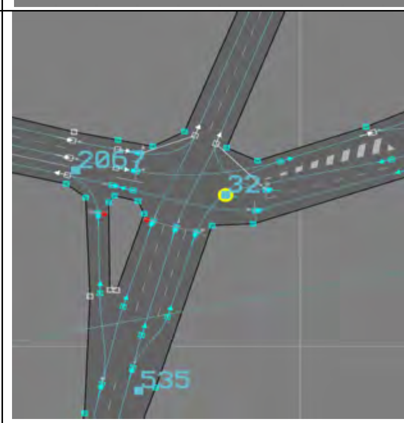
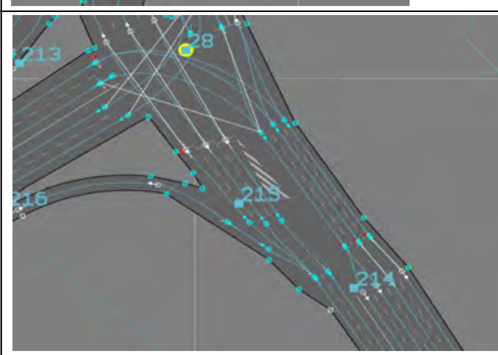
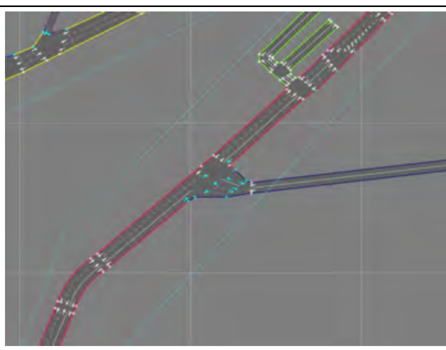
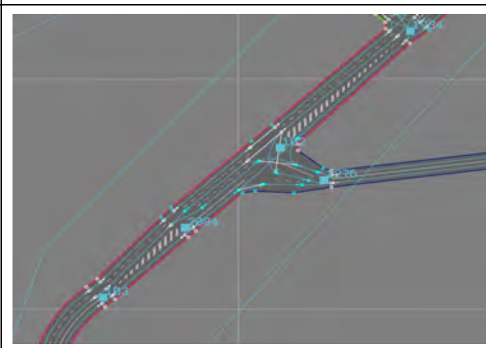
35	Crawford - Water		Additional NB exit lane Realign NE approach into NB lane 1	
36	Crawford - Queens Garden		Additional exit lane on W exit Additional exit lane on E exit Realign lane points	
38	Crawford - Dowling		Realign lane points Adjust vehicle trajectories Set next lane to restrict exit lane choice Correct signal period timings to function in IP and PM Add Dowling - Burlington movement to signals Increase cost on Dowling, reduce cost on Burlington	
45	Crawford - Hanover		Add one way link 501::1879 for NW carpark entrance Realign lane points and stop lines to adjust trajectories Add dummy link to carpark access to model stop at entrance	

46	Crawford - Frederick		Revise lane allocation Remove unnecessary stacking and realign lane points	
54	Gt King - Howe		Minor alignment of lane points	
348, 351, 310	Gt King - George - Bank		Remove exit lane to N, no space for separate RT Add RT approach EB to 310, realign kerb and lane points Realign all alne points to correct vehicle trajectories Add look thrus on E-W approaches to 310 Remove stop from NB 359::350 link	
312	Gt King - Opoho - North		Add look thru to W exit Ban RT to left slip at S exit Realign stop lines	

58	Cumberland - Dundas		Realign stop lines and correct trajectories Reduce turning length on E approach	
59	Cumberland - St David		Ajust stop lines and trajectories Reduce speed on E approach / exit	
60	Cumberland - Union		Realign E approach stop lines Realign N approach stop lines	
65	Castle - Frederick		Realign N approach LT Realign N approach to correct lane capacity Realign E aproach to correct lane capacity Add look thru to E approach	

1248	Hanover - Leith		Reduce to one lane approaches due to parking	
67	Castle - St Andrew		Add look thru on N approach @ carpark Reduce E approach lane capacity Realign all approach lane points Remove LT give way at node 1253	
68 - 69 - 286	Castle - Stuart		Realign stops at 68 and 286 Add look thrus on short links Reduce lanes S of node 286 until at corner	
1350	Queens Garden - Dunbar		Correct Dunbar to SB one way Correct Zone 59 flow to 80% in/out Dunbar	

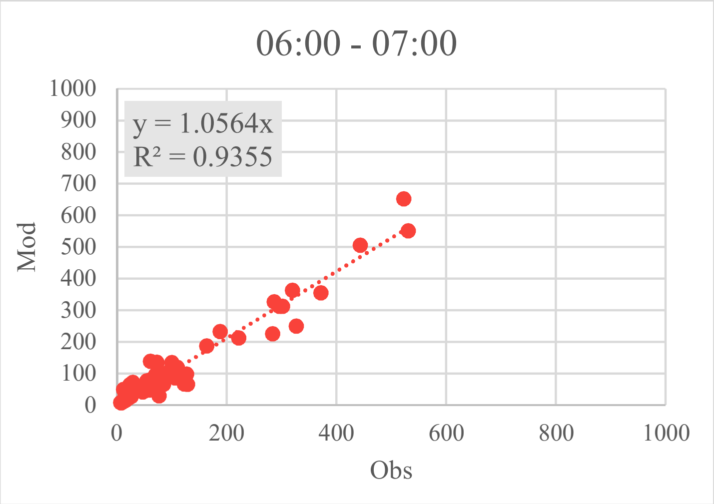
20	Cumberland - Queens Garden		Correct lane count and allocation on N approach Revise stopline and trajectories Add stay in lane at S exit to reduce weaving over L slip	
22	Cumberland - Police		Reduce lane capacity on Police St Add look thru to short links Remove visibility on S approach	
1963	Strathallan - Otaki		Remove four laning on Strathallan Realign stoplines and lane points Add look thrus to short links	
107	Wharf - Fryatt		Shorten S approach RT lane Adjust all stoplines Remove visibility from E approach stop sign Add next lane to E app RT to prevent U turn Adjust all vehicle trajectories Add stay in lane on N exit where lanes still seperated	

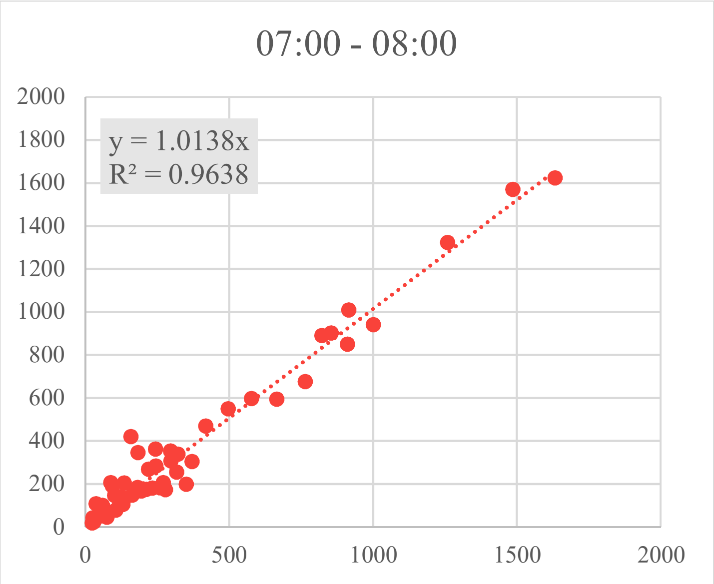
1179	Orari - Otaki		Reduce lane count on SW approach, revise lane allocation Realign SE approach Adjust vehicle trajectories Remove visibility from minor approaches	
142	Portobello - Shore		Look thru added to short links on W approach Visibility removed from minor approach Correct priority on W approach RT	
32	Crawford - Jervois		Add NB left slip lane not included in signals	
28	AB - SH1		S approach lane points adjusted to improve capacity	
102	Thomas Burns - Bombay		Add RT from median	

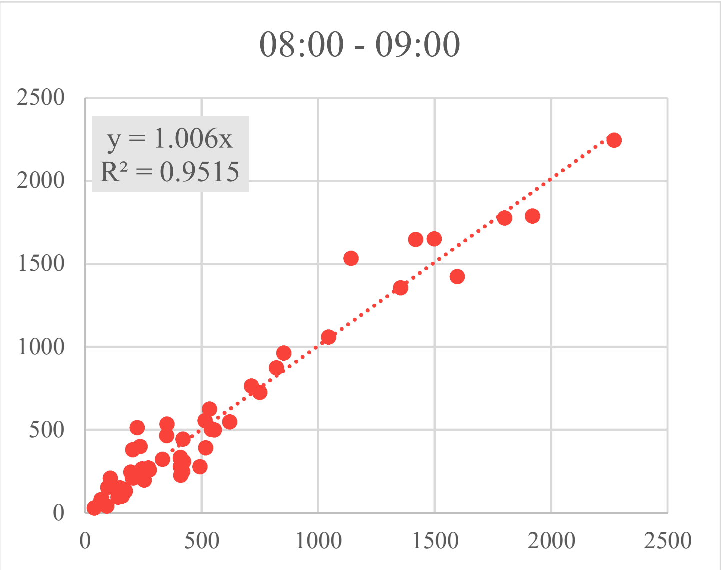
APPENDIX B - XY SCATTERPLOTS

SCREENLINE XY SCATTERPLOTS

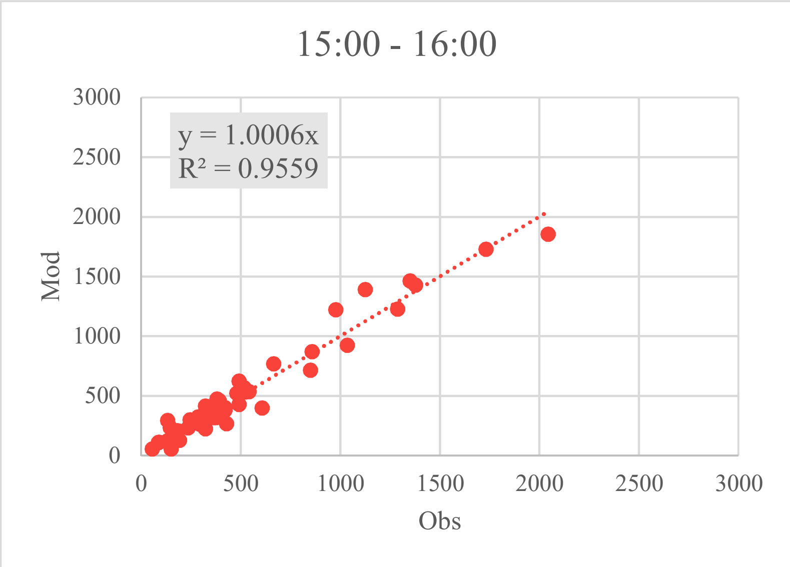
AM SCREENLINE MOVEMENT XY SCATTER PLOT

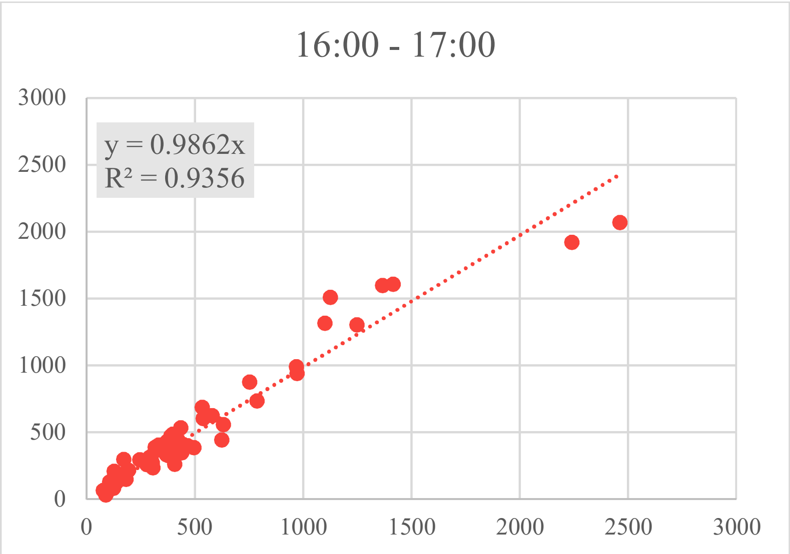


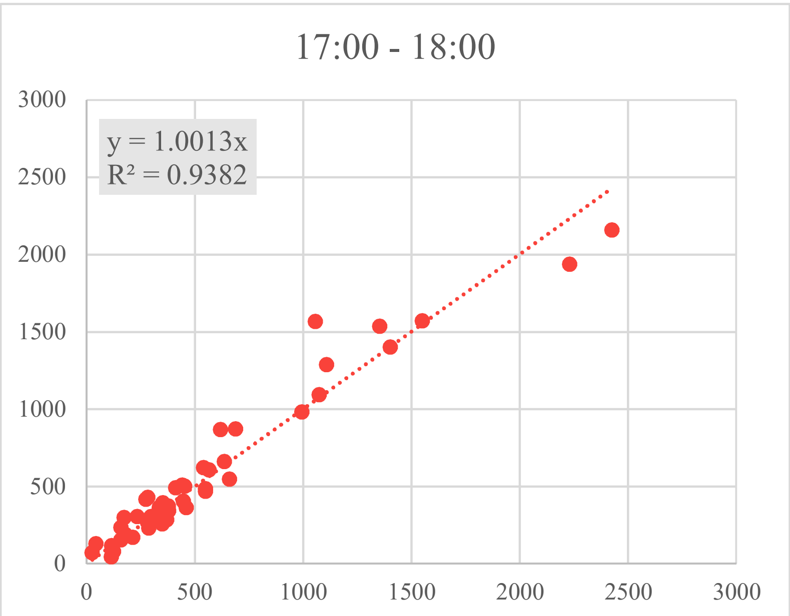




PM SCREENLINE MOVEMENT XY SCATTER PLOT

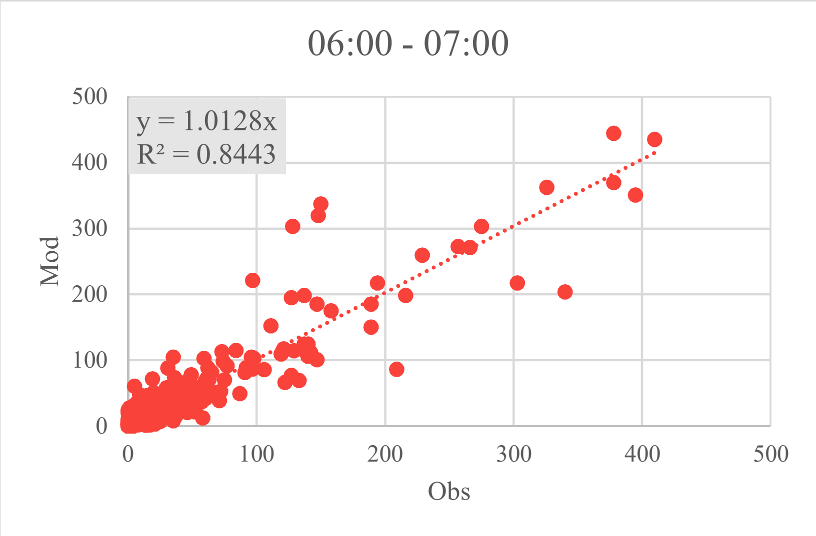


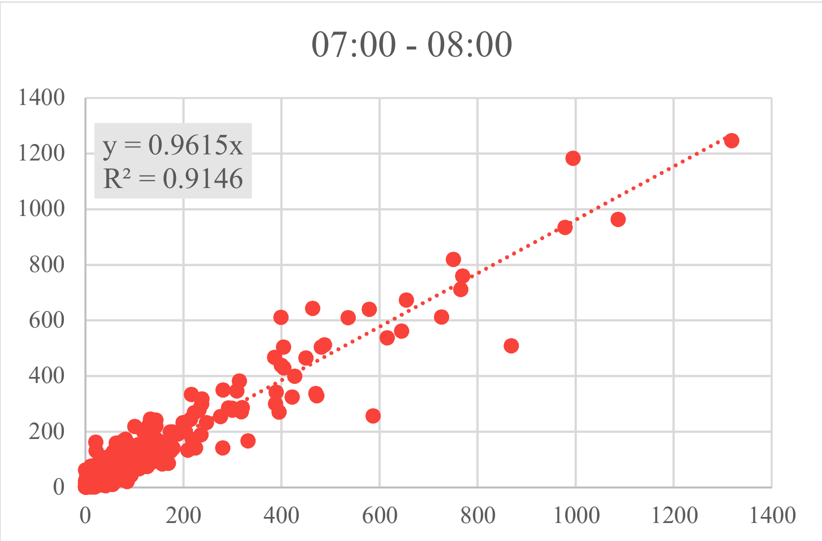


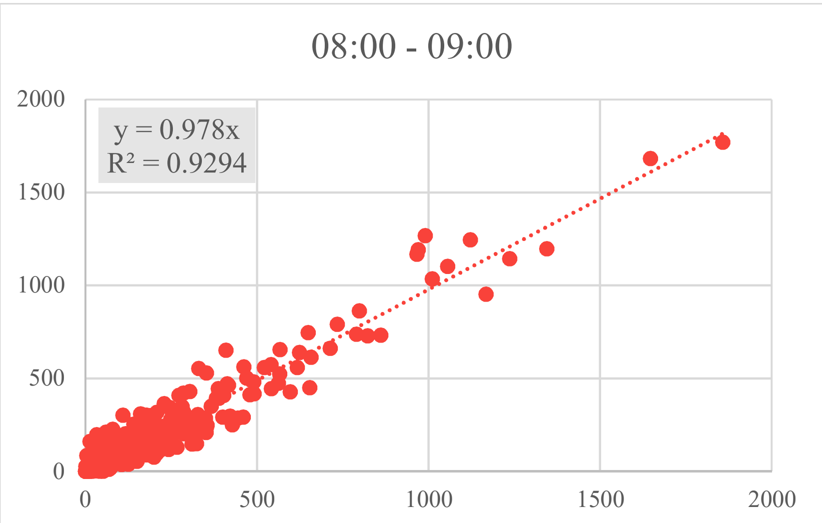


TURNING MOVEMENT XY SCATTER PLOTS

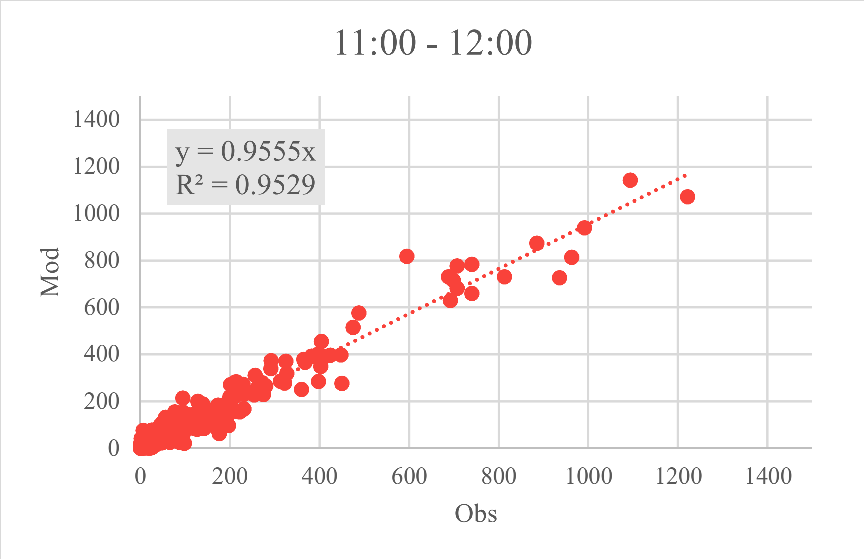
AM TURNING MOVEMENT XY SCATTER PLOT

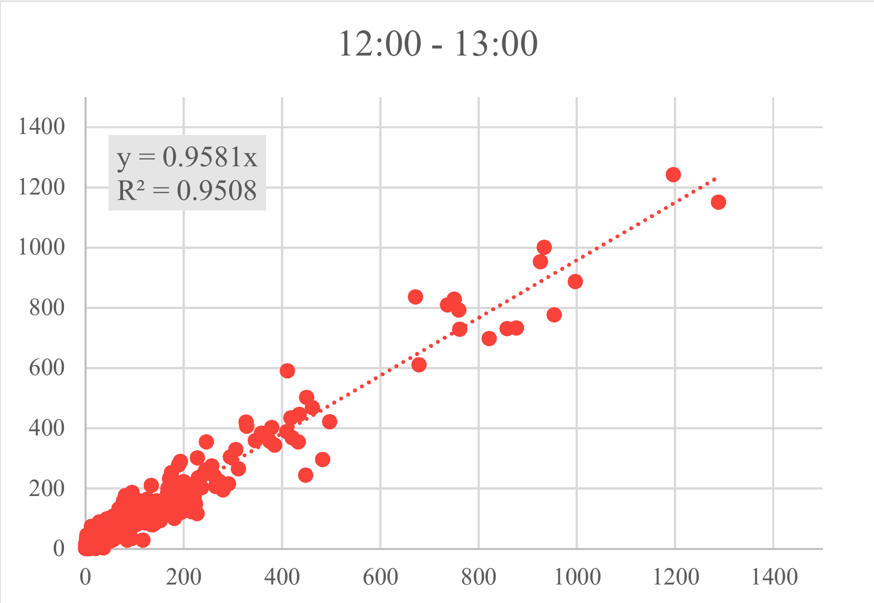




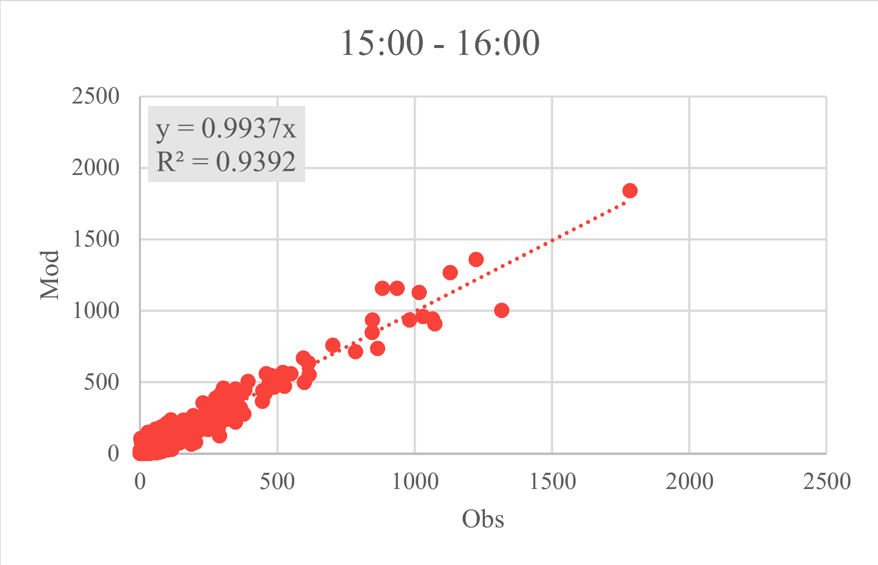


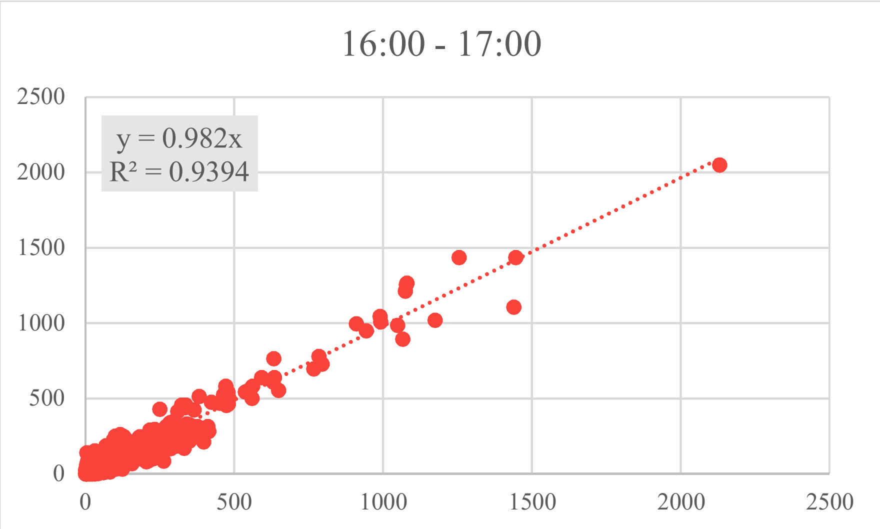
INTERPEAK TURNING MOVEMENT XY SCATTER PLOT

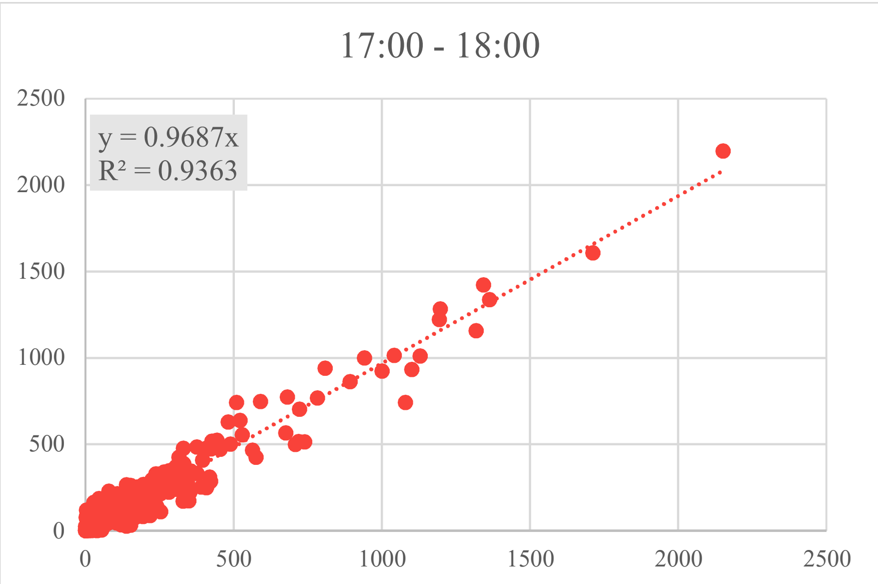




PM TURNING MOVEMENT XY SCATTER PLOT







APPENDIX C - ABSOLUTE TRAFFIC FLOW COMPARISONS

SCREENLINE TRAFFIC FLOW COMPARISONS

Table C1.1 AM screenline absolute traffic flows comparisons

INDIVIDUAL DIRECTIONAL LINK COUNT ON SCREENLINE	% OF COMPARISONS ACHIEVING TARGET			
	06:00 - 07:00	07:00 - 08:00	08:00 - 09:00	TARGET (C: Urban Area)
<700vph within 100vph	98%	86%	69%	>85%
700-2,700vph within 15%	NA	100%	82%	>85%
>2,700vph within 400vph	NA	NA	NA	>85%
Number <700	50	42	39	
Number 700-2,700	0	8	11	
Number <2,700	0	0	0	

Table C1.2 PM screenline absolute traffic flows comparisons

INDIVIDUAL DIRECTIONAL LINK COUNT ON SCREENLINE	% OF COMPARISONS ACHIEVING TARGET			
	15:00 - 16:00	16:00 - 17:00	17:00 - 18:00	TARGET (C: Urban Area)
<700vph within 100vph	88%	85%	85%	>85%
700-2,700vph within 15%	70%	55%	78%	>85%
>2,700vph within 400vph	NA	NA	NA	>85%
Number <700	40	39	41	
Number 700-2,700	10	11	9	
Number <2,700	0	0	0	

TURN COUNT TRAFFIC FLOW COMPARISONS

Table C1.3 AM turn count traffic volume comparisons

TURNING MOVEMENT	% OF COMPARISONS ACHIEVING TARGET			
	06:00 - 07:00	07:00 - 08:00	08:00 - 09:00	TARGET (C: Urban Area)
400vph within 50vph	96%	88%	78%	>85%
400-2,000vph within 12.5%	100%	54%	54%	>85%
>2000vph within 250vph	NA	NA	NA	>85%
Number <400	440	415	410	
Number 400-2,000	1	24	39	
Number >2,000	0	0	0	

Table C1.4 Interpeak turn count traffic volume comparisons

TURNING MOVEMENT	% OF COMPARISONS ACHIEVING TARGET		
	11:00 – 12:00	12:00– 13:00	TARGET (C: Urban Area)
400vph within 50vph	87%	87%	>85%
400-2,000vph within 12.5%	70%	58%	>85%
>2000vph within 250vph	NA	NA	>85%
Number <400	281	278	
Number 400-2,000	23	26	
Number >2,000	0	0	

Table C1 5 PM turn count traffic volume comparisons

TURNING MOVEMENT	% OF COMPARISONS ACHIEVING TARGET			
	15:00 - 16:00	16:00 - 17:00	17:00 - 18:00	TARGET (C: Urban Area)
400vph within 50vph	78%	73%	72%	>85%
400-2,000vph within 12.5%	74%	57%	43%	>85%
>2000vph within 250vph	NA	100%	100%	>85%
Number <400	382	379	398	
Number 400-2,000	34	37	42	
Number >2,000	0	1	1	

LINK COUNT TRAFFIC FLOW COMPARISONS

Table C1.6 AM Link count traffic volume comparison

LINK COUNT	% OF COMPARISONS ACHIEVING TARGET			
	06:00 - 07:00	07:00 - 08:00	08:00 - 09:00	TARGET (C: Urban Area)
<700 vph within 100vph	98%	86%	79%	>85%
700-2,700vph within 15%	NA	71%	70%	>85%
>2,700vph within 400vph	NA	NA	NA	>85%
Number <400	66	59	56	
Number 400-2,700	0	7	10	
Number >2,700	0	0	0	

Table C1.7 Interpeak Link count traffic volume comparison

LINK COUNT	% OF COMPARISONS ACHIEVING TARGET		
	11:00 – 12:00	12:00– 13:00	TARGET (C: Urban Area)
<700 vph within 100vph	82%	80%	>85%
700-2,700vph within 15%	80%	86%	>85%
>2,700vph within 400vph	NA	NA	>85%
Number <400	61	59	
Number 400-2,700	5	7	
Number >2,700	0	0	

Table C1.8 PM Link count traffic volume comparison

LINK COUNT	% OF COMPARISONS ACHIEVING TARGET			
	15:00 - 16:00	16:00 - 17:00	17:00 - 18:00	TARGET (C: Urban Area)
<700 vph within 100vph	81%	77%	65%	>85%
700-2,700vph within 15%	92%	85%	73%	>85%
>2,700vph within 400vph	NA	NA	NA	>85%
Number <400	54	53	55	
Number 400-2,700	12	13	11	
Number >2,700	0	0	0	

APPENDIX D - TRAVEL TIME VS DISTANCE GRAPHS

TIME VS DISTANCE GRAPHS

ROUTE 1 – TIME VS DISTANCE TRAVEL TIME COMPARISON GRAPHS

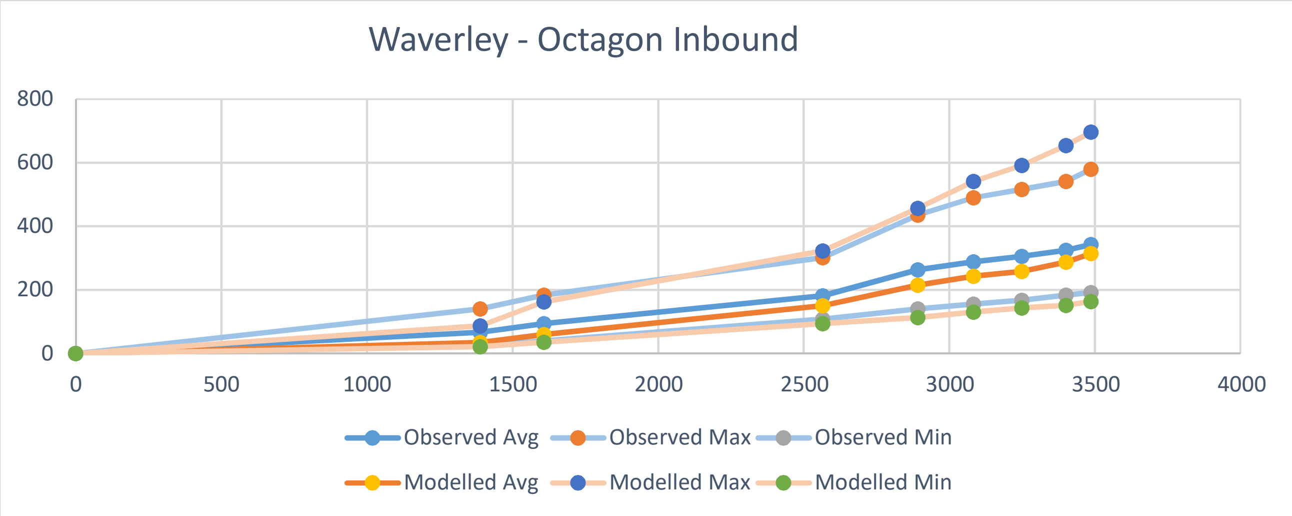


Figure D1.1 Route 1 - AM peak inbound

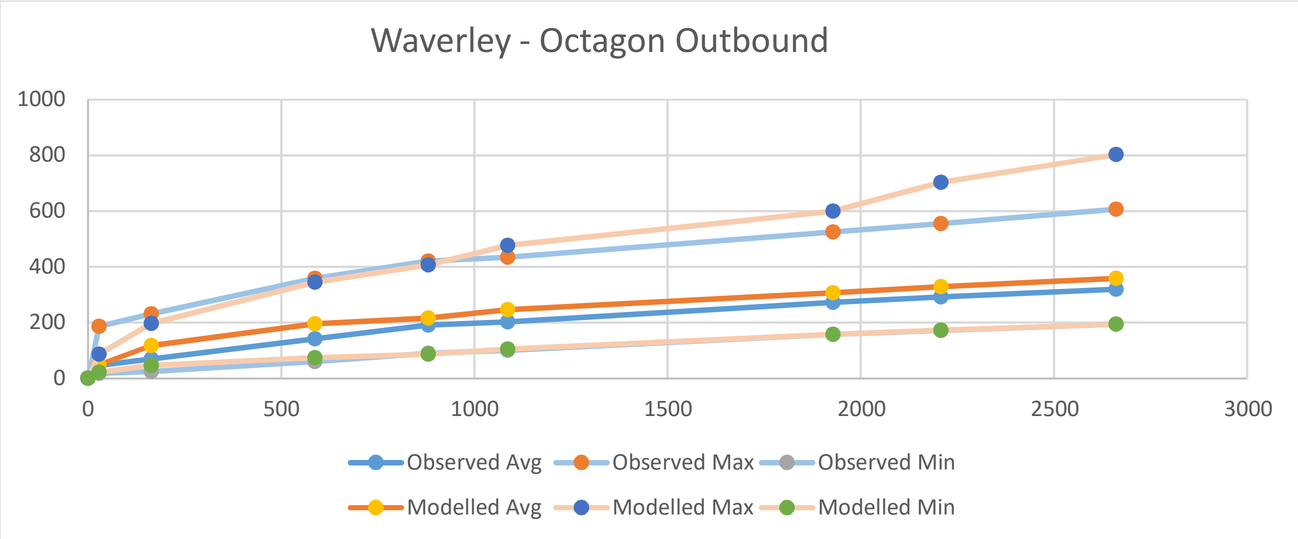


Figure D1.2 Route 1 - AM peak outbound

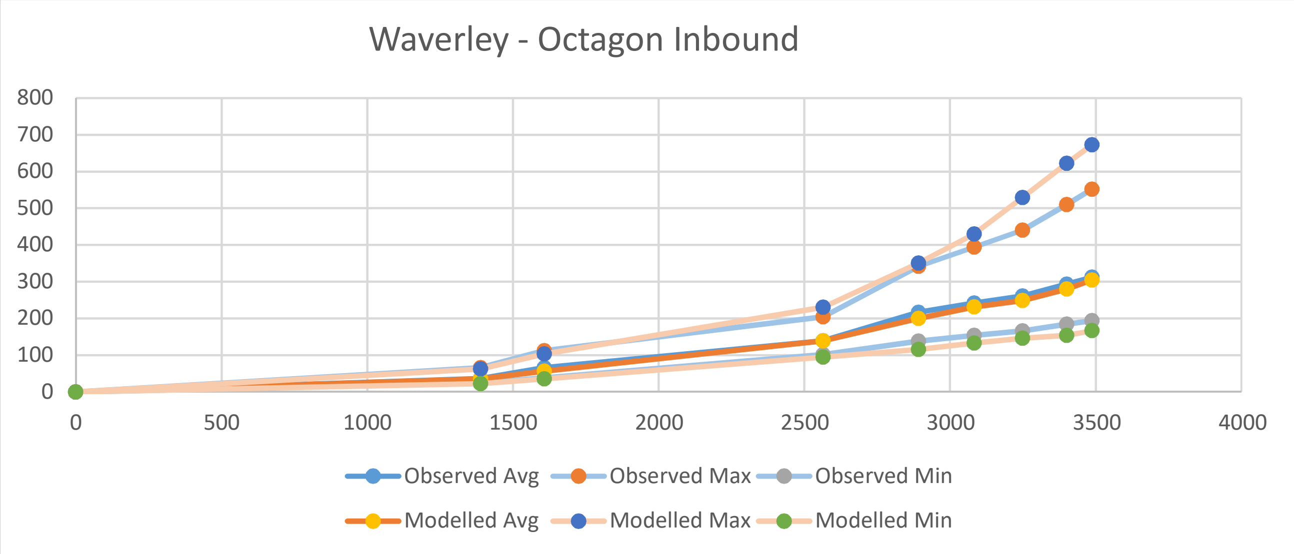


Figure D1.3 Route 1 - Interpeak inbound

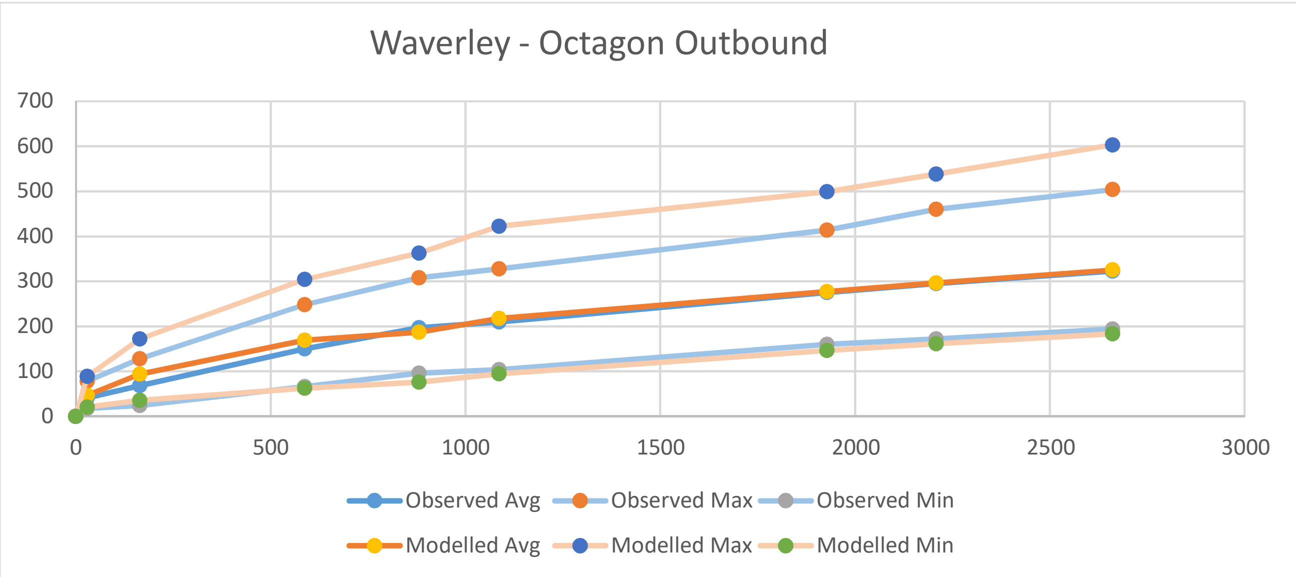


Figure D1.4 Route 1 - Interpeak outbound

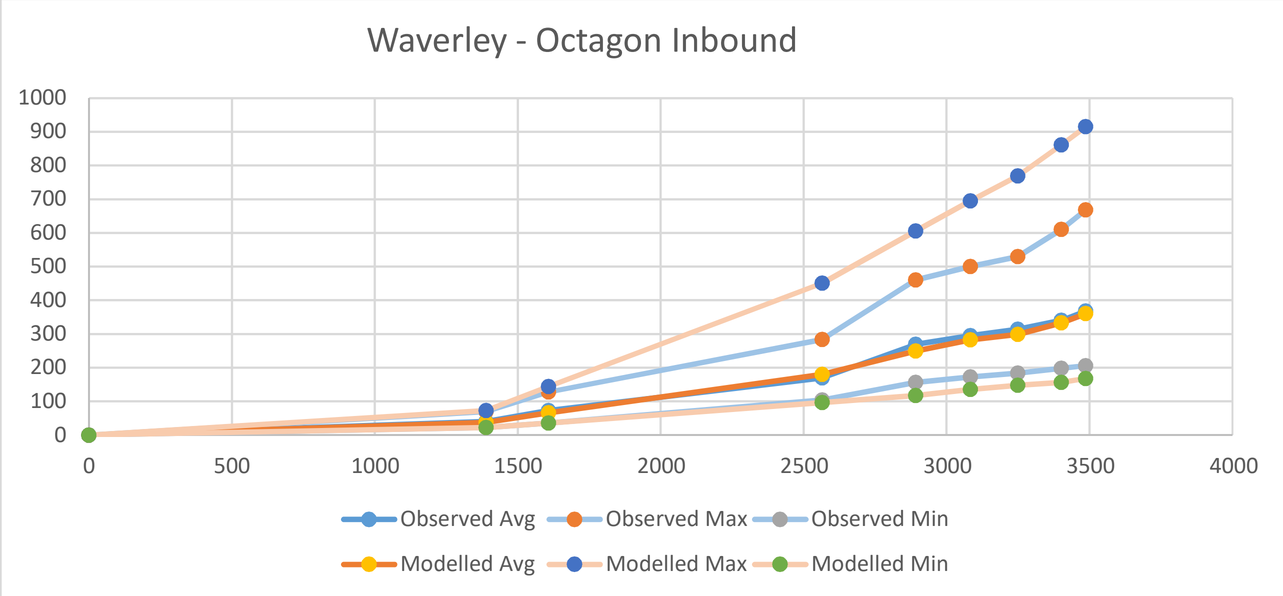


Figure D1.5 Route 1 – PM peak inbound

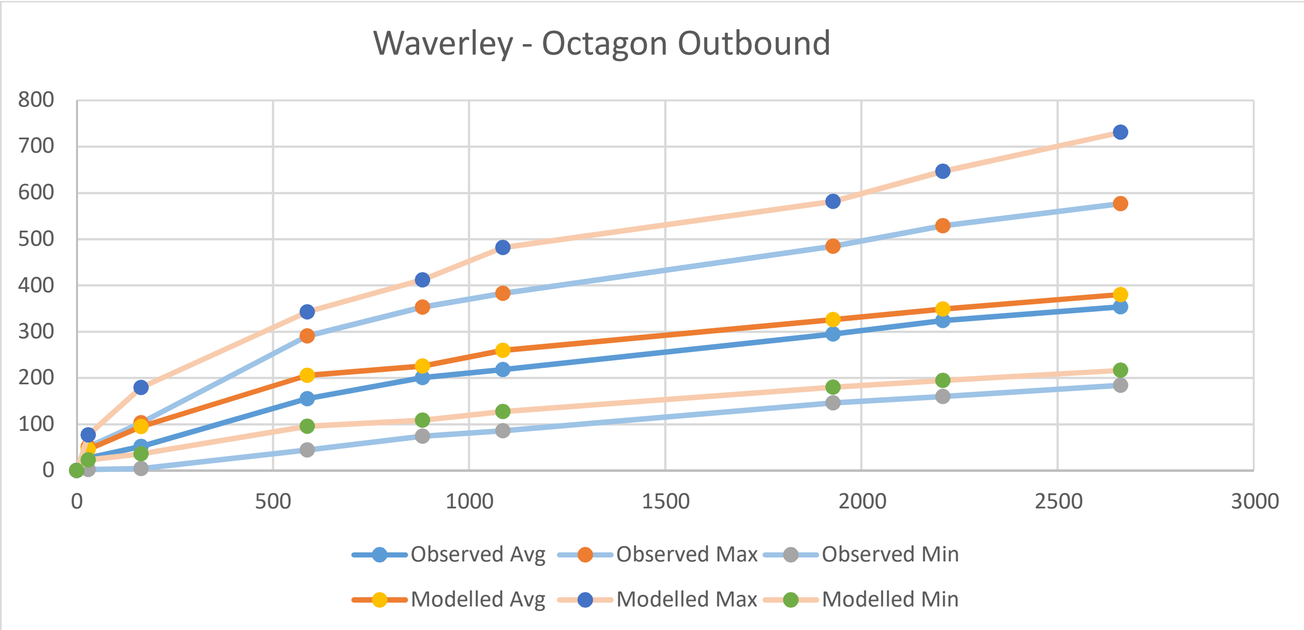


Figure D1.6 Route 1 – PM peak outbound

ROUTE 2 – TIME VS DISTANCE TRAVEL TIME COMPARISON GRAPHS

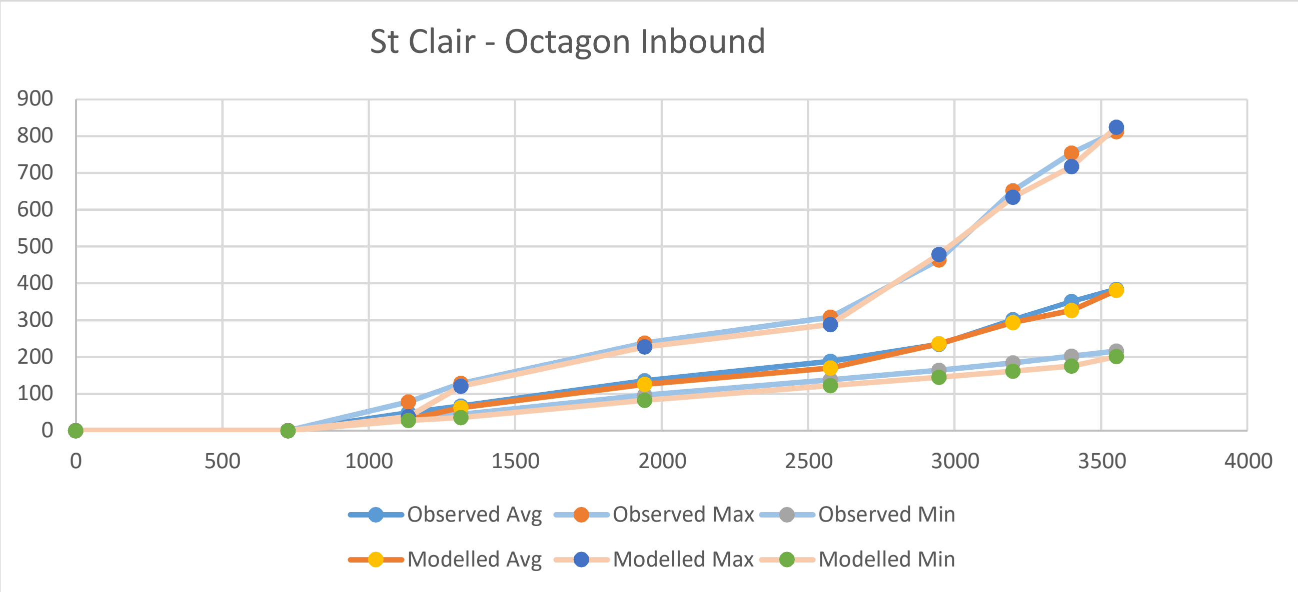


Figure D1.7 Time vs Distance Travel Time Comparison Graphs

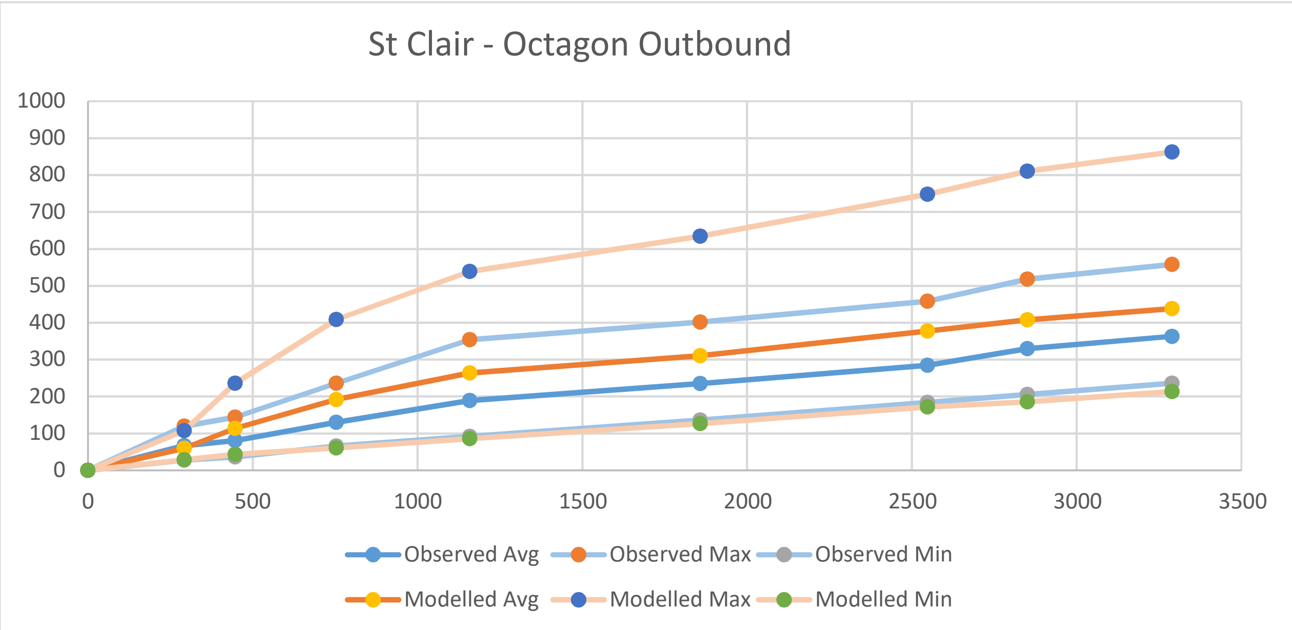


Figure D1.8 Route 2 - AM peak outbound

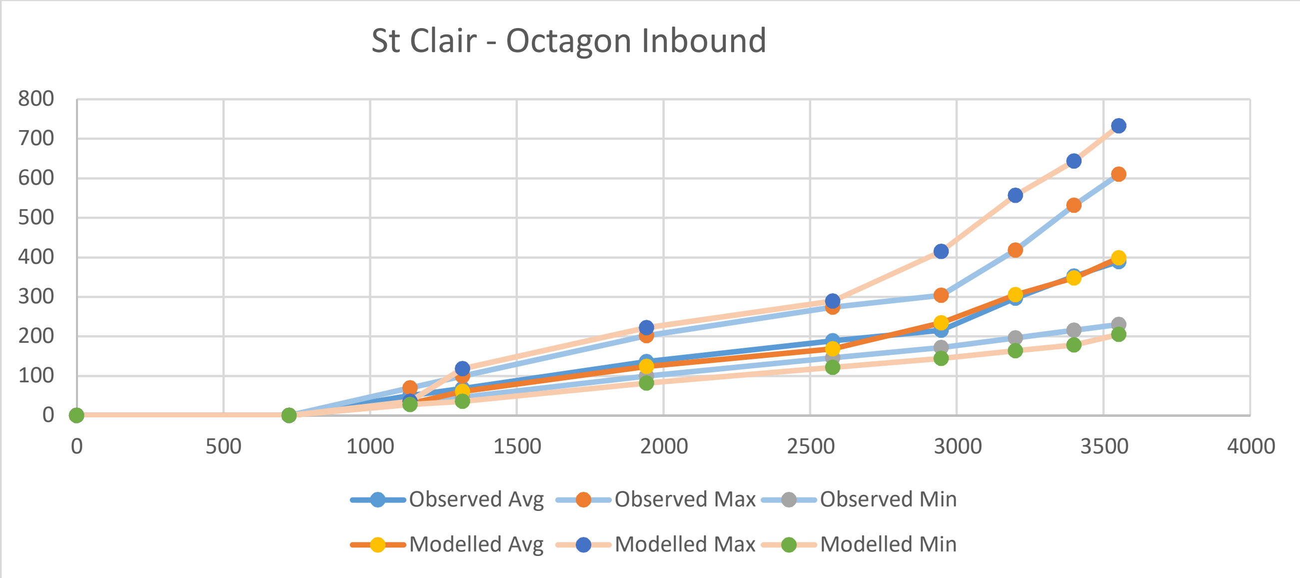


Figure D1.9 Route 2 - Interpeak inbound

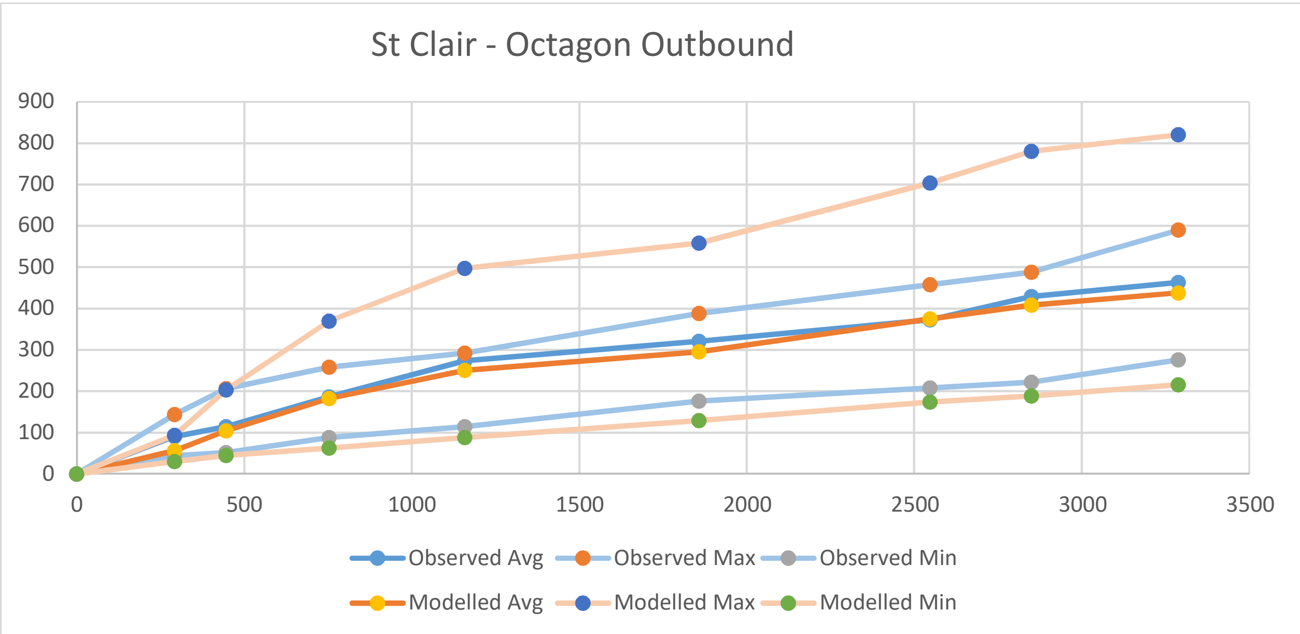


Figure D1.10 Route 2 - Interpeak outbound

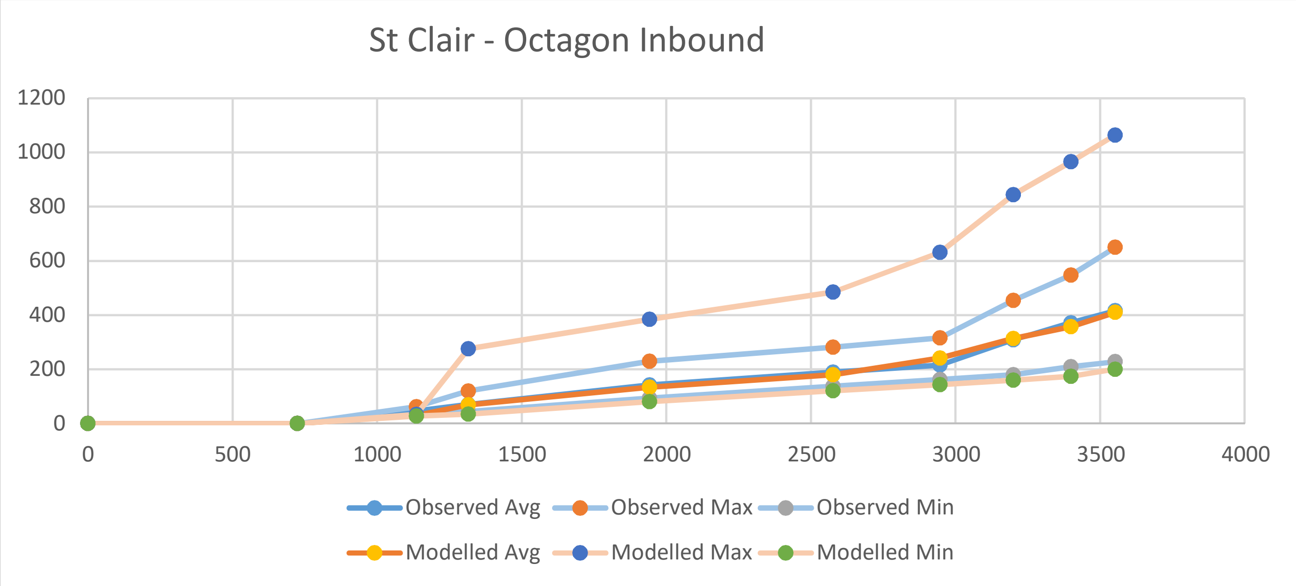


Figure D1.11 Route 2 - PM peak inbound

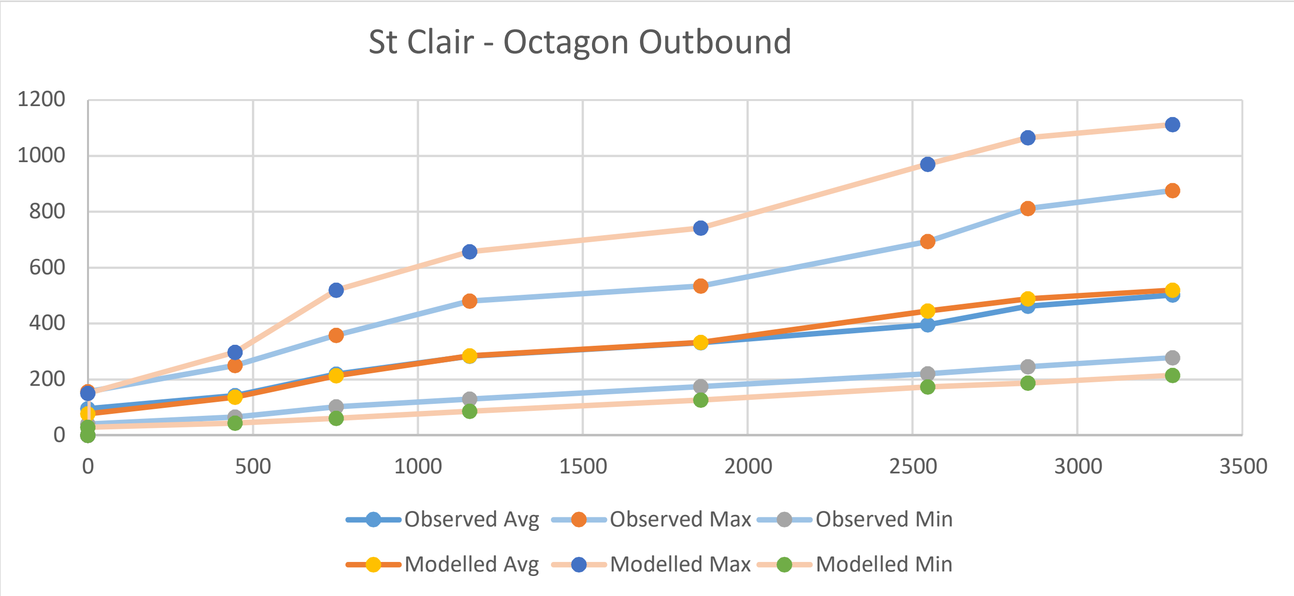


Figure D1.12 Route 2 - PM peak inbound

ROUTE 3 – TIME VS DISTANCE TRAVEL TIME COMPARISON GRAPHS

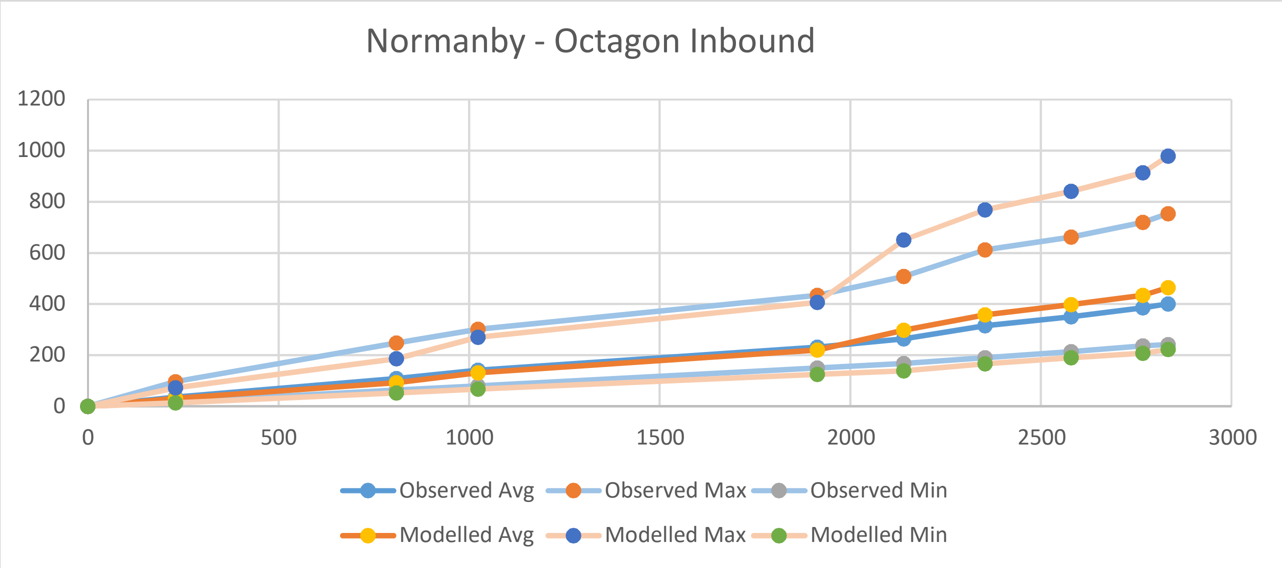


Figure D1.13 Route 3 - AM peak inbound

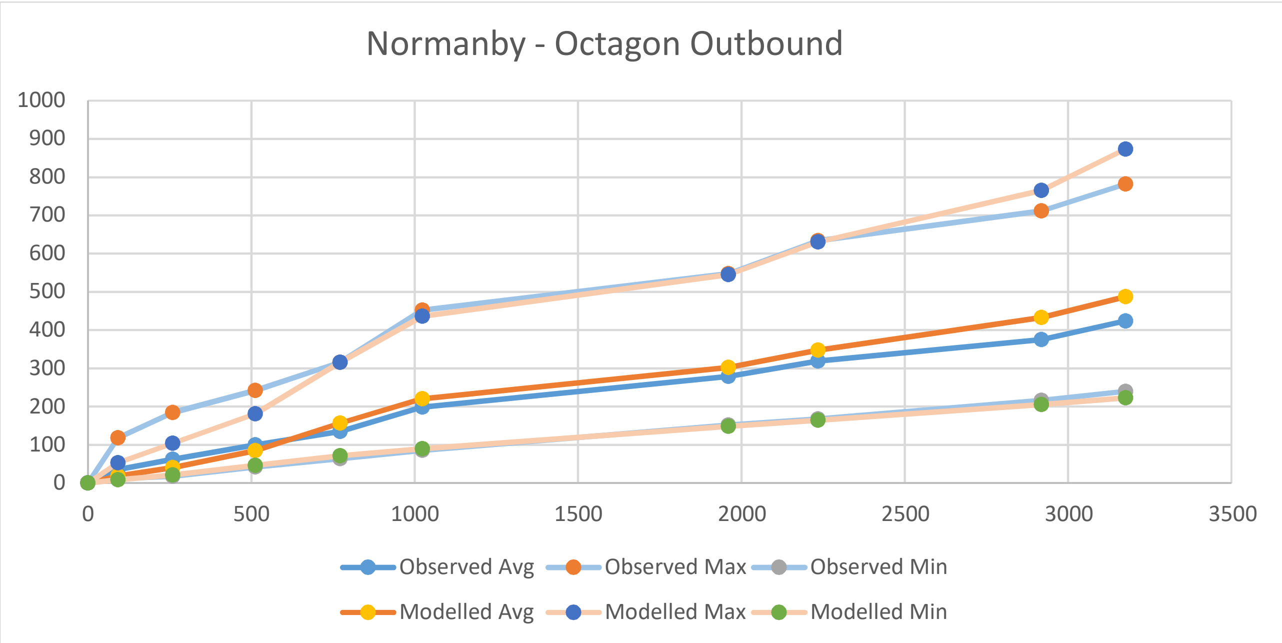


Figure D1.14 Route 3 - AM peak outbound

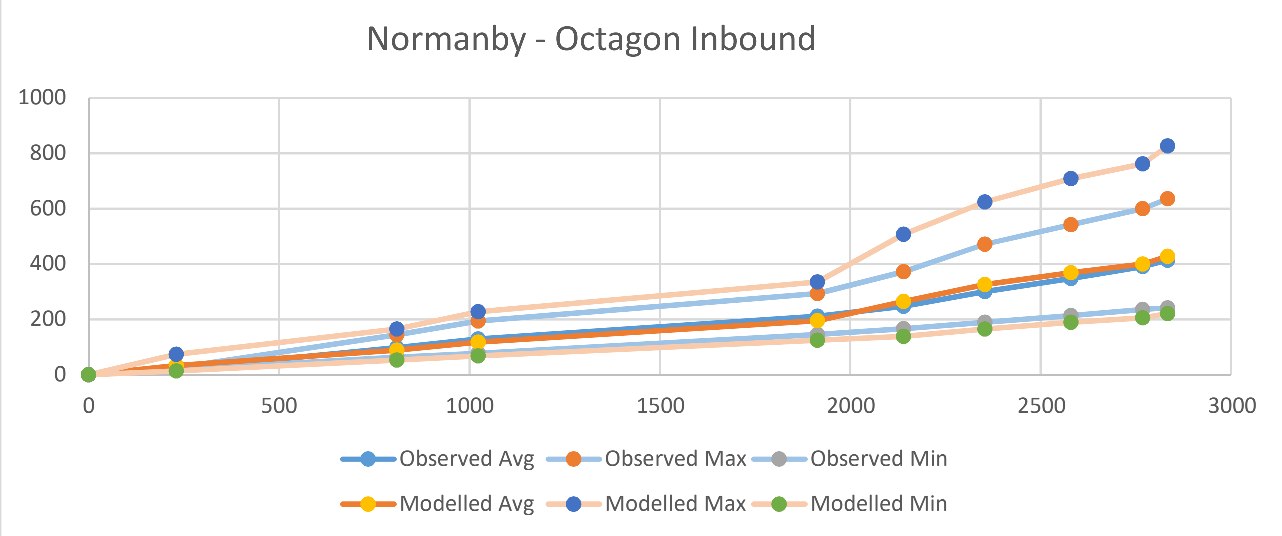


Figure D1.15 Route 3 - Interpeak inbound

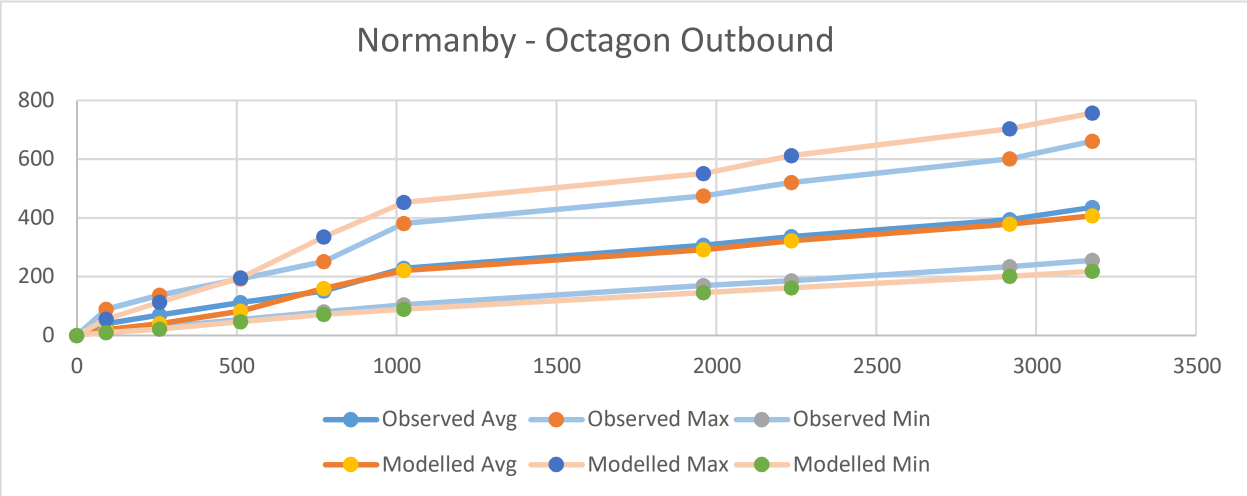


Figure D1.16 Route 3 - Interpeak outbound

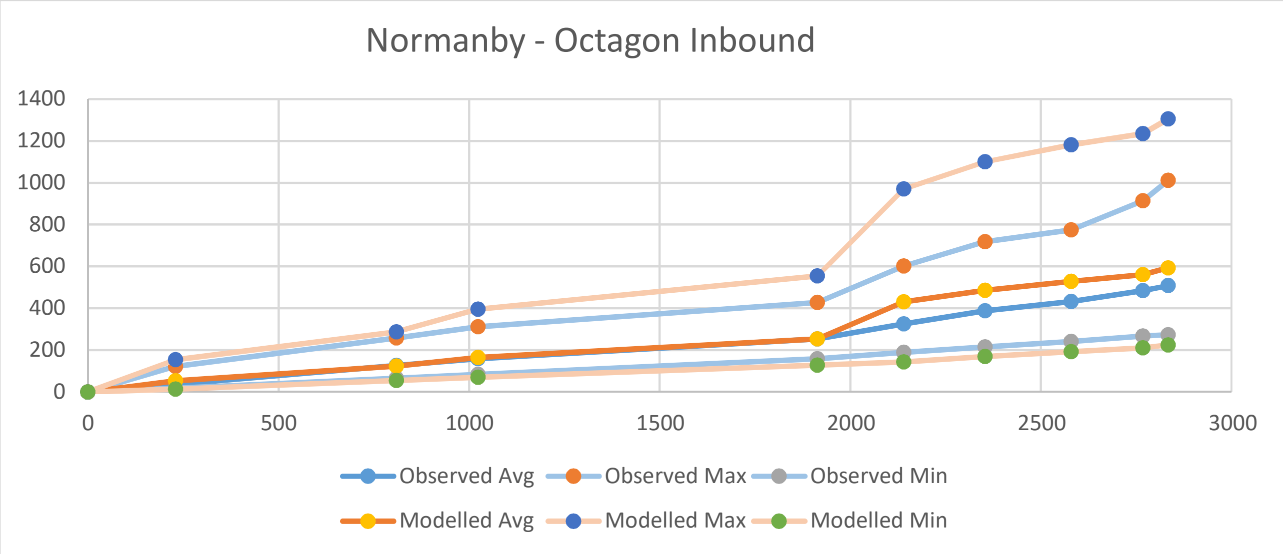


Figure D1.17 Route 3 - PM peak inbound

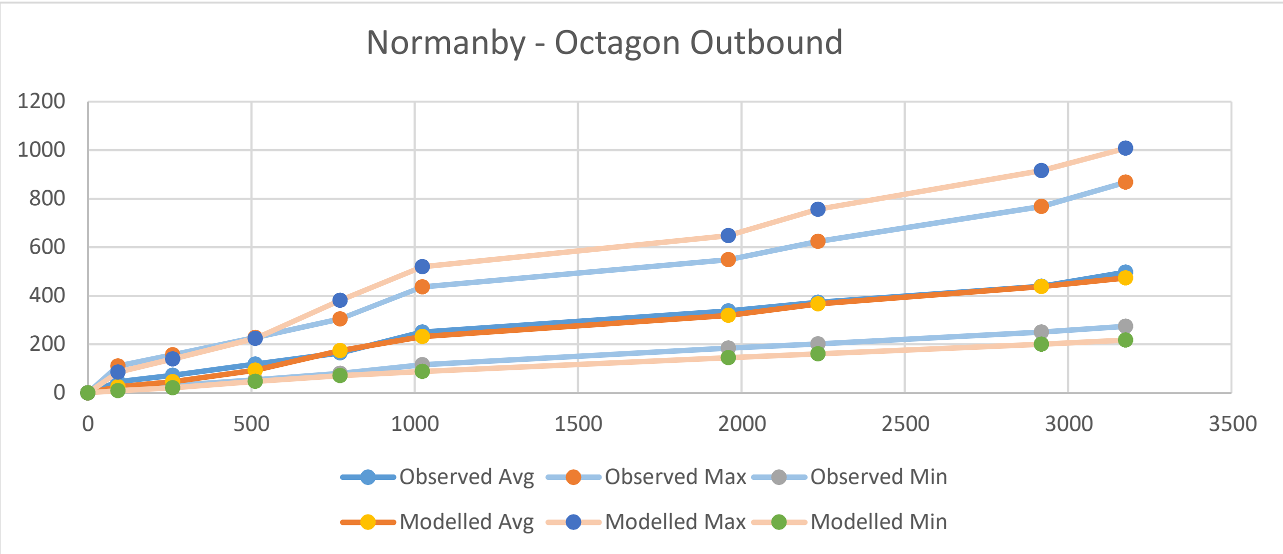


Figure D1.18 Route 3 - PM peak outbound

ROUTE 4 – TIME VS DISTANCE TRAVEL TIME COMPARISON GRAPHS

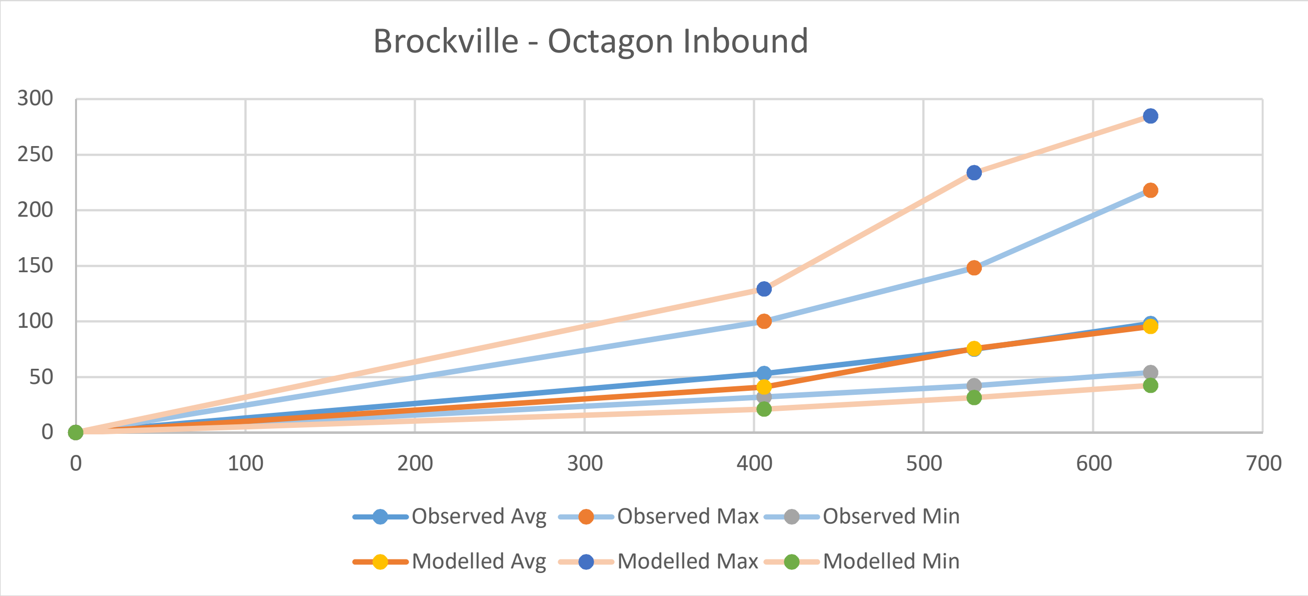


Figure D1.19 Route 4 - AM peak inbound

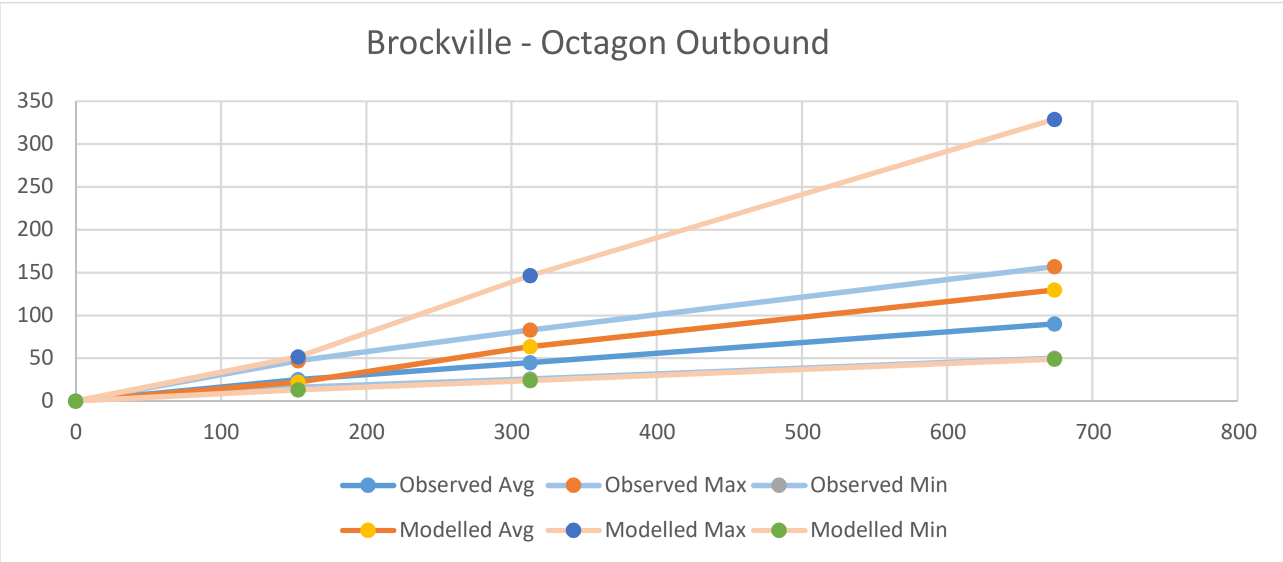


Figure D1.20 Route 4 - AM peak outbound

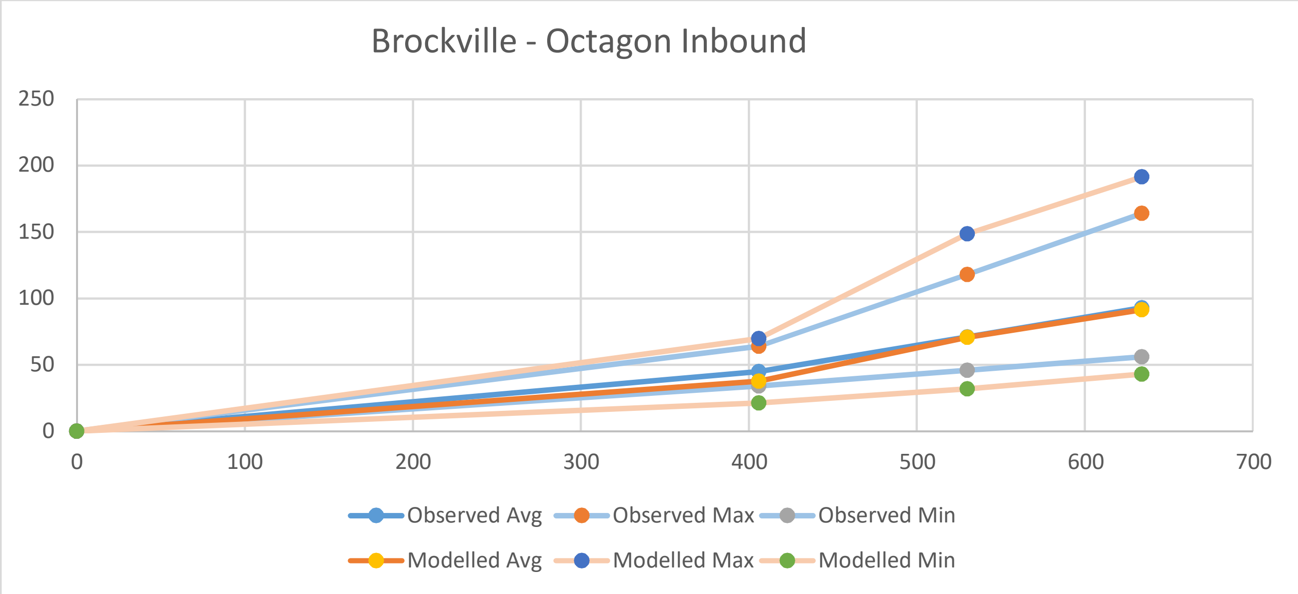


Figure D1.21 Route 4 - AM peak outbound

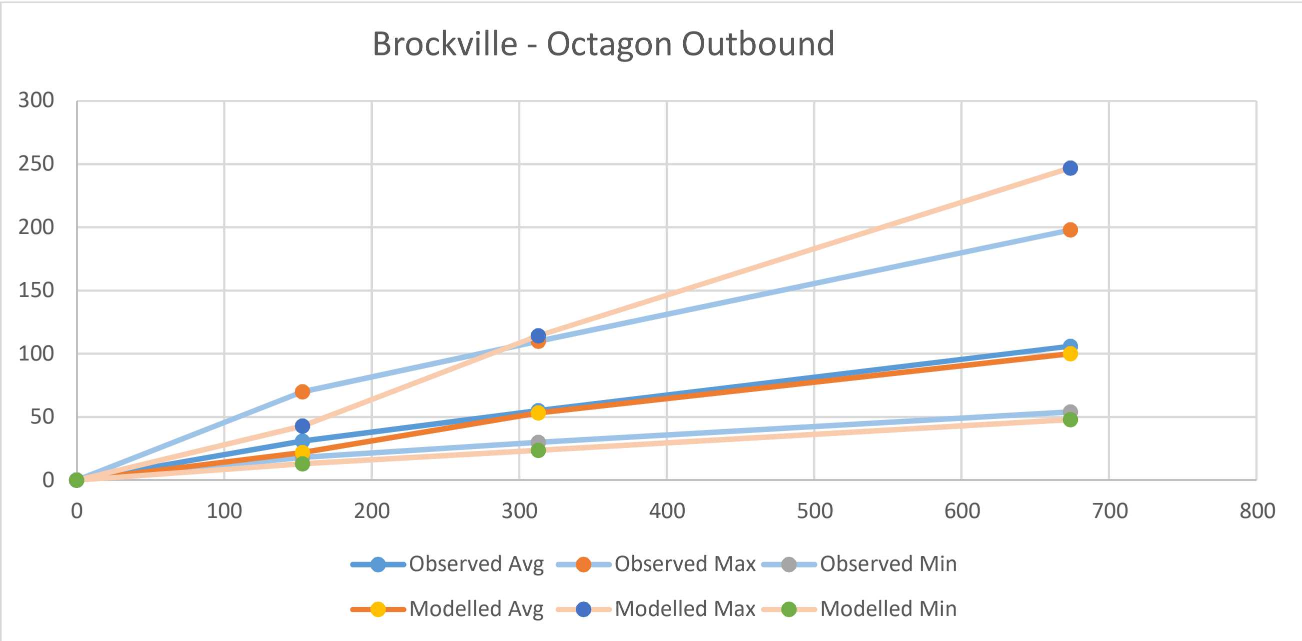


Figure D1.22 Route 4 - Interpeak outbound

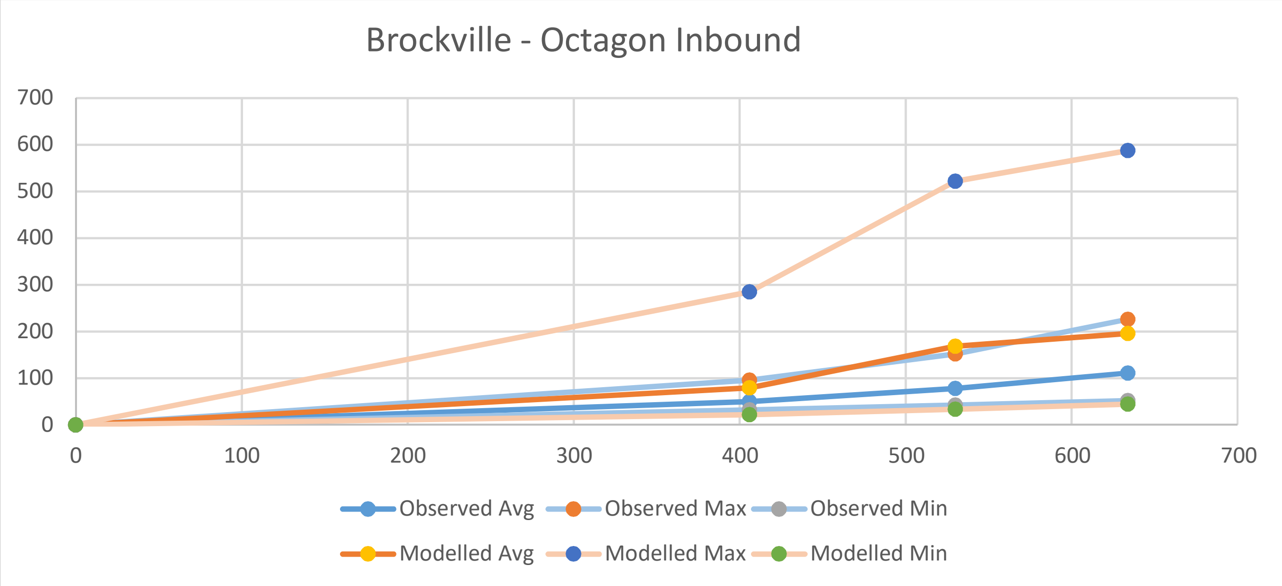


Figure D1.23 Route 4 - PM peak inbound

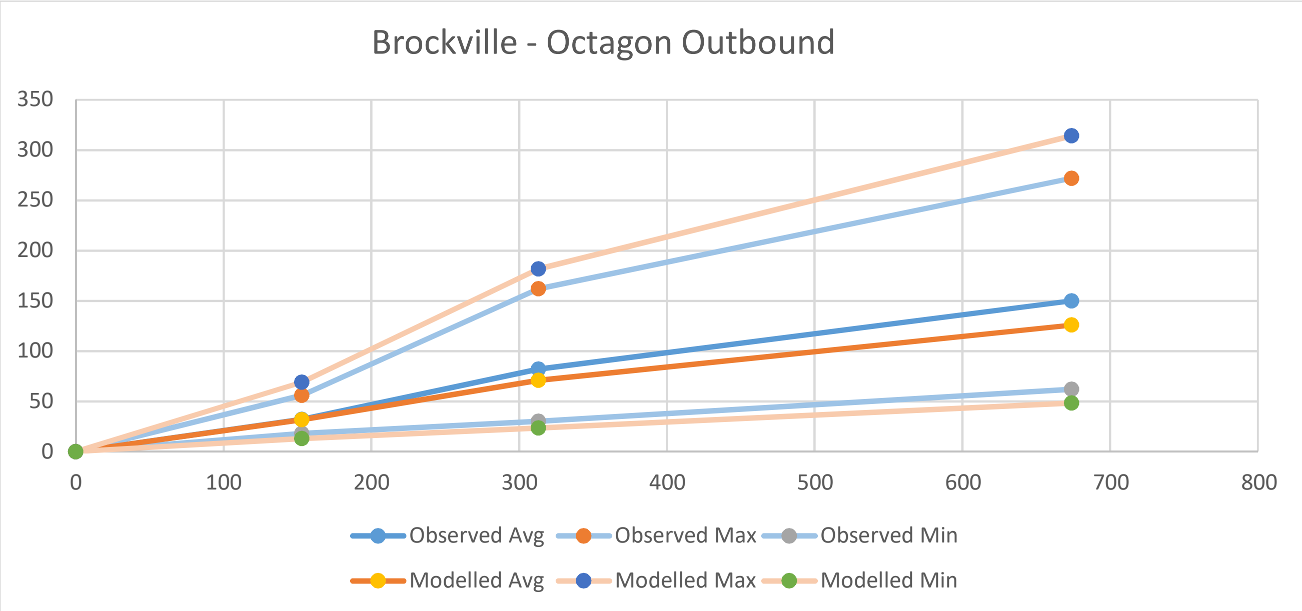


Figure D1.24 Route 4 - PM peak outbound

ROUTE 5 – TIME VS DISTANCE TRAVEL TIME COMPARISON GRAPHS

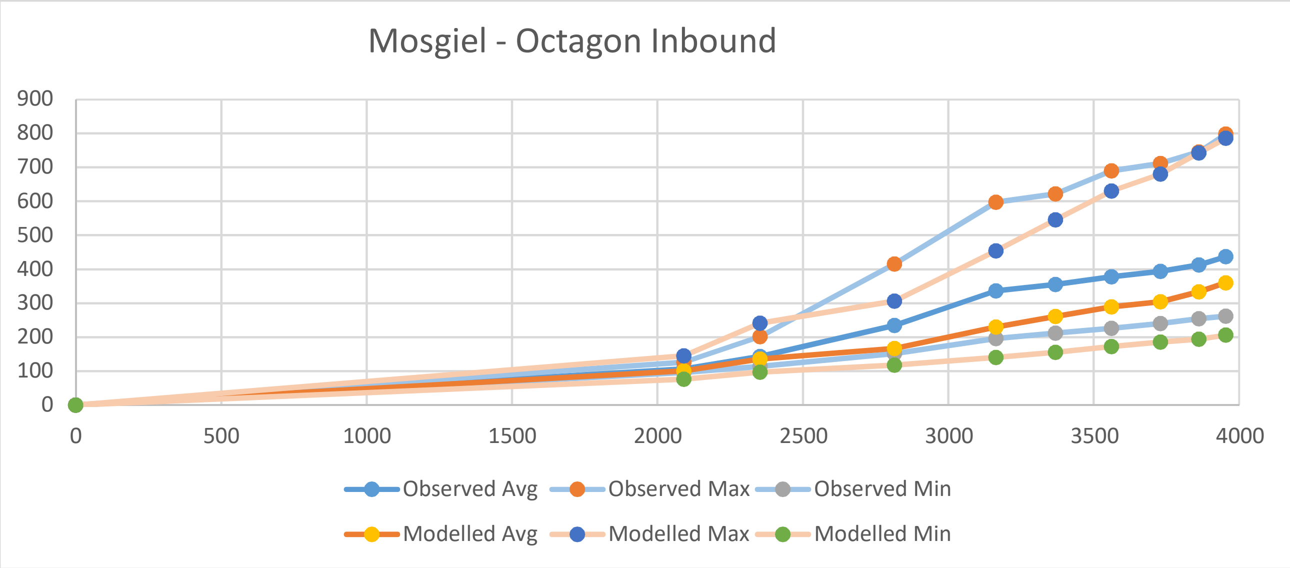


Figure D1.25 Route 5 - AM peak inbound

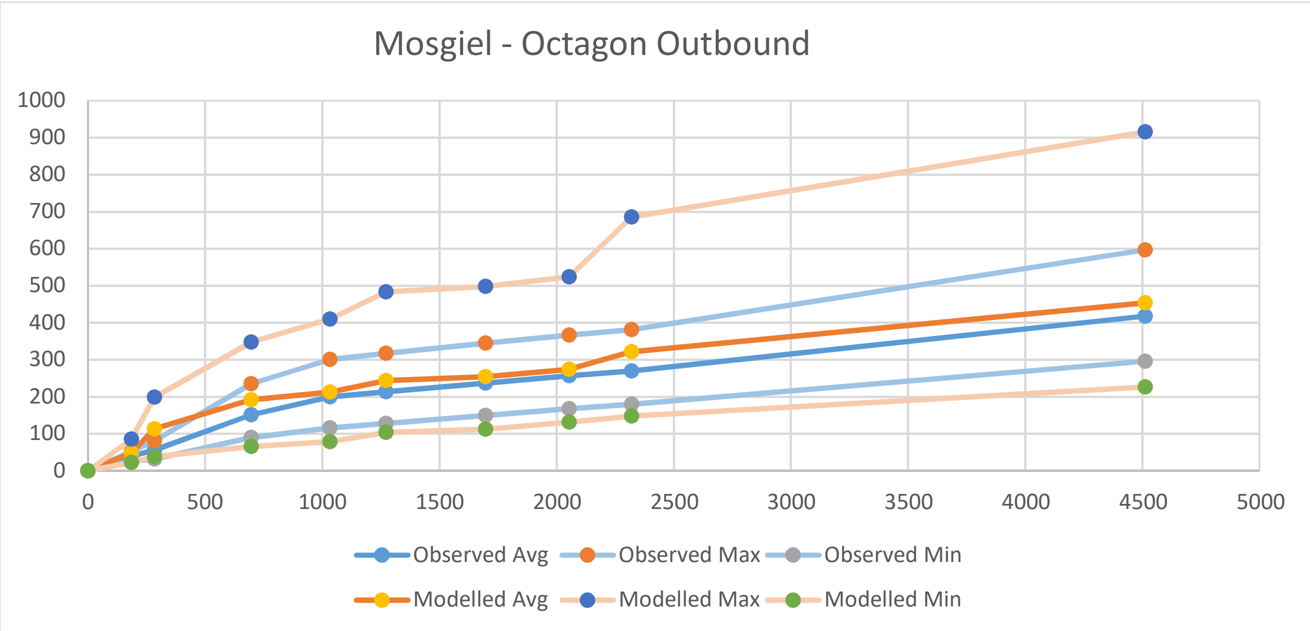


Figure D1.26 Route 5 - AM peak outbound

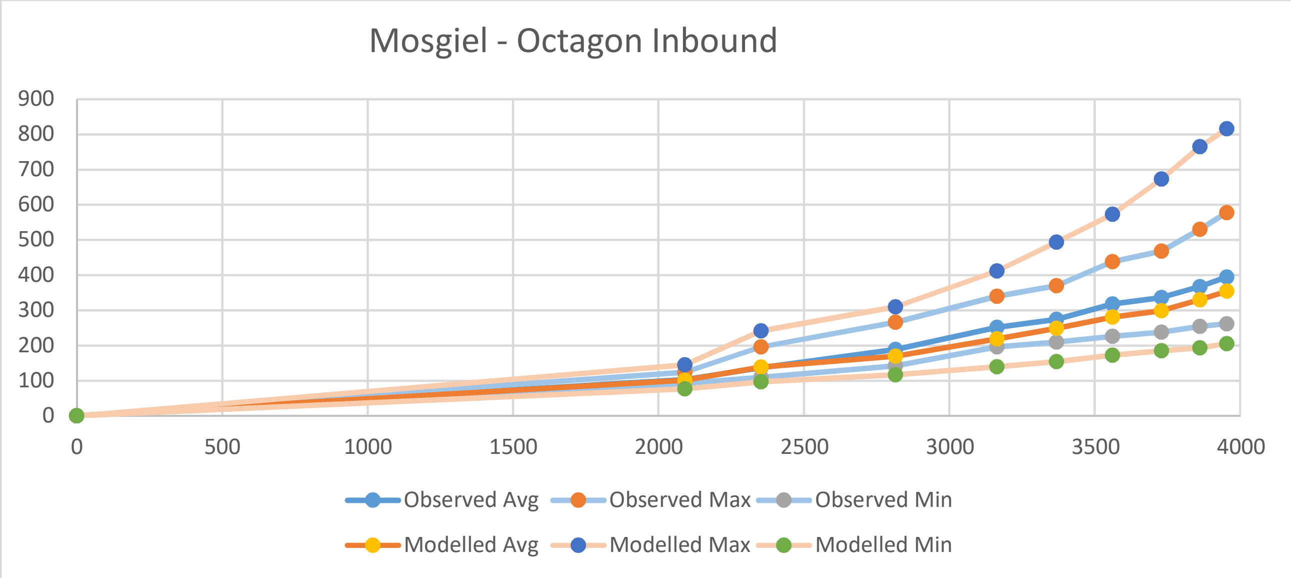


Figure D1.27 Route 5 - Interpeak inbound

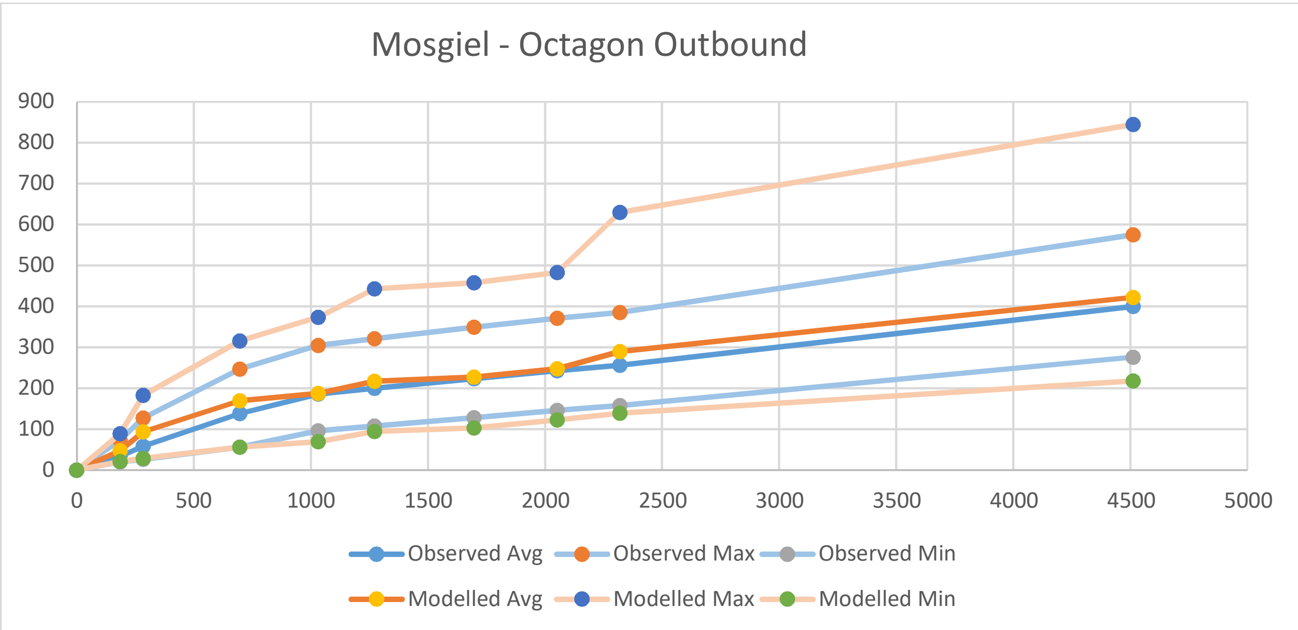


Figure D1.28 Route 5 - Interpeak outbound

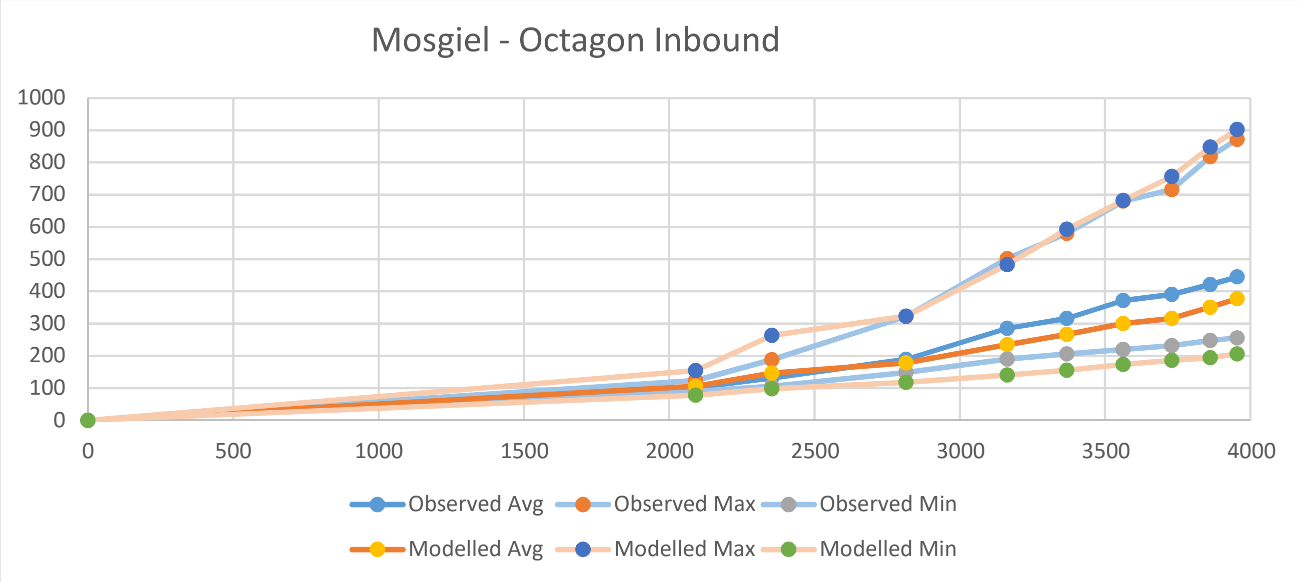


Figure D1.29 Route 5 – PM peak inbound

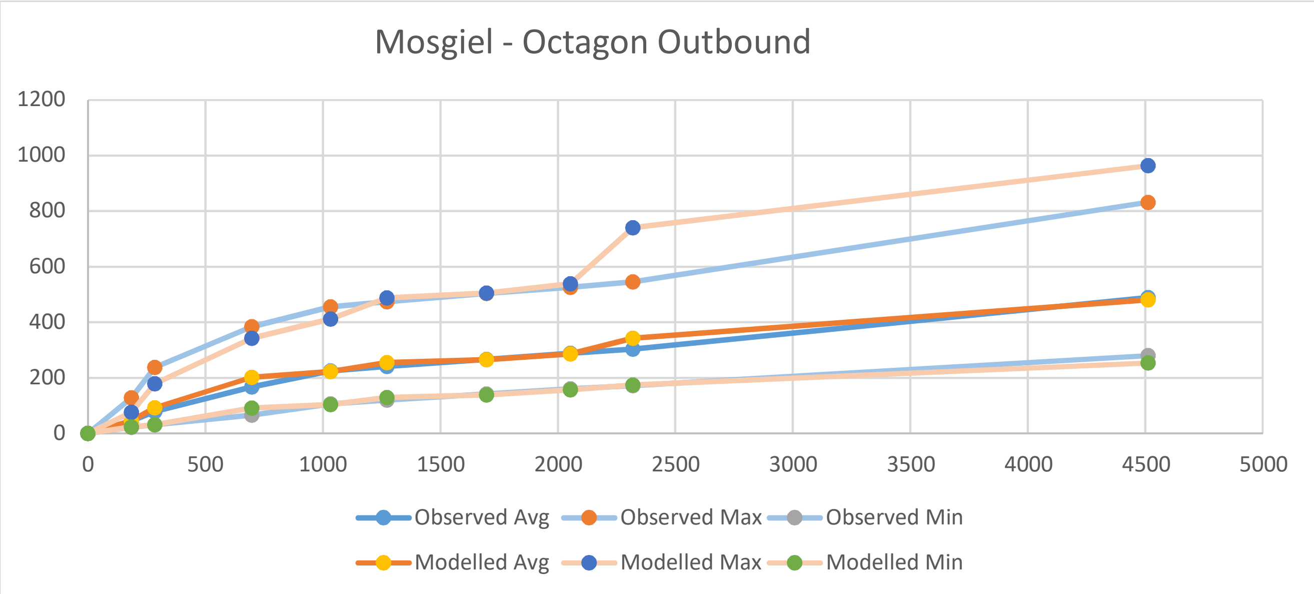


Figure D1.30 Route 5 – PM peak outbound

ROUTE 6 – TIME VS DISTANCE TRAVEL TIME COMPARISON GRAPHS

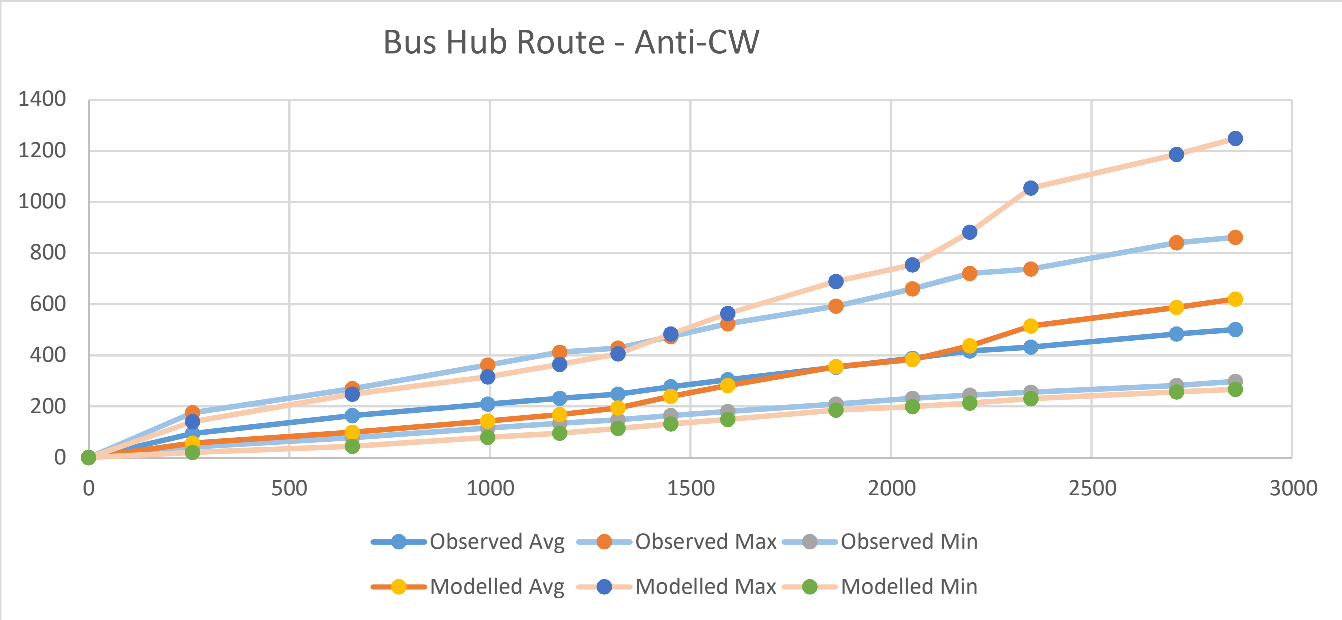


Figure D1.31 Route 6 - AM peak anticlockwise

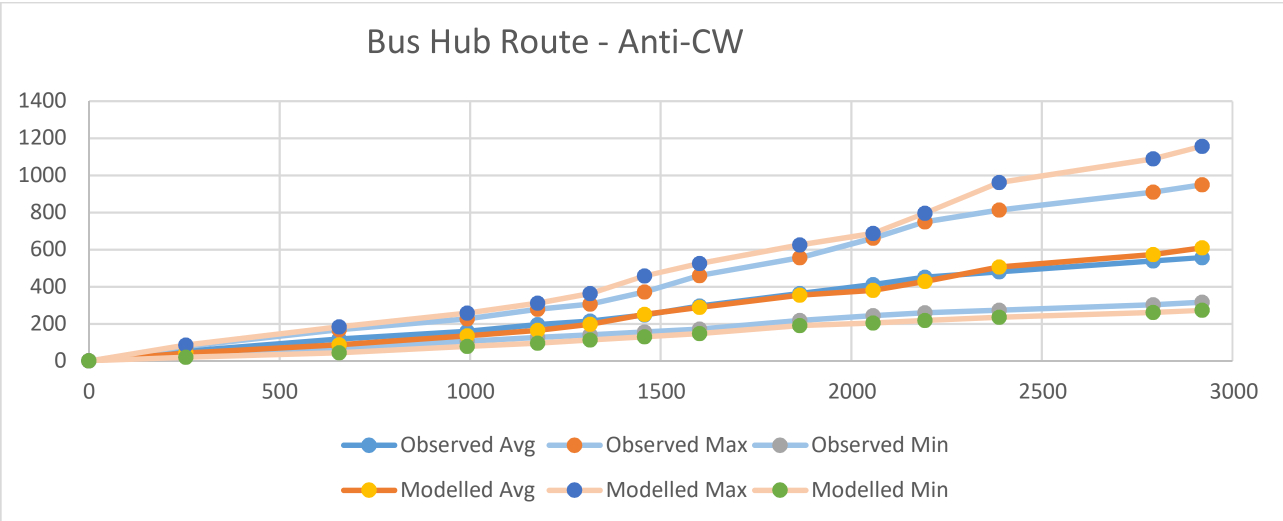


Figure D1.32 Route 6 - Interpeak anticlockwise

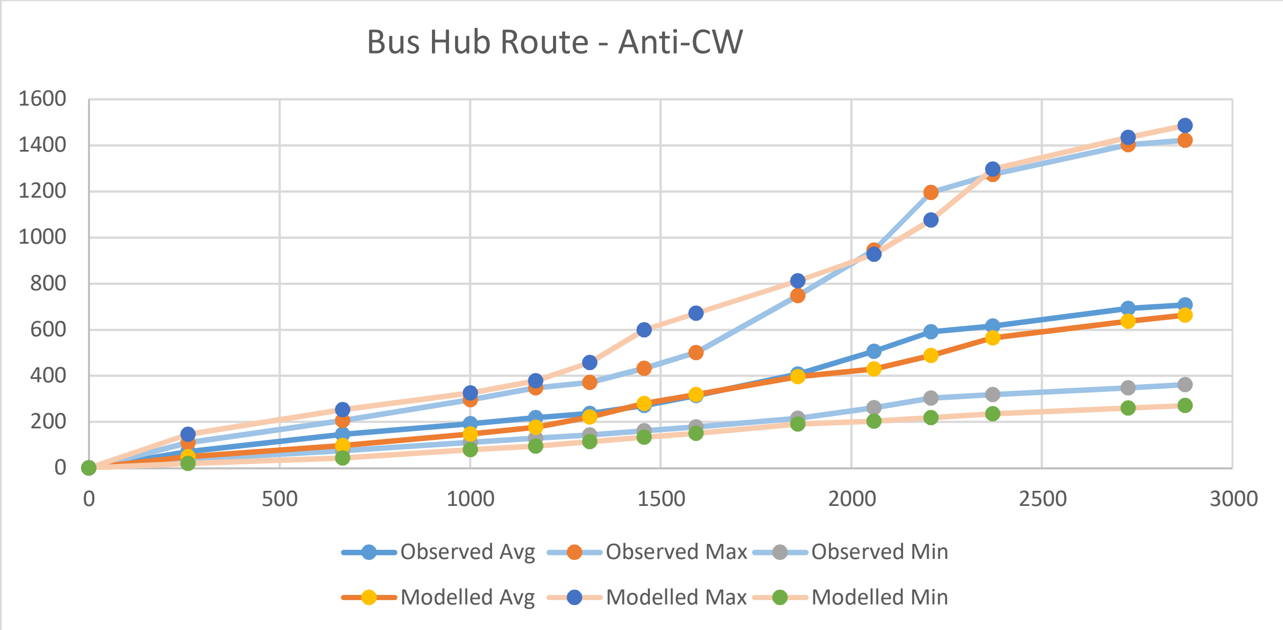


Figure D1.33 Route 6 - PM peak anticlockwise

APPENDIX E – PEER REVIEW RECORD

Gatenby, Matthew

From: Ian Clark <Ian@flownz.com>
Sent: Wednesday, 24 June 2020 15:42
To: Gatenby, Matthew; Qing Li
Cc: Chris Blackmore
Subject: RE: Dunedin Micro-sim model - Base Update (email 1 of 4)

Hi Matt

I am happy with the responses below, so I reckon you should continue to progress with Task 2.

I think the biggest issue raised by Qing was the fact that there are still some outliers (in terms of counts with high GEH values). But your response, that the model is now better than the original, is valid. Also, the difficulty in validating to adjacent inconsistent counts is a real issue that was also noted by Stantec when I made similar comments on the citywide validation (focussing on the CBD area).

I wonder if the next stage would be to forward the models to Hjarne. He has previously raised concerns about the extent of queueing in the model, so I guess he is the person we need to satisfy.

Ian

Ian Clark
Director
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www.flownz.com

From: Gatenby, Matthew [mailto:matthew.gatenby@wsp.com]
Sent: Monday, June 15, 2020 12:12 PM
To: Ian Clark <Ian@flownz.com>; Qing Li <Qing@flownz.com>
Cc: Chris Blackmore <chris.blackmore@abley.com>
Subject: RE: Dunedin Micro-sim model - Base Update (email 1 of 4)

Hi Ian/Qing

Sorry for the delay, struggling a bit with finding time last week. Our comments are in **red** below

Let me know if you have any other comments

Thanks

Matt

Matthew Gatenby
Principal Engineer Transportation

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From: Ian Clark <Ian@flownz.com>
Sent: Monday, 8 June 2020 14:08
To: Gatenby, Matthew <matthew.gatenby@wsp.com>
Subject: FW: Dunedin Micro-sim model - Base Update (email 1 of 4)

Hi Matt

See below – Qing has added comments in blue, under each of your headings.

Ian

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Director
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From: Gatenby, Matthew [mailto:matthew.gatenby@wsp.com]
Sent: Monday, May 25, 2020 9:26 PM
To: Ian Clark <Ian@flownz.com>
Cc: Chris Blackmore <chris.blackmore@abley.com>; Dave Smith <dave.smith@abley.com>
Subject: Dunedin Micro-sim model - Base Update (email 1 of 4)

Hi Ian

I attach the latest version of the 2017 model, which is now submitted for peer review. There will be **three** additional emails (due to file size):

- Email 2 – cal/val spreadsheets (zipped file of 4 files)
- Email 3 – demand change inventory (zipped file of 3 files)
- Email 4 – network change inventory (zipped file of 1 file)

The above spreadsheets contain more details on the changes made, and latest calibration/validation statistics. However, a brief summary of the key changes in the model (compared to the previous Stantec version) is provided below.

DEMAND (see email 3)

Some notes on the key changes are:

- Total demands reduced at zones with exceptionally high adjacent inter-related demands (Zones 84/87), reallocated to upstream zones to maintain volumes. An element of this specific issue at ABR/Strathallan for zone 84 (Warehouse) was due to calibration observed counts for SBRT and SBLT being transposed, so presumably this had been used in original matrix estimation – hence large volumes to/from Warehouse

Demand redistributed to residential areas, which seems reasonable.

- Amended portal/zone structure around Meridian Mall car parks

Portal seem to reflect carpark entries for the block, which is appropriate.

- Adjusted activity to strengthen tidal flow effects around E industial and wharf zones (reduce outbound in AM and inbound in PM peaks).

Adjustment criteria seem to be unclear. AM from trips have been adjusted to match the lowest from percentage while PM to trips have been adjusted to match the average. Have these been based on observations? How do the final results compare to regional model in/out splits? Should the resultant total trip gen checked against those of similar land use? Adjustment to promote the tidal flow required a stronger adjustment in the AM compared to the PM. The adjustments were using the modeller's judgement and then flows were factored using the Top 10 factoring to match overall directional traffic volumes in the E Ind / Wharf area.

- Balance traffic volumes across outer screenlines using select link analysis to target matrix adjustment factors for 3h total volumes. Focussed on demands near model boundaries.

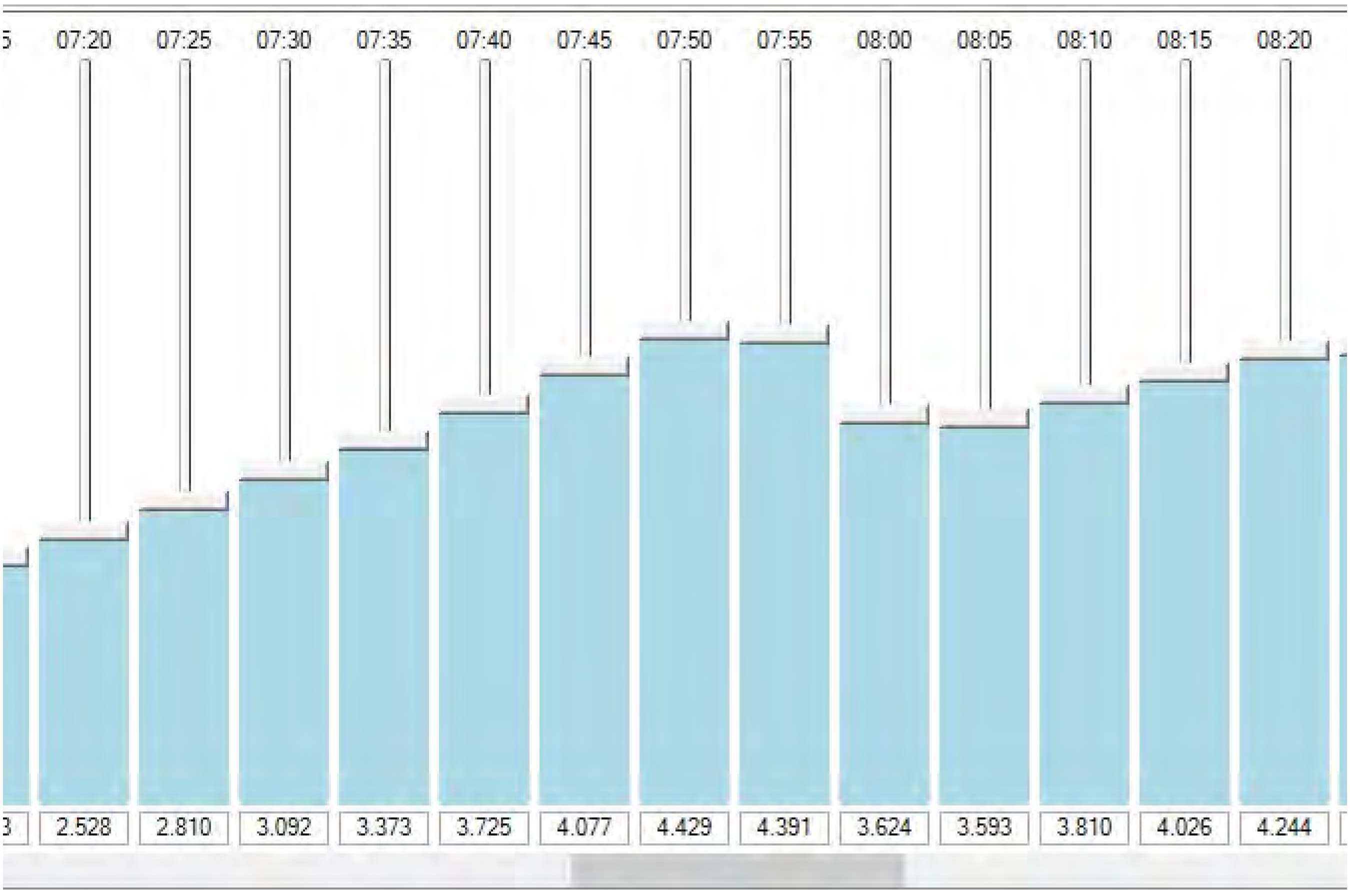
Screenline adjustments based on observed volumes, which seems appropriate. Some of the adjustments/differences are very high (e.g. 840 trips added to Portsmouth Dr NB in PM), which may indicate that it would also be worth checking the profiles (if these counts were used to help generate profiles)? Screenline counts are all independent of profile calibration turning counts.

- Shape traffic flows around key intersections and corridors using Turn Calibration counts and select link analysis to target matrix adjustment factors for 3h total volumes. Focussed on one way pairs, ABR, Jetty and Rattray areas, Southern Motorway and Thomas Burns St

It is indicated below that the overall calibration is similar to previous demands, is it because the adjustments have only been focused on the Top 10 differences, or these adjustments have made the GEH values at other locations slightly worse? A combination of focussing adjustments towards key movements, targeting the Top 10 differences, and network updates affecting flows that had been factored by matrix estimation in the original model development process. It should be noted that while the most obvious of these have been adjusted as part of the specific changes, the previous matrix estimation process is unable to be undone and will affect most zone pairs to some degree. A significant improvement in the calibration would only be possible by re-starting matrix estimation from scratch **and** re-balancing all the count data to a neutral month, something we did not scope (and would have had no guarantee this would improve things). It also may have impacted on the relationship between Cube and Paramics trips patterns, which we also wanted to avoid if possible

- Profiles adjusted by hour using the total turning movements across all intersections in the Turning Calibration sheet. A number of profiles in the original models were allocated to incorrect zones (especially IP) and these were also corrected.

The adjustments seem appropriate. We note however there is a sharp drop in the AM General-Light trips profile between 8.00 and 8.20 (as shown below). This may suggest that the profile was generated using traffic counts obtained at congested intersections, and it may need to be corrected to reflect a more realistic vehicle releasing pattern. Profile adjustments were focussed on correcting most significant outliers (mostly IB tidal routes in the AM and OB in the PM), the overall volume of traffic in each hour was then calibrated by factoring using the total turning movements. This tended to increase traffic loading earlier in the peak and reduce traffic loading later in the peak, the increase in the period just prior to 08:00 is an impact of this factoring rather than an indicator of the profile being derived from congested counts.



- Looped adjustments to worst performing movements using more guided select link analysis to shape demands further and identify rat running and network performance issues

Looks appropriate.

The general result is that the total demand is relatively unchanged from previous, but profiles tightened to result in sharper (shorter) absolute peaks, and obvious outliers (against reality) have been amended. Many profiles, especially on external links, were directly related to/calculated from additional count data (provided by DCC, for 2017)

NETWORK (see email 4)

A whole raft of changes were applied, main ones are:

- Offsets applied to model (non were previously entered) for SH1 (one-way pairs), ABR and Portsmouth Drive – this also involved minor changes to cycle times and phase lengths in places to ensure consistency within each mini-network. Timings were adapted from the original signal data (provided by Stantec). Looks good.
- Lanes removed in several locations (where lanes in the original model did not exist on-street) OK
- Turning allocations amended in several location (where lane allocations in the original model did not match the marked lane allocations and/or how lanes were used in practice) OK
- Signal timings were amended at a few locations where the phase order had been incorrectly coded, or other phase errors were coded OK

- Pedestrian protection timings also introduced and/or extended to better reflect delays to left and right turning traffic, either due to late start of red arrow signals and/or heavy pedestrian crossing volumes at particular sites. Delays/Late starts of 4 or 8 seconds have been applied in the model. Could the modeller provide more details on what assumptions have been used to estimate these delays? We have generally applied a two-step process for late start of turns (for pedestrian protection). Firstly, at sites where left/right turn signal delay is applied to traffic where a conflicting pedestrian signal group is activated (but where ped volumes are considered low), a 4 second delay is applied. This also takes into account the issue that left/right turn red arrows do not appear when the pedestrian signal group is not requested/activated. Secondly, at sites where pedestrian volumes are more significant (generally in the city centre shopping core), and therefore left/right turns can be delayed by yielding to pedestrian volumes themselves (both with or without a red arrow signal), a longer 8 second delay was inserted. Clearly both these applications are somewhat subjective, but are our best judgement at incorporating lost time into left/right turn movements due to pedestrian conflicts.
- All-red periods generally extended to better reflect actual signal timings (most were set at zero in the previous model) OK
- Stopline positions amended to better reflect on-street behaviour OK
- Link speeds – corrected in a number of locations, and Minor Level 2 and 3 categories reduced to 40kph (from 50kph). Minor Level 1 also reduced to 40kph (from 50kph) in city centre to reflect higher. SH1 Southern Motorway increased to 80kph (from 50kph) Speed reduced to reflect higher side road friction? Correct, mostly due to turns in/out of on-street kerbside spaces and individual accesses that aren't explicitly included in the model
- Other adjustment of some link categories from major to minor (or vice versa) to better reflect the actual usage of the road OK
- Many visibility parameters removed/reduced/changed to better reflect behaviour OK
- Next lanes and adherence parameters added where required to better model behaviour at intersections OK

The general result is that the model contains a lot more "friction" in the network than previously (particularly due to ped protection, lower link speeds, and removal of spurious lanes). This is with the exception of the SH1 one-way pairs which improved in terms of operation due to the signal offsets being applied ("green wave") – and this required some rebalancing with other parameters to ensure that volumes were matched against observed (i.e. equilibrium between competing corridors matches observed).

FLOW CALIBRATION (see email 2)

A few minor errors in the spreadsheets were corrected (duplication of turns, swapping of LT/RT volumes). But it should be also noted that the original work (by Stantec) did not re-balance any observed counts on the basis of seasonality – and in a few cases there are large discrepancies between counts at adjacent sites (so therefore difficult to calibrate well against both without introducing spurious movements in/out of intermediate zones).

In summary, the overall calibration is similar to previous, but we have concentrated on improving the level of calibration on a) higher volumes (i.e. the most significant volumes) and b) areas of the model that are considered more critical (SH1, Portsmouth Drive, Western Route, ABR, city centre)
This may have already been discussed in the original validation but some high GEH values are still reported for AM and PM screenlines (some are as high as 21). It was an issue in the original validation too. Although the total screenline comparison is still quite poor, we have improved the comparison of the individual links that make up the screenline (i.e. we've tried to improve the specifics rather than the total). It should also be noted that in a few locations, the observed link counts on the screenline are very different to adjacent observed turning counts (and vice versa) so it was very difficult/impossible to fit both (without "neutralising" all the original counts data, some of which we don't have the raw data for). We have generally tried to match turning counts as a higher level of importance than link/screenline counts given the purpose of the model to be more detailed in terms of intersection operation.

TRAVEL TIMES (see email 2)

As previously discussed we have had a few misgivings about the quality of the observed data (and/or the interpretation of the data) in the original validation – essentially round the issue of double counting link travel times at the start of each section. Reluctantly – due to time constraints, inability to collect data on current conditions as a proxy (due to COVID), and lack of ability to go back in time(!) – we have had to accept the original observed data as the validation set. Travel time validation is generally good, and in most cases, model travel times are longer than observed (which errs on the side of being conservative). There are a few individual travel time sections that have "odd" observed times, and this is commented on in the spreadsheets.

In summary, travel times in the model look reasonable (it's difficult to compare with the original validation due to the combination of "no offsets" and "over supply of capacity", which cancel each other out of some routes but not others). As above, we have applied a number of measures within the model to slow the network operation down to more realistic performance.

Comments on JT routes fall outside of 15%/1 min criteria look reasonable.

Please let me know if you have any questions on the above (and attachments)

Thanks

Matt

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From: Gatenby, Matthew
Sent: Tuesday, 12 May 2020 13:01
To: Ian Clark <Ian@flownz.com>; Wilmshurst, Bevan <bevan.wilmshurst@stantec.com>
Cc: Chris Blackmore <chris.blackmore@abley.com>
Subject: RE: Dunedin Micro-sim model - travel times

Hi Ian

Yes, should be all good for end of this week. They may be subject to some small tweaks thereafter, but we would hope only minor changes (if any).

Thanks

Matt

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Appendix C

Movement and Place Assessment

Appendix C Movement and Place Assessment

02-Jul-2021

Table of Contents

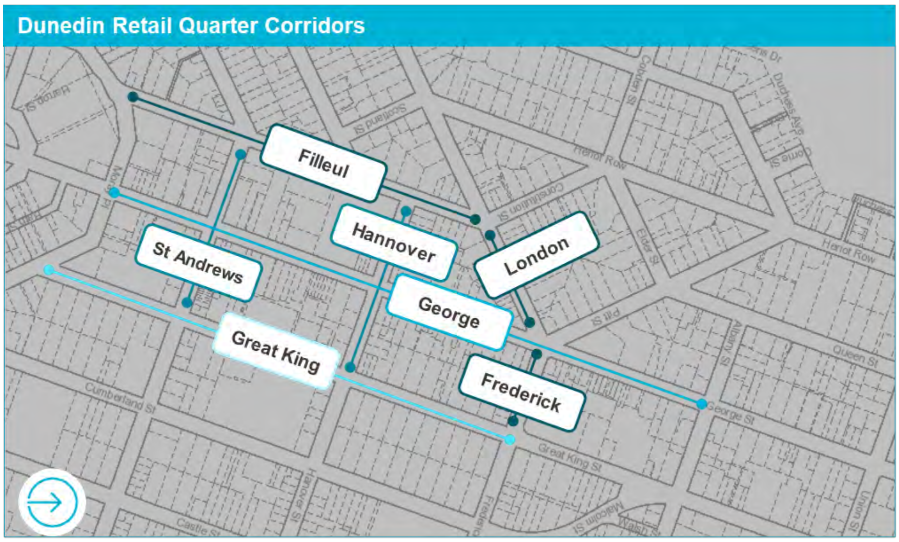
1.0 Introduction

This document details the Movement and Place assessment undertaken for the Retail Quarter Detailed Business Case.

This assessment followed the guidance of the Waka Kotahi One Network Framework (ONF), which is a new national standard released in 2021.

This supersedes the previous One Network Road Classification, which exclusively categorised roads according to their movement purpose. In comparison, the ONF considers how the surrounding land-use, or ‘place’, interacts with the movement occurring along the corridor. Due to the infancy of this approach, aspects are still under development as practitioners begin to test and implement the framework. Consequently, this project utilised the information that was available at the time.

This appendix summarises the guidance followed, and details the reasoning and metrics behind the classifications given to each corridor within the Retail Quarter, which is shown in Figure 1.



Road Name
George Street
Great King Street
Filleul Street
London Street
Frederick Street
Saint Andrew Street
Hanover Street

Figure 1 Dunedin Retail Quarter

2.0 Movement and Place assessment

The Movement and Place assessment takes into account the role the transport network plays as part of the public realm and the effect on adjacent land-use.

In practice, the ONF framework establishes the existing and intended function of a transport corridor, to help plan for levels of service and investment based on future aspirations for the corridor within the wider network, spatial and planning strategies.

This process is used to assess the current conditions of the existing corridor and can be used to indicate the desired future function by identifying gaps along the corridor itself and within the wider network to guide investment decision making.

The road corridors will be assessed and given a place function value and movement function value. Based on the place and movement function assessment, the combined place/movement matrix for urban roads (Figure 2) identifies the applicable ‘street category’ which classifies the general expectations of how the corridor functions.

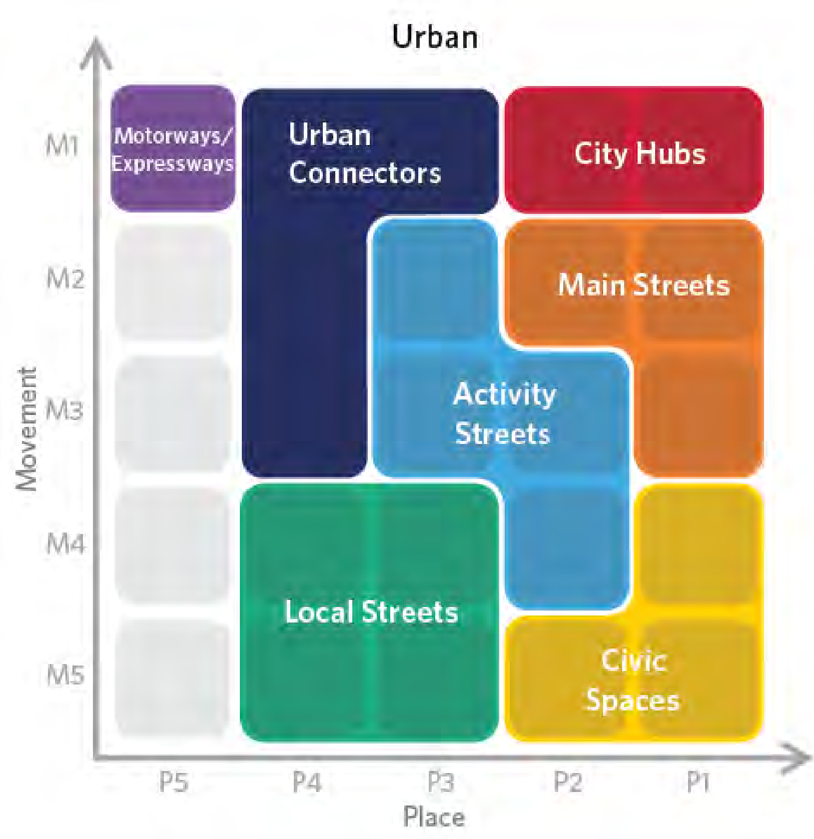


Figure 2 ONF Urban Movement and Place Matrix

2.1 Movement Function

The Movement function relates to the strategic importance of the network for moving people and goods. This accounts for all modes and looks at the scale of movement the corridor is intended to accommodate.

In accordance with the ONF, the classification of overall movement should achieve the following outcomes:

- Reflect the strategic significance of the network in terms of both the volume of movement, and the strategic importance of inter-regional connections
- Recognise the contribution to movement from all modes of transport, particularly public transport in urban areas.
- Focus on the total movement of people and goods along the network, not simply the number of vehicles using the roadway.
- Feel right when the movement and place classification combine into a street category

The expectations and general metrics defining the different movement functions are detailed in the Table 1 below.

Table 1 ONF Movement Function metrics

Movement Definition	Description	Scale of People Movement
M1 City centre	Mass movement of people and/or goods on routes of national-level movement function.	Typically >20,000 per day
M2 Town/ Sub-centre	Significant movement of people and/or goods on inter-regional routes or primary corridors linking main centres	10,000 – 25,000 per day
M3 Neighbourhood centre stopping places	Moderate movement of people and/or goods and on routes connecting suburbs/districts	3,000-12,000 per day
M4 Local	Movement of people and/or goods within a neighbourhood	300-4000 per day
M5 Limited	Local movement	Typically < 500 per day

2.2 Place Function

The place function reflects where activities are located along a corridor, where people dwell on the street, and how this influences how they travel along / across it. This is mostly applicable to urban environments, where streets contribute an important 'living' space in day-to-day life, e.g. main shopping streets.

When determining the Place function, the ONF explains the classification should achieve the following:

- Reflect the intended land use of the specific location
- Relate to the on-street activity generated by the adjacent land use
- Be informed by the density of activity occurring 'off-street'.
- Recognise the significance of the catchment from which the location attracts visitors, or the importance to the surrounding community

A brief summary of the different place functions is shown in Figure 3 with more detailed rationale and metrics explained in Table 2 below.

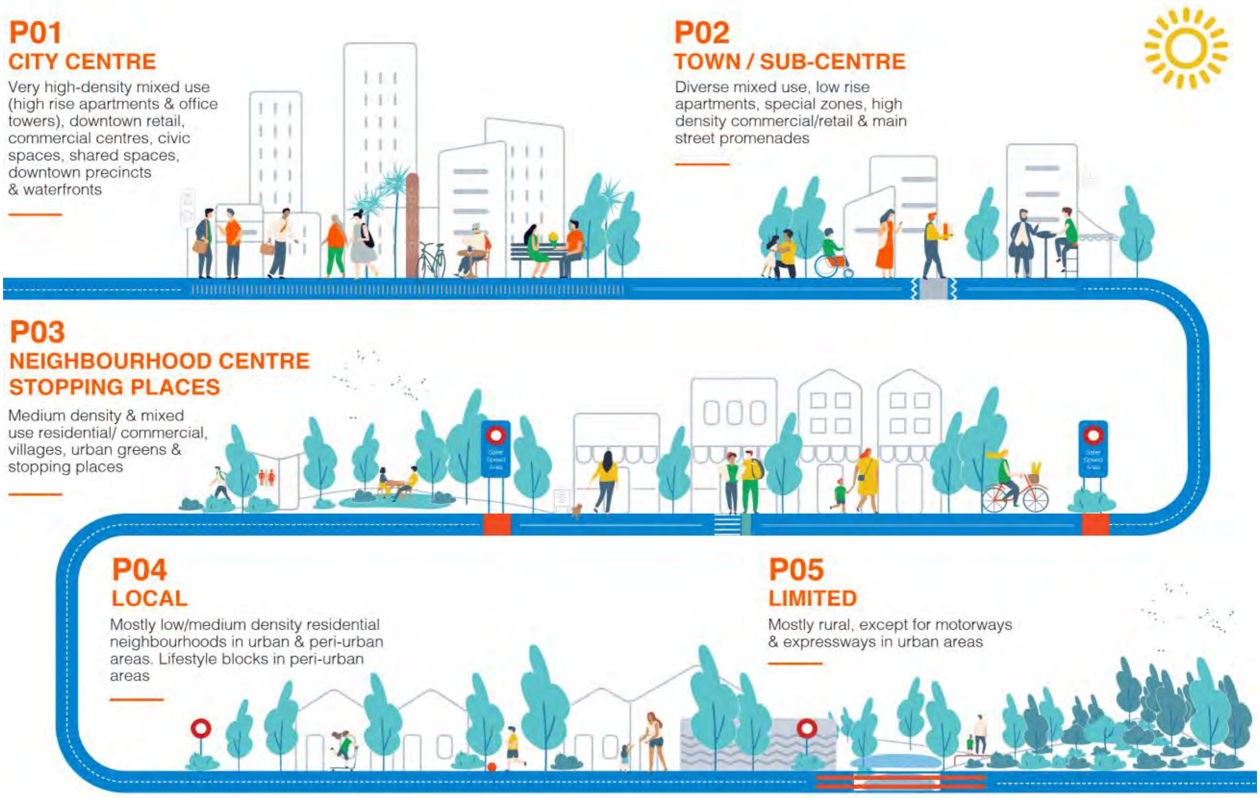


Figure 3 ONF Place Functions

Table 2 ONF Place Function metrics

Place Definition	Spatial Significance			Activity		Physical Form	
	Description	Metric: Activity generating facilities	Metric: Intensity of use / people dwelling	Description	Metric: Pedestrian Volume	Description	Metric: Land-use zone classification (density and built form)
P01 City centre	Location / destination that provides social, economic and cultural significance at a city scale	**City Centre Significant Locations:** CBD, Metro Stations, Events Arenas/ Stadiums, University, Waterfronts	> 4 Person hours/m2/ day (7am to 5pm)	Places where the highest human activity occurs. Large numbers of people live, work and visit.	**Aligned to W1** > 1000 /hour (peak) > 5,000 /day	High-density mixed use (high-rise apartments and offices), downtown retail, commercial centres, civic spaces, and waterfronts.	City Centre zone or Special purpose zones (e.g. Tertiary education zone)
P02 Town / Sub-centre	Location/destination provides social, economic and cultural significance at a town/subcentre scale	**City/District Significant Locations:** E.g. Main Shopping Centres, Transport Interchanges Secondary Schools	> 2 Person hours/m2/ day (7am to 5pm)	Centres where people work, shop and visit. In growing urban areas, where more and more people live. Town main streets and places with significant meaning.	**Aligned to W1,W2** > 2,500 /day	Diverse mixed use, low-rise apartments, special zones, high-density commercial/retail and main street promenades.	Metropolitan Centre, High Density Residential Zone, Commercial zone
P03 Neighbourhood centre	Location/destination provides social, economic and cultural significance at a neighbourhood scale	**Neighbourhood Significant Locations:** Suburban Shopping Centres, Suburban Metro Stations, Primary Schools, Sport Club Grounds, Local parks	> 1 Person hours/m2/day (7am to 5pm)	Local centres where people shop and visit and live nearby. Community facilities and points of interest in rural settings that generate human activity on the road or street.	**Aligned to W2** > 500 /day	Medium-density and mixed-use residential/commercial, villages, urban greens and stopping places.	Medium Density Residential zone, Neighbourhood Centre, Local Centre zone, Mixed use zone, Town Centre zone, Light Industrial zone General Industrial zone, Open space zone, Sport/Active Recreation zone
P04 Local	Location has local area significance.	**Suburban Residences**	< 1 Person hours/m2/day (7am to 5pm)	Places where people live and play. Primarily residential or peri-urban in nature.	**Aligned to W3** < 500 /day	Mostly low/medium density residential neighbourhoods in urban and peri-urban areas. Lifestyle blocks in peri-urban areas.	Large Lot Residential zone, Low Density Residential zone, General Residential Zone Rural zones (lifestyle zones)
P05 Limited	Local area has significance in the rural context, but does not contribute to street activity	**Rural Environment**	Effectively Nil	Little discernible on-street activity.	Limited pedestrian movement, Walking may be prohibited along corridor	Mostly rural, except for motorways and expressways in urban areas.	General Rural zone, Rural Production Zone

3.0 Methodology

Figure 4 outlines the methodology followed when undertaking this assessment. Based on the metrics required and outlined in Table 1 and Table 2, several sources were used to inform the movement and place assessment and classifications of the existing environment. The sources include:

- **Movement** - the Movement assessment is based on the overall people movement along a corridor, which has been informed by the following:
  - Vehicle counts (RAMM)
  - Bus Routes / Network (Orbus),
  - Cycle and Pedestrian counts and networks (MioVision)
  - Freight connections and OD routes
- **Place** – A qualitative assessment of the surrounding land use, informed by:
  - DCC GIS maps
  - DCC 2GP District Plan Zoning Maps
  - Google Maps to ascertain land-use patterns
  - Pedestrian Counts (which is in accordance with ONF Place metrics)

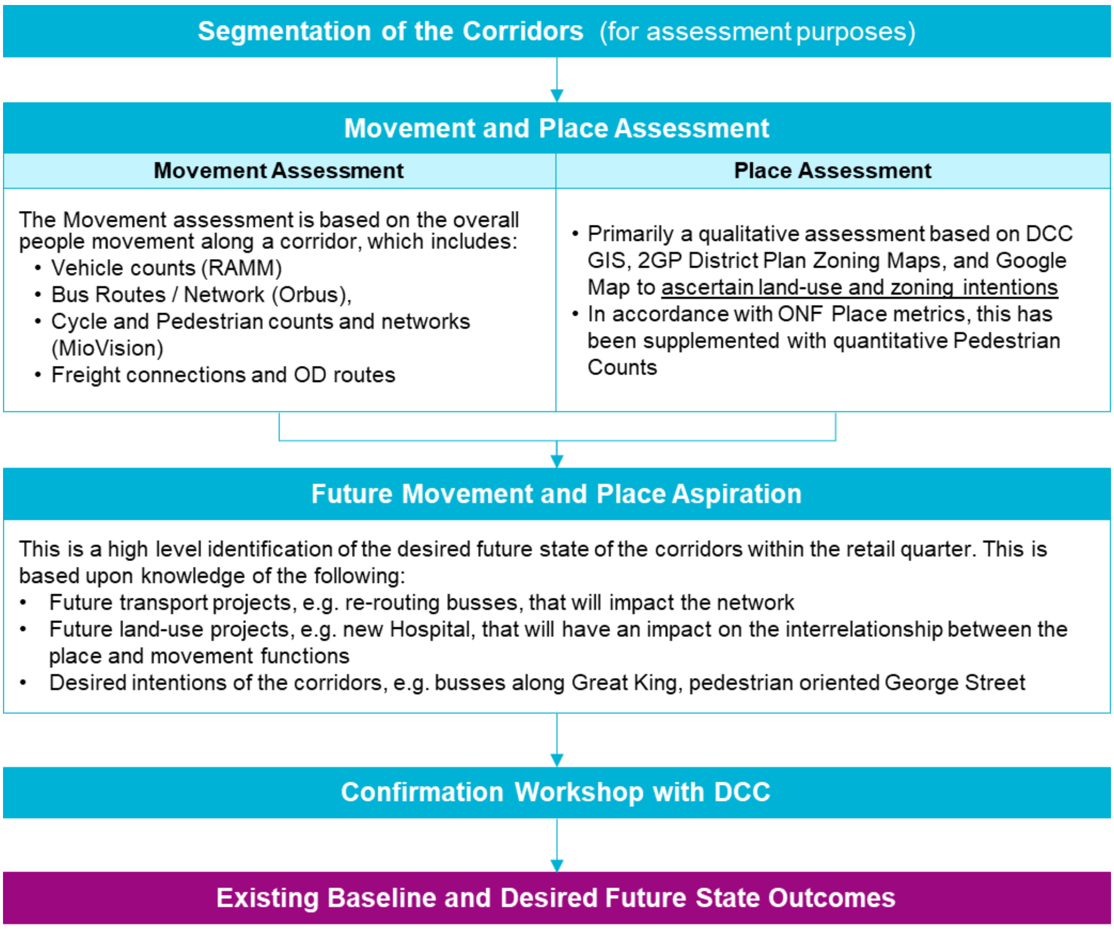


Figure 4 Methodology used for this assessment

4.0 Retail Quarter assessment of the existing environment

Figure 5 summarises the assessment results and the applicable 'street family' (see the place/movement matrix for urban roads) for the road corridors within the retail quarter. Some of these corridors have been split into multiple sections, as both the place and movement function can vary along a corridor, resulting in multiple classifications.

This assessment of the existing conditions establishes a baseline to be used when considering the future aspirations for the corridors, which will be discussed in section 5.0.

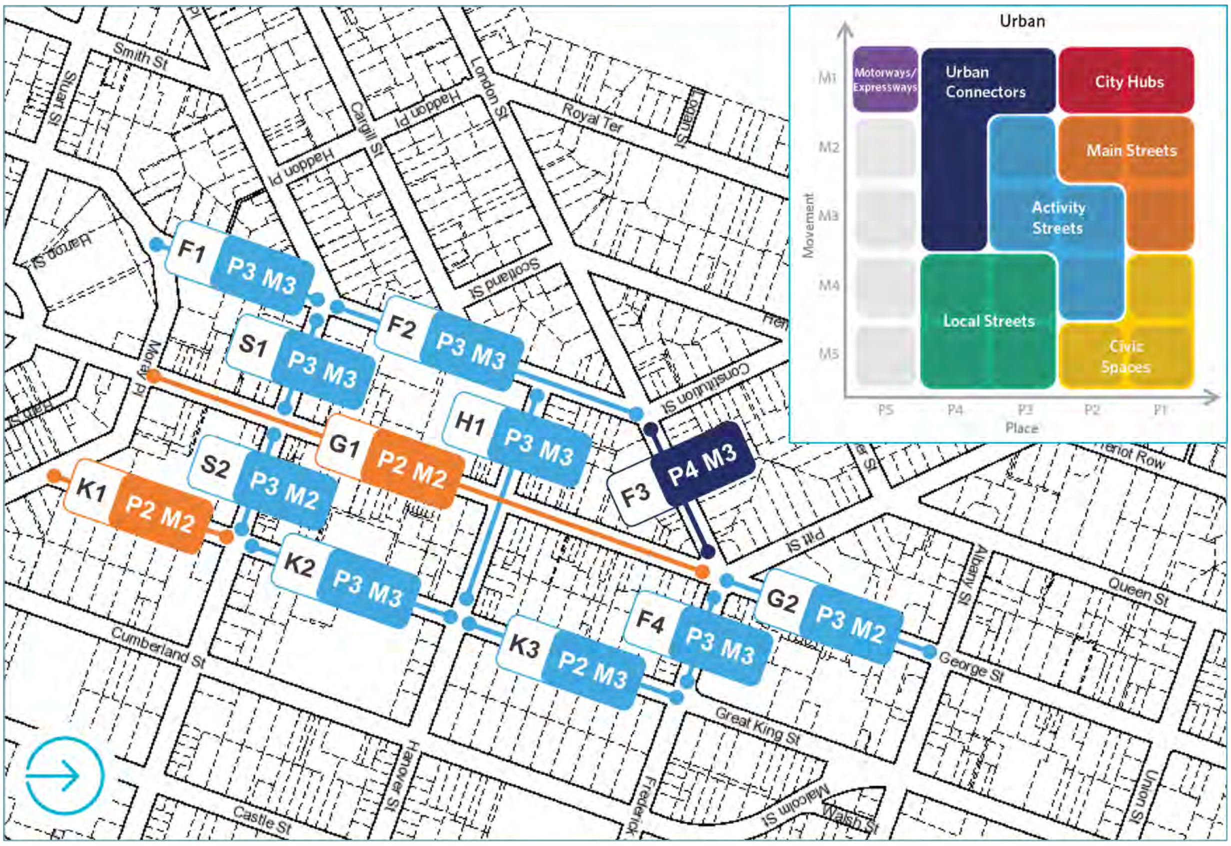


Figure 5 Existing Movement and Place classifications

Table 3 High level reasoning behind movement and place assessment

Street	ID	Description		Place		Movement	Street Family
George Street	G1	Moray to Frederick	P2	Social and economic significance for wider Dunedin Main shopping centre/street	M2	General Traffic: 8500 ADT Bus: 26 busses per hour during peak Pedestrian: 3720 ADT Cycle: 133 ADT	Main Street
	G2	Frederick to Albany	P3	Medium density mixed-use, fewer retail premises, some medium to low density residential. Less active frontage.	M2	General Traffic: 9500 ADT Bus: 26 busses per hour during peak Pedestrian: No Counts	Activity Street
Great King Street	K1	Moray to St Andrew	P2	City-wide transport interchange (bus hub). Some medium density mixed-use, but large proportion of off-street parking	M2	General Traffic: 4600 ADT Bus: 65 busses per hour during peak Pedestrian: ~240 ADT Cycle: 18 ADT	Main Street
	K2	St Andrew to Hanover	P3	Medium density mixed-use, primarily retail. Limited active frontage - servicing of retail along George Street and off-street parking.	M3	General Traffic: 2068 ADT Bus: 12 busses per hour during peak Pedestrian: 385 ADT Cycle: 34 ADT	Activity Street
	K3	Hanover to Frederick	P2	Within Tertiary zone, with a number of university buildings. Presently, the hospital is located in this section.	M3	General Traffic: Approx. 2068 ADT Bus: 12 busses per hour during peak Pedestrian: likely high foot traffic around Uni / Hospital	Activity Street
Filleul Street	F1	Moray to St Andrew	P3	Medium density mixed-use. Limited active frontage due to servicing of retail along George Street and off-street parking.	M3	General Traffic: 4000 ADT Bus: No Bus Routes Pedestrian: 1485 ADT Cycle: 64 ADT	Activity Street
	F2	St Andrew to London	P3	Medium density mixed-use. Limited active frontage due to servicing of retail along George Street and off-street parking.	M3	General Traffic: 4000 ADT Bus: No Bus Routes Pedestrian: 430 – 650 ADT Cycle: 5 ADT	Activity Street
London Street	F3	Filleul to George	P4	Primarily single-use residential	M3	General Traffic: 6100 ADT Bus: No Bus Routes Pedestrian: 570 ADT Cycle: 63 ADT	Urban Connector
Frederick Street	F4	George to Great King	P3	Within Tertiary zone with a number of university buildings. Active frontage near the corner of George Street (retail).	M3	General Traffic: 4300 ADT Bus: 4 busses per hour during peak Pedestrian: 1930 ADT	Activity Street
St Andrew Street	S1	Filleul to George	P3	Medium density mixed-use (retail, services, hospitality and a church). Supportive retail function to George St. Some active frontage.	M3	General Traffic: 5800 ADT. Provides a crucial link to SH1/SH88 Bus: No bus stops, but approx.16 busses per hour during peak Pedestrian: 1080 – 2630 ADT	Activity Street

Street	ID	Description	Place		Movement		Street Family
	S2	George to Great King	**P3**	Medium density mixed-use (retail, services, hospitality and a church) Some active frontage Supportive retail function to George St.	**M2**	General Traffic: 5800 ADT Provides a crucial link to SH1 and SH88 Bus: No bus stops, but approx. 40 busses per hour during peak Pedestrian: 1080 – 2630 ADT	**Activity Street**
Hanover Street	H1	Filleul to Great King	**P3**	Medium density mixed-use, including retail, services, and hospitality. Partly within CBD zone and University zone.	**M3**	General Traffic: 5200 Bus: No Bus Routes Pedestrian: 780 ADT	**Activity Street**

5.0 Retail Quarter desired future aspiration

As stated in the methodology Figure 4 above, assigning an aspirational future classification is based upon knowledge of any future transport projects, land-use plans and strategies, and the desired future intentions of the corridors and how it integrates with the wider network.

Accordingly, Figure 6 below summarises the desired future aspiration for the retail quarter corridors, with Table 4 explains the reasoning behind each classification.

Most notably, the reasoning behind the George Street classifications are as follows:

- G1 (Moray Place to Frederick St) has changed from a Main Street to an Activity Street. This is primarily due to the desired reduction in the movement value because of the intention to reduce through-traffic and the re-route busses along Great King Street (accounting for the increase in movement values along the Great King corridor).
- There is no change in place value, because despite the expectation that the upgrades will contribute a sense of 'attractiveness' along the street, they can't influence the intensity or type of adjacent land-use on their own. Additionally, from a holistic perspective, The Octagon is more likely to be a P1 compared to George Street.
- G2 is expected to have minimal change, as general traffic is unlikely to divert until London St, busses will still use this section until Frederick St.

As noted, achieving this desired future state for George Street is dependent on reduction in movement occurring along the corridor. Consequently, the current management of the road does not achieve this.

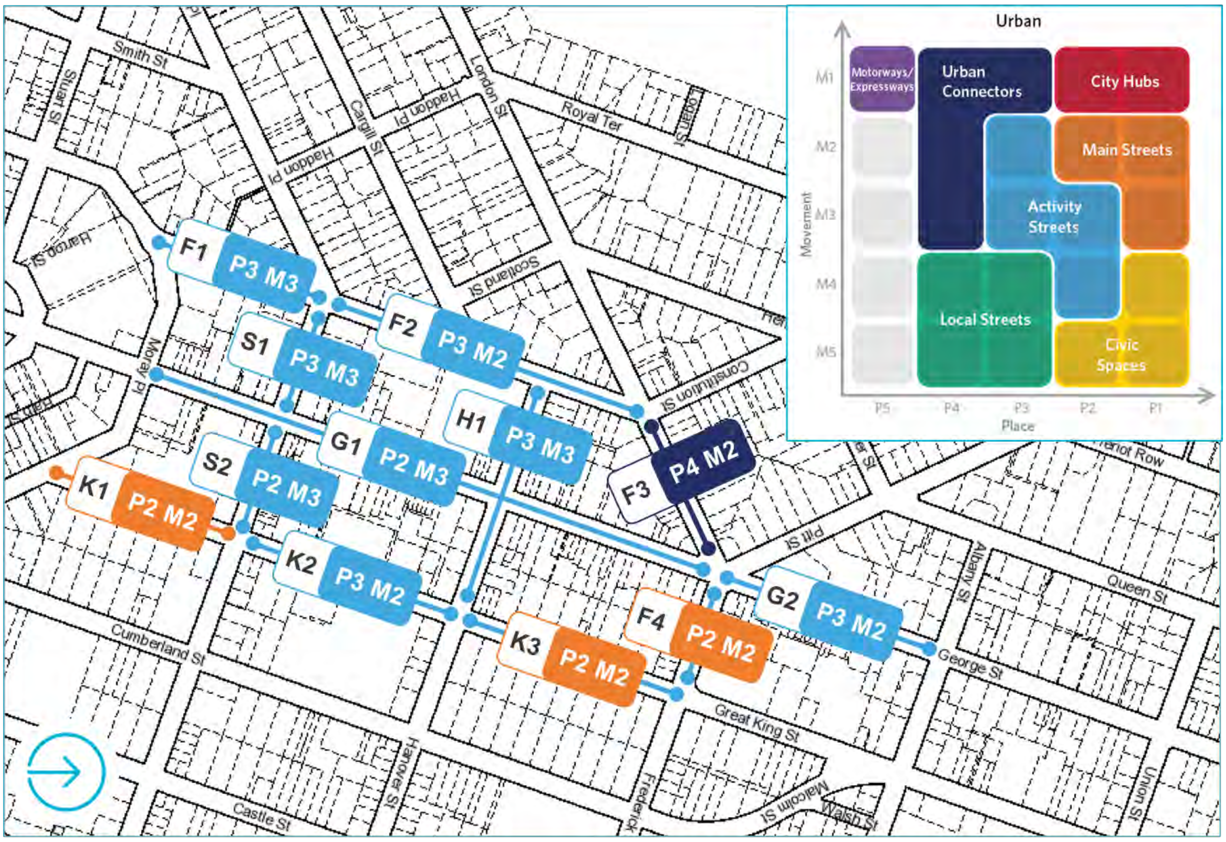


Figure 6 Future Movement and Place assessment

Table 4 Future Aspiration Reasoning

Street	ID	Description		Future Place		Future Movement	Street Family
George Street	G1	Moray to Frederick	**P2**	Most likely P2. Octagon more likely to be a P1. Upgrades will contribute to 'attractiveness' but won't necessarily contribute to the land-use metrics on their own	**M3**	M3 likely - reduce in movement but will still cater to high pedestrian movement. Upgrades will encourage re-routing of general traffic along Filluel. Busses re-routed along Great King. Likely encourage Waling and Cycling along George St because most direct	**Activity Street**
	G2	Frederick to Albany	**P3**	Most likely remains at P3. Upgrades will contribute to 'attractiveness' but won't necessarily contribute to the land-use metrics on their own	**M2**	May be minimal change in movement along this section. General Traffic unlikely to divert until London St. 26 busses during peak hour will still use this section, before turning down Frederick to access GK. Width of corridor is maintained for this.	**Activity Street**
	G3	Albany to St David	**P4**	No urban realm upgrades along this section. Primarily single-use residential.	**M3**	General Traffic unlikely to divert until London St. Same number of busses	**Urban Connector**
Great King Street	K1	Moray to St Andrew	**P2**	City-wide transport interchange (bus hub). Some medium density mixed-use, but large proportion of off-street parking	**M2**	Same number of busses as previously, so movement function remains the same. Additionally, likely to be high number of pedestrians, with bus interaction	**Main Street**
	K2	St Andrew to Hanover	**P3**	Place unlikely to change.	**M2**	Busses re-routed from George Street along this section. Additionally, likely to be high number of pedestrians, with bus interaction	**Activity Street**
	K3	Hanover to Frederick	**P2**	Still within Tertiary zone. Hospital location is moving, however there are intentions for the University to use the site, so place value will remain	**M2**	Busses re-routed from George Street along this section, has more significant movement function. Additionally, likely to be high number of pedestrians	**Main Street**
Filleul Street	F1	Moray to St Andrew	**P3**	Place value unlikely to change.	**M3**	Section has been split to account for movement differences expected between Moray-Andrew section and St Andrew-Cargill. Less general traffic expected on this section, instead using York Place.	**Activity Street**
	F2	St Andrew to London	**P3**	Place value unlikely to change.	**M2**	Higher proportion of general traffic expected on this section, re-routed from George Street.	**Activity Street**

Street	ID	Description	Future Place		Future Movement		Street Family
London Street	F3	Filleul to George	**P4**	Place unlikely to change.	**M2**	Higher proportion of general traffic expected.	**Urban Connector**
Frederick Street	F4	George to Great King	**P2**	Will be a key connecting street to bring more people up to George. Within Tertiary zone with a number of university buildings. University intending to develop along here. Therefore, a higher place importance overtime.	**M2**	Expected higher general traffic volumes in future. Significant increase in number of busses along this section, to account for re-route along Great King. Also will be a key pedestrian route up to George Street.	**Main Street**
St Andrew Street	S1	Filleul to George	**P3**	Unlikely to change, and the connection between George Street and Filleuel is not seen to be as key for pedestrians, in comparison to GK-George. This is why this section has been split further	**M3**	Busses coming to/from York Place will continue along this section.	**Activity Street**
	S2	George to Great King	**P2**	Will be a key connecting street to bring more people up to George. Removal of busses allows for the possibility of more pedestrian focus	**M3**	Removal of majority of busses along this section reduces the number of people moving along the corridor. Still busses coming to/from York Street.	**Activity Street**
Hanover Street	H1	Filleul to Great King	**P3**	Place unlikely to change.	**M3**	Unlikely to see much change Pedestrian will increase, connecting into George	**Activity Street**

Appendix D

MCA Assessment

Retail Quarter Upgrade DBC

Short List Assessment

Criteria	Investment Objective	KPI	Measure / Description	Assessor	Source	-3 Significant Adverse - Impact or Risk	-2 Moderate Adverse - Impact or Risk	-1 Minor Adverse - Impact or Risk	0 Neutral	+1 Minor Positive	+2 Moderate Positive	+3 Significant Positive	Do Minimum	One Way Northbound	One Way Southbound	Two Way slow
INVESTMENT	Reduce DSIs in Dunedin's Retail Quarter to 0 by 2038.	Reduced frequency of incidents Reduced severity of incidents	Speed reduction, reduced geometry and crossing distances	DBC team	Qualitative	Worse than DM			No change over DM	Minor Positive	Moderate Positive	Significant Positive	No change to existing layout 0	Speed reduction through design - 60 % reduction in crossing distance 2	Speed reduction through design - 60 % reduction in crossing distance 2	Speed reduction through design - 30 % reduction in crossing distance 1
	Reduce private vehicles using George Street as a thoroughfare* by 2038.	Reduction in thoroughfare vehicular traffic	Through vehicular trips from Moray to Frederick St	DBC Team	Assessment - modelling outputs	Worse than DM			Same as DM	-0-30% reduction from DM	-31-60% reduction from DM	->60% reduction from DM	 0	100% reduction 3	100% reduction 3	98% reduction 3
	Increase the number of people visiting George Street by 2038.	Improving perception of safety	Pedestrian LOS at 5 Arm	DBC Team	Assessment - SIDRA	Worse than DM			Same as 2038 DM	Minor positive improvement	Moderate positive improvement	Significant positive improvement	No change to existing layout. 0	Intersection geometry or phasing not fundamentally changed despite reduced carriageway width. Still requires traffic control phase for northbound approach. 0	Intersection geometry not fundamentally changed however removal of signal phase able to decrease total cycle time at the intersection. 1	Intersection geometry or phasing not fundamentally changed despite reduced carriageway width. Still requires traffic control phase for northbound approach. 0
		Improved sense of place and quality of experience.	Opportunity for retail investment and retain or increased spending by visitors to the space.	DBC Team	Assessment	Significant Adverse	Moderate Adverse	Minor Adverse	Neutral	Minor Positive	Moderate Positive	Significant Positive	No change from existing 0	Increased pedestrian area and place making setting will attract people and encourage them to dwell more. More attractive environment to invest in. 1	1	1
													Total **0**	**6**	**7**	**5**
ABILITY TO IMPLEMENT	Feasibility	Technical / constructability	Technical risk in developing or implementing the option. * Managing underground utilities. * Disruption effects to transport network * Surface treatment complexity * Managing access to businesses continuity	DBC team	Qualitative	Significant Adverse	Moderate Adverse	Minor Adverse	Neutral				 0	Significant disruption with 3 water replacement and high level of surface treatment constraining access. -2	Significant disruption with 3 water replacement and high level of surface treatment constraining access. -2	Significant disruption with 3 water replacement and high level of surface treatment constraining access. -2
		Safety in design / zero harm	H&S Risk in construction, operations and maintenance	DBC team	Qualitative	Significant Risk	Moderate risk	Minor Risk	Neutral				 0	Safety in design embedded in projects to minimise risk. ECI contractor involved from the outset. -2	Safety in design embedded in projects to minismise risk. ECI contractor involved from the outset -2	Safety in design embedded in projects to minimise risk. ECI contractor involved from the outset -2
		Impact on the wider transport network	Increase in modelled vehicle travel time across the network.	DBC team	Assessment	Total VTT >5 min increase (2038 DM PM Peak)	Total VTT 1-5 min increase (2038 DM PM Peak)	Total VTT <1 min increase (2038 DM PM Peak)	No change in total VTT (2038 DM PM Peak)	Total VTT <1 min decrease (2038 DM PM Peak)	Total VTT 1-5 min decrease (2038 DM PM Peak)	Total VTT >5 min decrease (2038 DM PM peak)	6:35 0	6:36 (+1 sec) -1	6:40 (+5 sec) -1	6:43 (+ 8 sec) -1
	Potential value for money	Benefit / cost ratio	NPV benefits / costs	DBC team	Assessment	BCR < -1	-1 < BCR < 0		0 < BCR < 1	1 < BCR < 3	3 < BCR < 5	5 < BCR	-1.6 0	5.4 3	3.6 2	5.1 3
	Stakeholder acceptability	Stakeholders / customers	How acceptable is this to stakeholders and customers? Use questionnaire from workshop two to determine.	Group	Qualitative	Significant Adverse	Moderate Adverse	Minor Adverse	Neutral	Minor Positive	Moderate Positive	Significant Positive	 0	Moderate positive sentiment 1	Moderate positive sentiment 1	Most acceptability by stakeholders 3
													Total **0**	**-2**	**-3**	**-1**
ASSESSMENT OF EFFECTS	Strategic Community Outcomes	Te Ao Maori	Impact on Te Ao Maori and Mana Whenua principles and values	Aukaha	Qualitative	Significant Adverse	Moderate Adverse	Minor Adverse	Neutral	Minor Positive	Moderate Positive	Significant Positive	No change to existing 0	Greater opportunity to embed manaakitangi. Most inline with Mana whenua values. 2	Greater opportunity to embed manaakitangi. Most inline with Mana whenua values. 2	Some space to embed manaakitangi and cultural enhancement. 1
		Arts and culture	Ability to foster a creative streetscape with opportunities for diverse arts and cultural activities. Embeds imaginative solutions within the physical environment to allow for ongoing creative use of the streetscape by public and private stakeholders.	DCC/Aukaha	Quantitative	Significant Adverse	Moderate Adverse	Minor Adverse	Neutral	Minor Positive	Moderate Positive	Significant Positive	No change to existing 0	Increased space to foster and embed art, culture and creativity into the streetscape. 2	Increased space to foster and embed art, culture and creativity into the streetscape. 2	Minor increase in space to foster and embed art, culture and creativity into the streetscape. 1
		Heritage	Impact on hertiage and/or archaeological value	Heritage rep/Aukaha	Qualitative	Significant Adverse	Moderate Adverse	Minor Adverse	Neutral	Minor Positive	Moderate Positive	Significant Positive	No impact 0	No impact on heritage or archelogical value from streetscape work however minor positive opportunity for investment in restoration of facades etc following streetscape investment. 1	No impact on heritage or archelogical value from streetscape work however minor positive opportunity for investment in restoration of facades etc following streetscape investment. 1	No impact on heritage or archelogical value from streetscape work however minor positive opportunity for investment in restoration of facades etc following streetscape investment. 1
		Environmental	Impact of design on sustainability (rain gardens, drainage, permeable surfaces)	DBC team	Quantitative				No change to existing	Moderate Positive +2 use of rain gardens and/or permable surfaces			No change to existing 0	Design encorporates use of rain gardens and sustainable design features 2	2	2
			Impact on air quality.	DBC Team	Assessment	Total VKT 11-15% increase	Total VKT 6-10% increase	Total VKT 0-5% increase	No change in total VKT from DM	Total VKT 0-5% decrease	Total VKT 6-10% decrease	Total VKT 11-15% decrease	 0	0.6% increase -1	1.5% increase -1	0.2% increase -1
		Accessibility	How accessible and functional is the option for all? (Considering the needs for groups with varied needs and disabilities)	DBC team	Qualitative	Less quality than existing -1			Neutral	Minor Positive	Moderate Positive	Significant Positive	No change to existing 0	Narrow carriageways and level surfaces significant improve accessibility for all. 3	Narrow carriageways and level surfaces significant improve accessibility for all. 3	Two way carriageway with only some reduced geometry and level surfaces to improve accessibility for all. 2
		Amenity and Urban comfort	Extent of option to support quality public realm, amenity and urban comfort. Seating, planting, drink fountains etc (Specific TBC)	Jasmax Aukaha	Qualitative	Less quality than existing -1			Neutral	Minor Positive	Moderate Positive	Significant Positive	No change to existing 0	More space for activity, providing more opportunity for people to congregate. 2	More space for activity, providing more opportunity for people to congregate. 2	Less space for activity, providing less opportunity for people to congregate. 1
		Personal security	CPTED/IPTED initiatives 7 Qualities of safer places - access, surveillance and sightlines, layout, activity mix, sense of ownership, quality environments, physical protection.	Jasmax Aukaha	Qualitative				No change to exisitng	Minor Positive	Moderate Positive	Significant Positive	No change to existing 0	More opportunity for activity space that is open, no big trees, good lighting and limited passive surveillance from vehicles. Good lighting. 2	More opportunity for activity space that is open, no big trees, good lighting and limited passive surveillance from vehicles. Good lighting. 2	Less opportunity for activity space that is open, no big trees, good lighting and minimal passive surveillance from vehicles. Good lighting. 2
													Total **0**	**13**	**13**	**9**

Criteria	Do Minimum	One Way Northbound	One Way Southbound	Two Way slow
Investment	0	6	7	5
Ability to implement	0	-2	-3	-1
Assessement of Effects	0	13	13	9
Capital cost	$9m	$19m	$19m	$18m
BCR range	-1.6	4.0 - 10.3	2.2 - 8.5	3.5 - 10.6

Appendix E

Economic Assessment

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14 September 2021

TBC

Dear TBC

Dunedin Retail Quarter - Shortlist Assessment Economics

1.0 Purpose

This letter outlines the results of the economic evaluation of the project options using the Waka Kotahi Monetised Benefits and Costs Manual (MBCM).

It details the evaluation parameters and assumptions made and provides Benefit / Cost Ratios (BCR) for the project options.

2.0 Basis of the Evaluation

2.1 Options

The Do Minimum and three options have been assessed, of which all four scenarios include the identified enabling works. All options are assessed due to the replacement of the water pipes below George Street.

Enabling Works: These are works which are required to improve the intersections and road network on Filleul Street and Great King Street so that when the Three Waters project is started, and the closure of George Street, these improvements will allow traffic to be diverted with minimal impact.

Do Minimum: The Do Minimum option sees the surface level of George Street returned, after the implementation of three waters project, to its current arrangement but with replacement pavers and road surfacing whilst retaining the current 30km/h speed limit.

Option 1 – 10km/h two-way road: This option reduces the carriageway width from 10 m - 11 m to 6 m (two 3 m lanes). It also sees a reduction of speed to 10 km/h and the carriageway raised to the same level from building line to building line.

Option 2 – 10km/h one-way northbound: This option changes George Street to one-way northbound, reduces the carriageway to 3m and provides an at-grade approach to George Street (same level from building line to building line). This is a shared space and a reduction of speed to 10 km/h.

Option 3 – 10km/h one-way southbound: This option changes George Street to one-way southbound, reduces the carriageway to 3m and provides an at-grade approach to George Street (same level from building line to building line). This is a shared space and a reduction of speed to 10 km/h.

2.2 Transportation Modelling

The Base Case (Do Nothing), Do Minimum and Option scenarios were modelled by WSP using Paramics Discovery. The total network travel distance and travel time were extracted from the models and used as inputs for this economic assessment. Summary of the inputs from the Paramics models, as received from WSP, are shown in Table 1 to Table 3.

Due to instabilities in the Do Minimum model, and the results not being considered realistic in comparison to the Base Case and the Options, especially for the 2038 forecast year, the Base Case scenario summary statistics were used as representative of the Do Minimum for economic evaluation purposes. Assessment of the summary statistics showed that the total network travel time for the 2038 Do Minimum was higher than the options (especially during the interpeak hours from which a large proportion of the daily benefits are yielded) and significantly higher than the Base Case – which is unlikely going to be the situation given the relatively minor changes made to the network. These differences translate to large travel time costs in the Do Minimum compared to the Options which then leads to the BCRs being over-estimated. The results of the Base Case were therefore considered more appropriate to be sued in the calculation of the BCRs.

Table 1: 2019 Paramics Models Network Statistics Summary

Time Period	Network Statistics	Base
AM Peak Hour	Travel Time (hr)	1,697
	Trip distance (km)	49,886
Interpeak Hour	Travel Time (hr)	1,228
	Trip distance (km)	38,360
PM Peak Hour	Travel Time (hr)	2,110
	Trip distance (km)	55,989

Table 2: 2028 Paramics Models Network Statistics Summary

Time Period	Network Statistics	Base	Do Min	Two-way	One-way NB	One-Way SB
AM Peak Hour	Travel Time (hr)	1,809	1,805	1,794	1,803	1,809
	Trip distance (km)	51,513	51,610	51,622	51,735	51,710
Interpeak Hour	Travel Time (hr)	1,278	1,275	1,279	1,286	1,293
	Trip distance (km)	39,457	39,505	39,603	39,589	39,608
PM Peak Hour	Travel Time (hr)	2,303	2,402	2,386	2,394	2,467
	Trip distance (km)	56,794	56,868	57,084	56,966	57,095

Table 3: 2038 Paramics Models Network Statistics Summary

Time Period	Network Statistics	Base	Do Min	Two-way	One-way NB	One-Way SB
AM Peak Hour	Travel Time (hr)	1,967	1,942	1,980	1,978	2,016
	Trip distance (km)	52,665	52,674	52,898	52,770	52,861
Interpeak Hour	Travel Time (hr)	1,381	1,408	1,349	1,382	1,380
	Trip distance (km)	41,254	41,264	41,220	41,304	41,310
PM Peak Hour	Travel Time (hr)	2,651	2,686	2,738	2,689	2,695
	Trip distance (km)	55,569	55,299	55,430	55,249	54,732

3.0 Economic Evaluation

3.1 Evaluation Assumptions

- The base date for the evaluation is 1 July 2021;
- Time zero is 1 July 2021;
- The evaluation period is 40 years;
- The base assumption for the discount rate is 4%;
- Construction for the enabling works is assumed to commence on 1 January 2022 and be completed by 31 December 2022;
- Construction of the Do Minimum and the options is assumed to commence on 1 January 2023 and be completed by 31 December 2023;

- Benefits have been straight line extrapolated between the model years 2019, 2028 and 2038. The benefits were capped at 2038 levels for the later years; and
- All update factors, base value travel times, vehicle operating costs etc. are based on update factors from the MBCM (August 2021 Update). Values from MBCM used are shown in Table 4 and Table 5.

Table 4: MBCM Values Used

Item	Value	Units	Detail
Travel time cost for all periods $/hr	16.27	$/hr	Urban arterial all periods
Vehicle Operational Cost (VOC)	21.8	cents/km	50km and 0% gradient
Weekdays	245	days	MBCM default
Other days	120	days	MBCM default
Light vehicle VOC to CO_2 factor	0.0009		MBCM default
Heavy vehicle VOC to CO_2 factor	0.0016		MBCM default
LV%	95%		Average model statistics
HCV%	5%		Average model statistics
CO_2 cost	65.58	$/ton	MBCM default
Generalised CO_2 cost	0.000935		MBCM default
New conventional cyclist benefit	2,500	$/user	MBCM default
New electrical cyclist benefit	2,000	$/user	MBCM default
Assumed new conventional cyclist	80	%	Estimated
Assumed new electrical cyclist	20	%	Estimated
Generalised new cyclist benefits	2,400	$/user	Weighted average of conventional/electric
New pedestrian benefit	1,250	$/user	MBCM default

Table 5: MBCM Update Factors

Update Factors	Factors
Travel Time Cost Saving	1.57
Vehicle Operating Cost Saving	1.06
Crash Cost Saving	1.14
Walking and cycling Benefits	1.04
Emission Reductions Benefits	1.15

3.2 Annualisation Factors

Vehicular benefits have been based on the extrapolation of the AM, Inter and PM peak hour Paramics model outputs. Given there were no full day counts available within the study area, network wide modelling summary statistics were used in the calculation of benefits. Traffic counts between 22 June

2021 to 24 June 2021 were extracted from Waka Kotahi's traffic monitoring for state highways database and used to determine the annualisation factor for peak hours to the daily value.

Figure 1 shows the location of the traffic counts and the names of the counters.

Figure 2 shows the hourly traffic volume across the three-day period and an average daily flow profile.

Figure 1: Traffic Count Locations

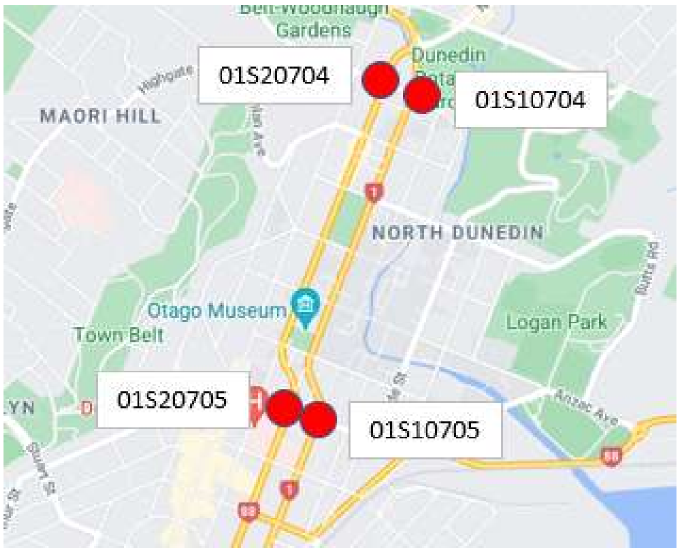


Figure 2: Hourly Traffic Volume

245 workdays and 120 public holiday/weekend days have been assumed per annum (MBCM default). This economic assessment has however only included benefits for 245 workdays as the Paramics models were only representative of a 'typical' workday.

The annualisation factor assumptions are:

- AM Peak: 245 days x 1.85 hours per day x AM Peak;
- Inter Peak: 245 days x 9.16 hours per day x Inter Peak;
- PM Peak: 245 days x 1.85 hours per day x PM Peak;

4.0 Costs

4.1 Capital Costs

The 'expected' estimates for the scheme, both undiscounted and discounted present value (PV) costs, are summarised in Table 6.

Table 6: Undiscounted and PV Costs ($m)

Description	Expected Estimate ($m)	NPV Costs ($m)
Enabling works	5.4	5.2
Do Minimum	9.0	8.3
Option 1: Two-way	18.0	16.6
Option 2/3: One-way	19.0	17.6

4.2 Maintenance Costs

Routine Maintenance

It was estimated the that annual routine maintenance cost:

- For Do Minimum is $5,990 per year; and
- For all the options are $6,990

Resurfacing & Pavement Rehabilitation

It was estimated that the cost:

- Of resurfacing is $236,800; and
- Of rehabilitation is $1,024,000.

A summary of the maintenance costs is shown in Table 7.

Table 7: Maintenance Cost Summary

Description	Do Minimum ($)	Option 1 ($)	Option 2 ($)	Option 3 ($)
Annual Routine Maintenance	5,990	6,990	6,990	6,990
Resurfacing	236,800	236,800	236,800	236,800
Rehabilitation	1,024,000	N/A	N/A	N/A

All maintenance costs shown in Table 7 are present value costs. It was further assumed that the maintenance cost will increase by an additional 3% per year.

Table 8 shows the maintenance schedule for Do Minimum and the options.

Table 8: Maintenance Schedule

Maintenance	Do Minimum	Option 1/2/3
Carriageway AC resurfacing	- 2030 - 2045 - 2060	- 2040
Footpath renewals	- 2040	N/A

Total Maintenance Costs

Table 9 shows the undiscounted and NPV of total maintenance costs over the 40-year analysis period.

Table 9: Undiscounted and NPV of Maintenance Costs ($m)

Description	Do Minimum ($m)	Option 1 ($m)	Option 2 ($m)	Option 3 ($m)
Total maintenance costs (undiscounted)	3.8	0.9	0.9	0.9
NPV maintenance costs	1.6	0.4	0.4	0.4

Table 9 shows that the net present value (NPV) maintenance costs for:

- Do Minimum is $1.6 million over 40 years; and
- All the options are $0.4 million over 40 years.

5.0 Benefits

This section outlines the tangible benefits of the Option, based on the NZTA MBCM. All base value travel times, vehicle operating costs, crash costs and update factors etc. have been based on the August 2021 Update of the MBCM.

The benefits summarised in this section are stated as a comparison of the options and the Do Minimum using a fixed trip matrix methodology.

5.1 Benefit Calculation

Benefit sources that have been included in the economics are:

- Travel time costs;
- Vehicle operating costs;
- Carbon emissions costs; and
- Walking and cycling health benefits.

5.2 Crash Cost Saving

Given the lack of crash history/evidence in the project study area, and recent changes to crash hotspot intersections having eliminated the pedestrian and cycling crashes previously observed, quantifying monetised crash cost savings using the existing MBCM and Waka Kotahi's Crash Estimation Compendium did not prove effective.

While the project can be expected to improve the overall safety, especially for vulnerable road users, with reduced flows, shorter crossing distances and lower speeds, the monetised crash cost savings for all options have been conservatively assumed to be zero.

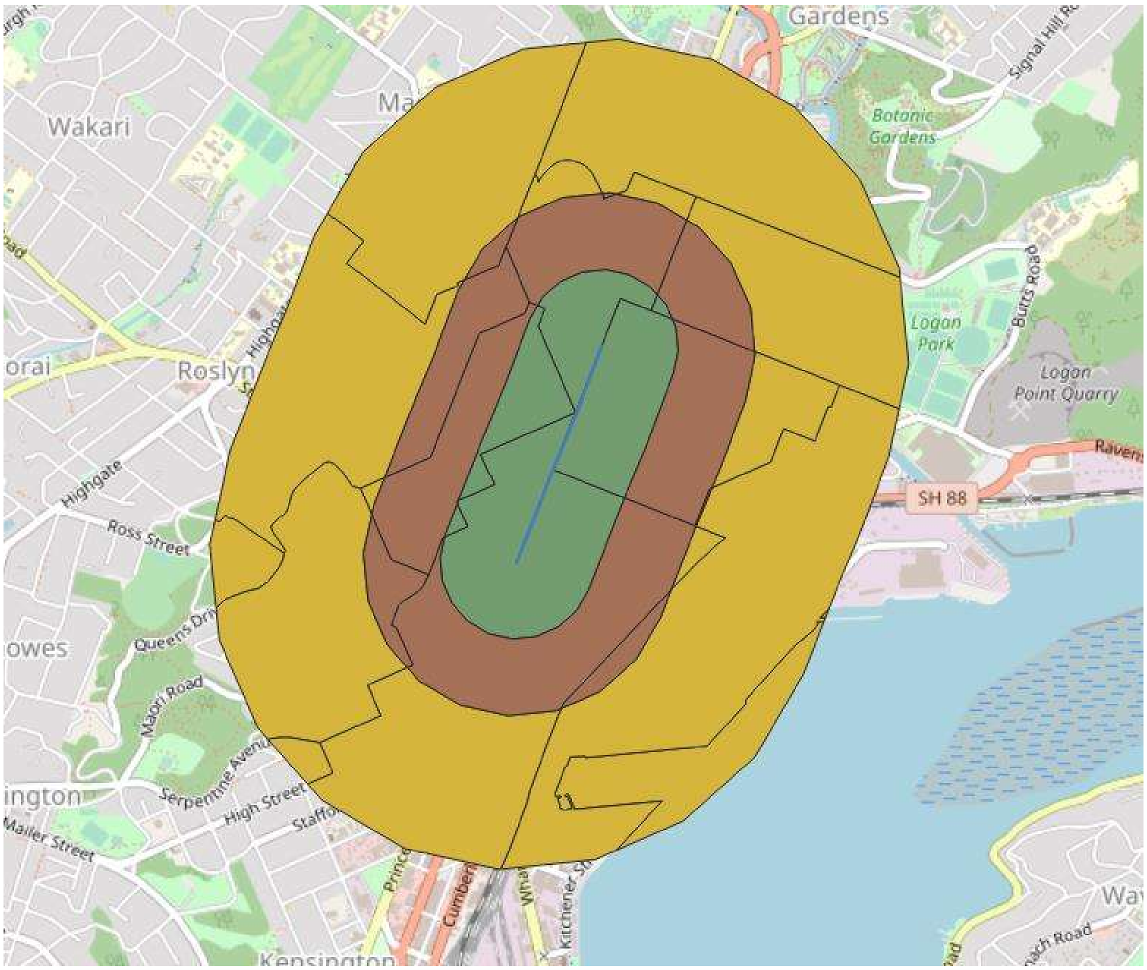
5.3 Walking and cycling Health Benefits

The proposed upgrade options are likely to attract new pedestrians and cyclists, and therefore health benefits are a primary monetised benefit. This section outlines the methodology for calculating the health benefits. The calculations have been guided by Waka Kotahi's SP11.

Cycling

- Step 1 – A buffer along the project corridor was determined using distances of 400m, 800m and 1,600m (shown in Figure 3)

Figure 3: Project Buffer



- Step 2 – 2018 Census Data was used to determine the existing population, journey to work and journey to education within the buffer zones.
- Step 3 – The census information was input into the SP11 spreadsheet to determine the existing and future cyclists for 2028 and 2038 (model years).
- Step 4 – The estimated cycling numbers were then scaled down (using a factor of 0.36) according to the difference between the SP11 existing cycling numbers estimate and the recent cyclist counts (204 cyclists per day however but adjusted for assumed double counting[1]) provided by Dunedin City Council.

[1] As the cycling counts represented volumes recorded a several points along the corridor over time, it can be assumed that some double counting of cyclists occurred as some cyclists can be expected to traverse the entire corridor. The highest value

- Step 5 – New cycling numbers for other years were interpolated from 2018, 2028 and 2038. It was conservatively assumed that the number of new cyclists is constant after 2038 (e.g. same value of health benefits from new cyclist between 2038 – 2060).

Table 10 and Table 11 shows the estimated 2028 and 2038 future cycle demand using the SP11 method.

Table 10: SP11 Summary for 2028 Cycle Demand

	Buffers (km)	Less than 400m	400m - 800m	800m - 1600m
1	Area (km^2)	0.7	3.6	1.2
2	Density	Different for every SA2 zone		
3	Population in each buffer	3,191	8,714	5,278
4	Total population in all buffers (Sum of **(3)**)	17,183		
5	Commute share	2.6%		
6	Likelihood of new cyclist multiplier	1.04	0.54	0.21
7	Row **(7)** = **(3)** x **(6)**	3,319	4,706	1,108
8	Sum of row **(7)**	9,133		
9	Cyclist rate **(9)** = (**(5)** x 0.96) + 0.32%)	2.8%		
10	Total existing daily cyclists	447		
11	Total new daily cyclists	257		
12	Total new daily cyclists scaled	92		

Table 11: SP11 Summary for 2038 Cycle Demand

	Buffers (km)	Less than 400m	400m - 800m	800m - 1600m
1	Area (km^2)	0.7	3.6	1.2
2	Density	Different for every SA2 zone		
3	Population in each buffer	3,364	9,148	5,569
4	Total population in all buffers (Sum of **(3)**)	18,081		
5	Commute share	2.6%		
6	Likelihood of new cyclist multiplier	1.04	0.54	0.21
7	Row **(7)** = **(3)** x **(6)**	3,499	4,940	1,169
8	Sum of row **(7)**	9,608		
9	Cyclist rate **(9)** = (**(5)** x 0.96) + 0.32%)	2.8%		
10	Total existing daily cyclists	509		
11	Total new daily cyclists	271		
12	Total new daily cyclists scaled	97		

observed was used as the count with an assumption that 25% of observations were double counted. The observed value was therefore scaled down by a factor of 0.75.

Pedestrians

- Previous studies have shown similar shared path projects in New Zealand have increased pedestrian numbers by 10% to 20%[2] following the first year of construction. This uplift has been as high as 54% increase in certain areas[3] but a 10% uplift was conservatively assumed for this project.
- Recent pedestrian counts (10,926 pedestrians per day but subjected to double counting assumption adjustment[4]) and population growth data (0.3% per year) from the 2018 census was used to determine the future number of pedestrians without the project.
- As pedestrian benefits make up a significant proportion of benefits, a range of pedestrian uplift scenarios were tested, which varied the assumptions on double counting, uplift and growth. The assumptions used can be seen in Table 12 below.
- It was conservatively assumed that the number of new pedestrians is constant after 2038 (i.e. pedestrian health benefits capped at 2038 levels).

Table 12: Pedestrian Uplift Assumptions

Case	% of pedestrian counts assumed to be unique	1st year new pedestrian growth after project completion.	2nd year new pedestrian growth after project completion	3rd year new pedestrian growth after project completion	4th year and onwards pedestrian growth after project completion
High Case	75%	20%	10%	5%	Existing
Base Case	75%	10%	5%	2.5%	Existing
Low Case	50%	10%	5%	2.5%	Existing

Table 13: Pedestrian Forecast

	Do Minimum		High Case		Base Case		Low Case	
Year	Growth Rate	Pedestrians	Growth Rate	Pedestrians	Growth Rate	Pedestrians	Growth Rate	Pedestrians
2019		8,196		8,196		8,196		5,464
2020	0.3%	8,224	0.3%	8,224	0.3%	8,224	0.3%	5,483
2021	0.3%	8,252	0.3%	8,252	0.3%	8,252	0.3%	5,501
2022	0.3%	8,280	0.3%	8,280	0.3%	8,280	0.3%	5,520
2023	0.3%	8,308	0.3%	8,308	0.3%	8,308	0.3%	5,539
2024	0.3%	8,336	0.3%	8,336	0.3%	8,336	0.3%	5,558
2025	0.3%	8,365	20.0%	10,004	10.0%	9,170	10.0%	6,113
2026	0.3%	8,393	10.0%	11,004	5.0%	9,628	5.0%	6,419
2027	0.3%	8,422	5.0%	11,554	2.5%	9,869	2.5%	6,579
2028	0.3%	8,450	0.3%	11,593	0.3%	9,903	0.3%	6,602
2029	0.3%	8,479	0.3%	11,633	0.3%	9,936	0.3%	6,624
2030	0.3%	8,508	0.3%	11,672	0.3%	9,970	0.3%	6,647

[2] N2P (Nelson to Petone) Demand Estimates Memo dated 28th April 2020
[3] Case Study for the Transformation of Fort Street into a Shared Street https://globaldesigningcities.org/publication/global-street-design-guide/streets/shared-streets/commercial-shared-streets/case-study-fort-street-auckland-new-zealand/
[4] As with cycling numbers, it was assumed that double counting had occurred and the highest count was therefore scaled down by a factor of 25%.

	Do Minimum		High Case		Base Case		Low Case	
Year	Growth Rate	Pedestrians	Growth Rate	Pedestrians	Growth Rate	Pedestrians	Growth Rate	Pedestrians
2031	0.3%	8,537	0.3%	11,712	0.3%	10,004	0.3%	6,669
2032	0.3%	8,566	0.3%	11,752	0.3%	10,038	0.3%	6,692
2033	0.3%	8,595	0.3%	11,792	0.3%	10,072	0.3%	6,715
2034	0.3%	8,624	0.3%	11,832	0.3%	10,106	0.3%	6,738
2035	0.3%	8,653	0.3%	11,872	0.3%	10,141	0.3%	6,761
2036	0.3%	8,683	0.3%	11,912	0.3%	10,175	0.3%	6,783
2037	0.3%	8,712	0.3%	11,953	0.3%	10,210	0.3%	6,807
2038	0.3%	8,742	0.3%	11,994	0.3%	10,245	0.3%	6,830

5.4 Source of Benefits

The NPV benefits of the all options are summarised from Table 14 to Table 16.

Table 14: Summary of High Case NPB Benefits

	Travel Time ($m)	Vehicle Operation ($m)	Carbon Emission ($m)	Crash Cost ($m)	Health ($m)
10km/h Two Way	-0.7	-0.9	-0.1	0.0	77.3
10km/h NB Only	6.4	-0.8	-0.1	0.0	77.3
10km/h SB Only	-8.2	-0.6	0.0	0.0	77.3

Table 15: Summary of Base Case NPV Benefits

	Travel Time ($m)	Vehicle Operation ($m)	Carbon Emission ($m)	Crash Cost ($m)	Health ($m)
10km/h Two Way	-0.7	-0.9	-0.1	0.0	38.0
10km/h NB Only	6.4	-0.8	-0.1	0.0	38.0
10km/h SB Only	-8.2	-0.6	0.0	0.0	38.0

Table 16: Summary of Low Case NPV Benefits

	Travel Time ($m)	Vehicle Operation ($m)	Carbon Emission ($m)	Crash Cost ($m)	Health ($m)
10km/h Two Way	-0.7	-0.9	-0.1	0.0	26.7
10km/h NB Only	6.4	-0.8	-0.1	0.0	26.7
10km/h SB Only	-8.2	-0.6	0.0	0.0	26.7

Table 14 to Table 16 have shown that the health benefits varies significantly depending on the pedestrian uplift assumptions. For example, the health benefits for:

- High Case is $77.3 m (103% increase compared to Base Case);

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- Base Case is $38.0 m; and
- Low Case is $26.7 m (30% decreased compared to Base Case)

6.0 Evaluation Results

6.1 Benefit Cost Ratio

The Do Minimum has assumed that funding has been committed for the three waters projects and the enabling works and the subsequent renewal of George Street to its current state.

The BCRs compared to the Do Minimum are shown in Table 17.

Table 17: Benefit Cost Ratio Ratios compared to the Do Minimum

	High Case			Base Case			Low Case		
	NPV Benefit ($)	NPV Cost ($)	BCR	NPV Benefit ($)	NPV Cost ($)	BCR	NPV Benefit ($)	NPV Cost ($)	BCR
Do Minimum		15.1			15.1			15.1	
10km/h Two Way	75.7	22.3	10.6	36.3	22.3	**5.1**	25.1	22.3	3.5
10km/h NB Only	82.8	23.2	10.3	43.5	23.2	**5.4**	32.2	23.2	4.0
10km/h SB Only	68.6	23.2	8.5	29.2	23.2	**3.6**	17.9	23.2	2.2

7.0 Conclusion

It can be concluded that:

- The proposed upgrade options are likely to attract new pedestrians and cyclists, and therefore health benefits are a primary monetised benefit;
- The BCR is sensitive to the assumptions on pedestrian and cycling uplift due to the project so a range of pedestrian uplift scenarios were tested (high, base and low case) to estimate a range of BCRs in response to the uncertainty of pedestrian numbers in the future resulting from the project;
- The BCRs for the options were calculated against the summary statistics from the Base Case as the Do Minimum modelling results were considered unrealistic in comparison;
- The two-way option is forecast to result in the best BCR (10.6 for high case, 5.1 for base case and 3.5 for low case);
- The one-way northbound option is forecast to result in the second best BCR (10.3 for high case, 5.4 for base case and 4.0 for low case); and
- The one-way southbound option is forecast to result in the third best BCR (8.5 for high case, 3.6 for base case and 2.2 for low case).

Yours faithfully

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Total NPV Cost ($mil)					
	Travel Time Cost	Vehicle Operation Cost	CO2 Cost	Crash Cost	Project Cost
Base	2604.2	667.4	44.4	51.2	
Do Minimum	2627.8	667.6	44.4	51.2	15.1
10kmh Two Way	2604.8	668.3	44.5	51.2	22.3
10kmh NB Only	2621.4	668.4	44.5	51.2	23.2
10kmh SB Only	2635.9	668.1	44.4	51.2	23.2

Total NPV Benefit ($mil)							
	Travel Time Benefit	Vehicle Operation Benefit	CO2 Benefit	Safety Benefit	Health Benefit	Project Cost	BCR
Do Minimum						15.1	
10kmh Two Way	-0.7	-0.9	-0.1	0.0	38.0	22.3	5.1
10kmh NB Only	6.4	-0.8	-0.1	0.0	38.0	23.2	5.4
10kmh SB Only	-8.2	-0.6	0.0	0.0	38.0	23.2	3.6

High Case - Total NPV Benefit ($mil)							
	Travel Time Benefit	Vehicle Operation Benefit	CO2 Benefit	Safety Benefit	Health Benefit	Project Cost	BCR
10kmh Two Way	-0.7	-0.9	-0.1	0.0	77.3	22.3	10.6
10kmh NB Only	6.4	-0.8	-0.1	0.0	77.3	23.2	10.3
10kmh SB Only	-8.2	-0.6	0.0	0.0	77.3	23.2	8.5

	High Case			Base Case			Low Case		
	Benefit	Cost	BCR	Benefit	Cost	BCR	Benefit	Cost	BCR
10kmh Two Way	75.7	22.3	10.6	36.3	22.3	5.1	25.1	22.3	3.5
10kmh NB Only	82.8	23.2	10.3	43.5	23.2	5.4	32.2	23.2	4.0
10kmh SB Only	68.6	23.2	8.5	29.2	23.2	3.6	17.9	23.2	2.2

Base Case - Total NPV Benefit ($mil)							
	Travel Time Benefit	Vehicle Operation Benefit	CO2 Benefit	Safety Benefit	Health Benefit	Project Cost	BCR
10kmh Two Way	-0.7	-0.9	-0.1	0.0	38.0	22.3	5.1
10kmh NB Only	6.4	-0.8	-0.1	0.0	38.0	23.2	5.4
10kmh SB Only	-8.2	-0.6	0.0	0.0	38.0	23.2	3.6

Low Case - Total NPV Benefit ($mil)							
	Travel Time Benefit	Vehicle Operation Benefit	CO2 Benefit	Safety Benefit	Health Benefit	Project Cost	BCR
10kmh Two Way	-0.7	-0.9	-0.1	0.0	26.7	22.3	3.5
10kmh NB Only	6.4	-0.8	-0.1	0.0	26.7	23.2	4.0
10kmh SB Only	-8.2	-0.6	0.0	0.0	26.7	23.2	2.2

Appendix F

Risks and Opportunities Register

Identification								Current Assessment									Action Plan (BIC)
Risk ID	Status	Mod Date	Title	Risk Statement (Threat / Opportunity)	Notes / Discussion	Risk Owner	Risk Response Strategy	Probability	Cost	Schedule	Quality	HSS	Envmt.	Legal	Perception	OVERALL RISK LEVEL	Action Plan (BIC)
1	Open	29/03/2021	Client approvals	Large number of parties involved in the decision making process. Could result in delay to deadline	Requires DCC to have one decision make to reduce impact	AECOM / DCC		4	4	4	2	0	0	0	5	19	AECOM to provide a matrix with decisions which are required and set out date required to ensure programme does not slip
2	Closed	29/03/2021	Starting Point	Council resolution agreed however potential to step back to option testing		AECOM / DCC		1	0	0	0	0	0	0	0	1	Risk Resolved
3	Closed	29/03/2021	Transport Modelling	WSP / Flow will be running the model for the project. Meeting required with WSP / Flow to discuss the base model which will assist in setting the base. In addition AECOM to understand the future years of the transport model		AECOM		1	0	0	0	0	0	0	0	1	Risk Resolved
4	Open	29/03/2021	Option Testing	It is understood that only the one way requires to be tested however potential option to take this two way		AECOM		3	3	4	3	0	0	0	3	16	AECOM to agree final options at outset
5	Closed	29/03/2021	IBC does not finalise on one item rather a series of options with little testing	The IBC has been left open ended with a number of tests required to be carrie dout within the DBC stage. This could result in extensive works to complete the DBC		AECOM		1	0	0	0	0	0	0	0	1	Risk Resolved
6	Closed	29/03/2021	IBC ILM requires rephrasing into the DBC	Potential for the scheme to be needed to be religitated. AECOM to provide a solution to ensure this is not required		AECOM / DCC		1	0	0	0	0	0	0	0	1	Risk Resolved
7	Open	29/03/2021	Transport Modelling	The Transport Model was validated against 2017 volumes for the recent update. This could give lower volumes than current.		DCC		3	4	4	2	0	0	0	2	15	Recommendation to carry out junction counts at each intersection on George Street to compare and contrast model outputs to ensure a level of compatility
8	Open	29/03/2021	Transport Modelling	Hospital is not included withn the Base or Future models. Could have large impacts on travel patterns in 2028 and 2038	OD along George Street and Car Parks could be heavily impacted	DCC		2	2	3	3	0	0	3	3	16	Recommendation to put the hospital into a sensitiviy model. We may be asked at the later stages of why this wasn't done especially with a large trip generator such as this
9	Open	21/05/2021	Expansion of Scope	Expansion of scope to incude additional block could cause issue with IBC Status - now been verbally told this is excluded		AECOM / DCC		2	4	2	3	0	0	0	4	15	DCC to confirm extension / removal of the project scope of works formally. Recognition that a major risk will occur if this is later requested to be put back in the scope
10	Open	21/05/2021	Engagmeent	Engagement dates pushed until mid June and no confirmation of when the first round of counsulation will occur	This can have a significant impact on the DBC scehdule	DCC		4	2	5	4	0	0	0	4	19	DBC timescale is impacted by the delay, engagement and options will be critical going forward
11	Open	7/05/2021	Transport Modelling	Transport Model does not include any Shaping Future Dunedin works or changes to the Hospital. Potential to impact the volumes on George Street		DCC		3	2	4	2	0	0	0	2	13	GP to speak to WSP and NS to discuss the options and produce a Transport Model Report
12	Open	7/05/2021	Engagmeent Scope	AECOM to obtain Variation Order for Engagement Works		AECOM / DCC		4	5	5	4	0	0	0	4	22	AECOM to provide a VO to GH for review and acceptance.
13	Open	14/05/2021	Transport Modelling	Base model to be agreed prior to options assessment. Should models be completed without this being carried out - reruns will be required		AECOM / DCC		4	4	4	0	0	0	0	0	12	AECOM to submit a modelling specification report to DCC for approval.
14	Open	21/05/2021	Data Collection	Data requested submitted to DCC on the 28th April 2021 - partial data received on 20th May 2021, further information required on additional data and obtaining this within the timeframe is less likely given the restricted programme		DCC		4	4	5	4	0	0	0	2	19	AECOM to review the data received and determine the viability of obtaining more within the timeframes/the implications of not having data available
15	Open	14/05/2021	Approval of DBC by DCC	Approval from DCC to is required prior to NZTA reviewing and / or approving the DBC	Allowed 1 week in programme	DCC		4	4	5	3	0	0	0	4	20	GH to set up process for approval to allow timeframe to be met
16	Open	14/05/2021	Approval of DBC by NZTA	IQA process could take significant time from NZTA and therefore potential to put programme of development at risk		AECOM / DCC		4	4	4	3	0	0	0	4	19	AECOM to submit staged submissions of the DBC content to NZTA to seek approval prior to submission of completed document
17	Open	21/05/2021	Movement and Place Function Assessment	Potnetial risk that AECOM assessment of the network does not match with DCC assessment of network		AECOM / DCC		2	2	2	2	0	0	0	2	10	AECOM to meet with Senior User Group to discuss movement and place function - meeting organised on 31st May 2021
18	Open	14/05/2021	Shaping Future Dunedin	NZTA requirmeent of ensuring alignment of Retail Quarter and Shaping Future Dunedin - SFD has not been finalised at this stage		DCC		3	4	4	4	0	0	0	3	18	DCC / AECOM and NZTA to meet to resolve this risk
19	Open	21/05/2021	Senior User Group availability	The Senior User Group will be required for a number of workshops and meetings to verify sections of work throughout the project lifcycle. Given the tight timeframe, any unavailability for key deliverable weeks will be impacted		AECOM / DCC		3	3	4	3	0	0	0	4	17	AECOM to liase with GH early on weeks specified in the programme on when the Senior User Groups time will be provided

Appendix G

Consultation Report

Prepared for
Dunedin City Council
ABN: N/A

Dunedin Retail Quarter (George Street) Upgrade Engagement Report

Summary of Engagement

15-Sep-2021
Dunedin Retail Quarter (George Street) Upgrade
Doc No. A

Dunedin Retail Quarter (George Street) Upgrade Engagement Report

Summary of Engagement

Client: Dunedin City Council

ABN: N/A

Prepared by

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15-Sep-2021

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Quality Information

Document Dunedin Retail Quarter (George Street) Upgrade Engagement Report

Ref 60612233

Date 15-Sep-2021

Prepared by Vanessa Honore & Grace Forno

Reviewed by Glenda Dobbyn

Revision History

Rev	Revision Date	Details	Authorised	
			Name/Position	Signature
A	22-Aug-21	Draft for review	Robyn Hyde, Principal Transport Planner	RHyde
A	15-Sept-21	Final	Geoff Prince Associate Director - Transportation Advisory	

Table of Contents

Executive Summary

This report summarises partner and stakeholder engagement for the Dunedin City Council (DCC) Retail Quarter (George Street) Upgrade Detailed Business Case (DBC), which was developed between the period of June 2021 to September 2021.

The Dunedin Retail Quarter (George Street) Upgrade is a current priority project in the Central City Plan (CCP). The CCP is designed to guide the development of Dunedin's central city area, with an aspirational vision and the Dunedin city's goal of becoming *"one of the world's great small cities*".

A range of partners, including the Waka Kotahi NZ Transport Agency, Otago Regional Council and Aukaha, and a selected group of stakeholders (Central City Advisory Group (CCAG)), were involved throughout the DBC phase to test the optioneering process.

Engagement began in June 2021 with a series of Cup of Tea Meetings with 18 CCAG members (who represented diverse groups in the community) which reviewed a long list of options including the DCC's preferred option. These initial meetings led to the development of the four options, which were the main focus of the second round of engagement in July / August 2021.

The four options tested were as follow; noting a smart street variant could be applicable for each:

- **Do minimum option** – Three waters replacement and minor design improvements. Traffic speed remains at 30km/hr
- **Option 1** – One-way northbound. Speed is reduced to 10km/hr
- **Option 2** – One-way southbound. Speed is reduced to 10km/hr
- **Option 3** – Two-way. Speed is reduced to 10km/hr.

Engagement in July / August 2021 involved the completion of a Multi-Criteria Assessment (MCA) with all partners and a set of workshops (face to face and online) with 22 CCAG member groups, including Aukaha, where each were invited to complete a questionnaire of their likes/ dislikes and preference in options. Overall, both groups were positive with the level of technical assessment provided to develop the four options and were comfortable progressing with the selection of the emerging preferred option.

There was a split preference between Option 2 and Option 3 – with 41% support each and overall these are the preferred options based on the CCAG questionnaires.

Option 2- One-way this option was strongly supported by stakeholders particularly students, young people, Pasifika Trust, Plunket and disability groups. This option was preferred by these groups as it enhances pedestrian access, safety and allowed for more space for on street amenities to encourage activity along George Street.

Option 3 – Two way was strongly supported by commercial groups (retailers), landlords/developers, Grey Power, bus user advocacy group and Urban Access Dunedin as it retains the current access and parking configuration on George Street with improvements to pedestrian safety and access.

The One-way Southbound option was preferred over the One-way Northbound because most accessibility groups (disabled persons assembly), commercial businesses and Pasifika communities live in South Dunedin, this option would provide convenient access to the state highway south.

Next steps

This Engagement Report supports the Dunedin City Council (DCC) Retail Quarter (George Street) Upgrade Detailed Business Case which will be presented both in formal papers and presentation by the DBC Team to DCC Planning and Environment Committee on 28 September 2021 to determine a preferred option and approve the funding for the project to move into the construction phases.

Following approvals, the project will progress to the developed, and detailed design phase with specific engagement activities with stakeholders, partners and the wider community. When the project reaches the detail design phase, final refinements will be made through stakeholders, partners and directly affected engagement activities.

1.0 Introduction

1.1 Purpose of this report

The Dunedin City Council (DCC) Retail Quarter (George Street) Upgrade, referred to hereafter as the Retail Quarter project, intends to reinvent and celebrate the Dunedin central city area. At the centre of the planning for this project are the views of the project partners, stakeholders and the community.

This report provides a comprehensive summary of the targeted engagement and activities undertaken between March to August 2021 to support the development of the Retail Quarter project Detailed Business Case (DBC). The engagement feedback captured during the development of the DBC and outlined in this report have been instrumental in contributing the investment decision making and ultimately the decision made by DCC Committee on 28 September 2021.

1.2 DCC Retail Quarter (George Street) Upgrade

1.2.1 Central City Plan (CCP)

The Central City Plan (CCP) is a living document that guides Dunedin central areas' development over the 2015/16-2024/25 term. It is a place-based plan dividing the central city area into four quarters listed below:

- **The Warehouse Precinct:** The Warehouse Precinct was the first of the four quarters to be completed, including accessibility and amenity improvements along Jetty Street, Vogel Street, and Bond Street.
- **The Retail Quarter:** The Retail Quarter focuses on improvements along George Street. The Indicative Business Case (IBC) was completed in February 2020. This report refers to the engagement undertaken to progress the DBC.
- **The Creative Quarter:** This quarter will follow on completion of the Retail Quarter and will look at improvements across Lower Moray Place, Princes Street and the Exchange Square.
- **The Cultural and Entertainment Quarter:** This quarter will follow the completion of the Creative Quarter with works planned on the Octagon, Bath Street and Lower Stuart Street.

Each quarter intends to reflect the different activities in these respective parts of the city, encouraging certain types of development into specific areas and helping foster a distinctive character in each.

1.2.2 Retail Quarter (George Street) Upgrade

The Dunedin Retail Quarter is the current priority project as outlined in the CCP. The CCP's upgrades form part of the Long-Term Plan 2015/16 – 2024/25 (adopted by Council in June 2015).

1.2.2.1 Project Area

The proposed Retail Quarter upgrade work will occur within the George Street road corridor from Moray Place to Albany Street (shown in green in Figure 1-1), across four city blocks that have gradually developed their character and clusters of uses:

- **Farmers Block** (Moray Place to St Andrew Street) has a mixed-activity and user experience feel. This block is strongly influenced by the banking sector, services, and non-fashion retail
- **Golden Block** (St Andrews to Hanover Street) has been consolidated as the heart of clothing retailing and anchored as such by the three interconnected malls – The Meridian, Golden Centre, and Wall Street
- **New Edinburgh Way** (Hanover Street to Frederick Street intersection) is characterised by several café and restaurants and more boutique retail offerings; and
- **Knox Block** (Frederick Street to Albany Street) is heavily populated by cafes, bars, restaurants, and boutique retail.

Engagement for the Enabling Works (geotechnical works shown in dark pink in Figure 1-1) was undertaken with directly affected parties through public notices and direct door-knocking during the geotechnical investigations in June and July 2021. Further engagement is expected to occur from August 2021 through to the Enabling Works – pre-construction phase in early 2022. All activities are outlined in the Retail Quarter Upgrade - Enabling Works Tactical Plan.

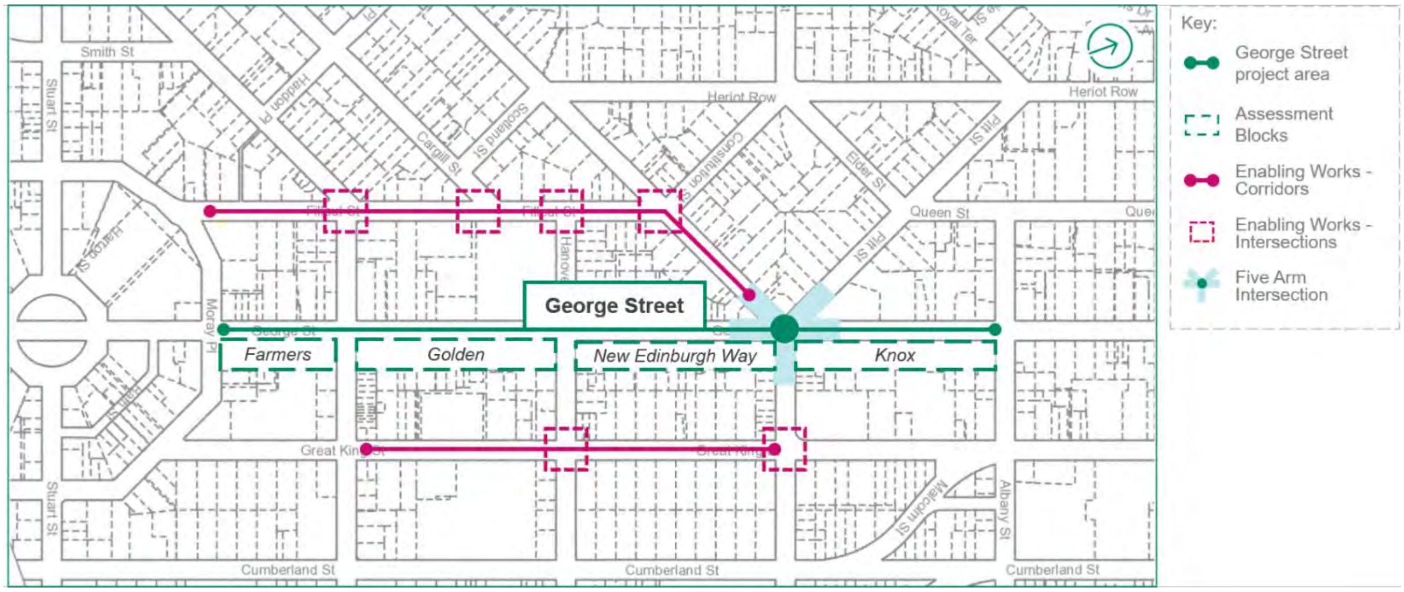


Figure 1-1: Project area

1.2.2.2 Vision and Outcome

An overall vision for the future of the Retail Quarter, which aligns to the CCP, was developed by DCC in partnership with Aukaha, the Ō3 Collective – made up of Isaac (Construction), AECOM and Jasmax (the Consultants Team) – and the wider advisory group, in addition to the workshopping process undertaken with key stakeholders. The project vision (see below Figure 1-2) is aspirational and aims to support Dunedin city's goal of becoming "one of the world's great small cities".

VISION

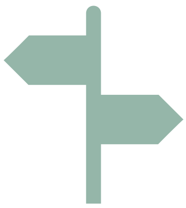
To achieve the following outcomes and make Dunedin a distinctive destination and one of the world's great small cities.

OUTCOMES:

Putting people first, by:
- Improving the pedestrian experience of the city
- Improving safety
- Celebrating our walkable city
- Creating meeting and resting points
- Increasing pedestrian space in the central city

Creating an Ōtepoti Dunedin sense of place, by:
- celebrating Dunedin's distinctive heritage, culture and character
- enhancing the city with input from its residents
- reflecting Dunedin's past and develop its future

Greening the city, by:
- creating a green network of trees and plants in the central city to reduce carbon emissions
- greening the streets to contribute to stormwater improvements
- restoring wildlife corridors and habitats for birds and insects



Streets as places, by:
- promoting George Street as a destination
- creating a memorable and distinctive place; an accessible city; and places for people to meet

Figure 1-2:Retail Quarter project vision and outcomes

2.0 Engagement approach and methods used

2.1 Purpose of the DBC phase engagement

In engaging on the DBC, we worked closely with our partners and stakeholders while providing regular updates to elected members.

The engagement approach and methods used during the development of the DBC phase of works is guided by the Retail Quarter upgrade – Communication and Engagement Strategy, which outlines the engagement's scope, objectives, and frameworks of the Retail Quarter project. The strategy is a living document. It enables a flexible approach and the ability to respond to social changes and new and emerging issues while upholding DCC Significance and Engagement Policy and its overarching values.

The communication and engagement objectives for engagement on the DCC Retail Quarter (George Street) Upgrade DBC include:

- Build positive relationships with directly impacted stakeholders within the project area.
- Highlight how the Retail Quarter project will provide economic and commercial opportunities and an economic boost for Dunedin.
- Demonstrate how the Retail Quarter project aligns to DCC strategies, including the Central City Plan.

2.1.1 Engagement journey

The engagement purpose and scope will adapt during the lifecycle of the Retail Quarter project.

This engagement is expected to continue until project completion in early 2024. Figure 2-1 shows the engagement journey summarising the Retail Quarter project's phases, timing and high-level engagement activity.

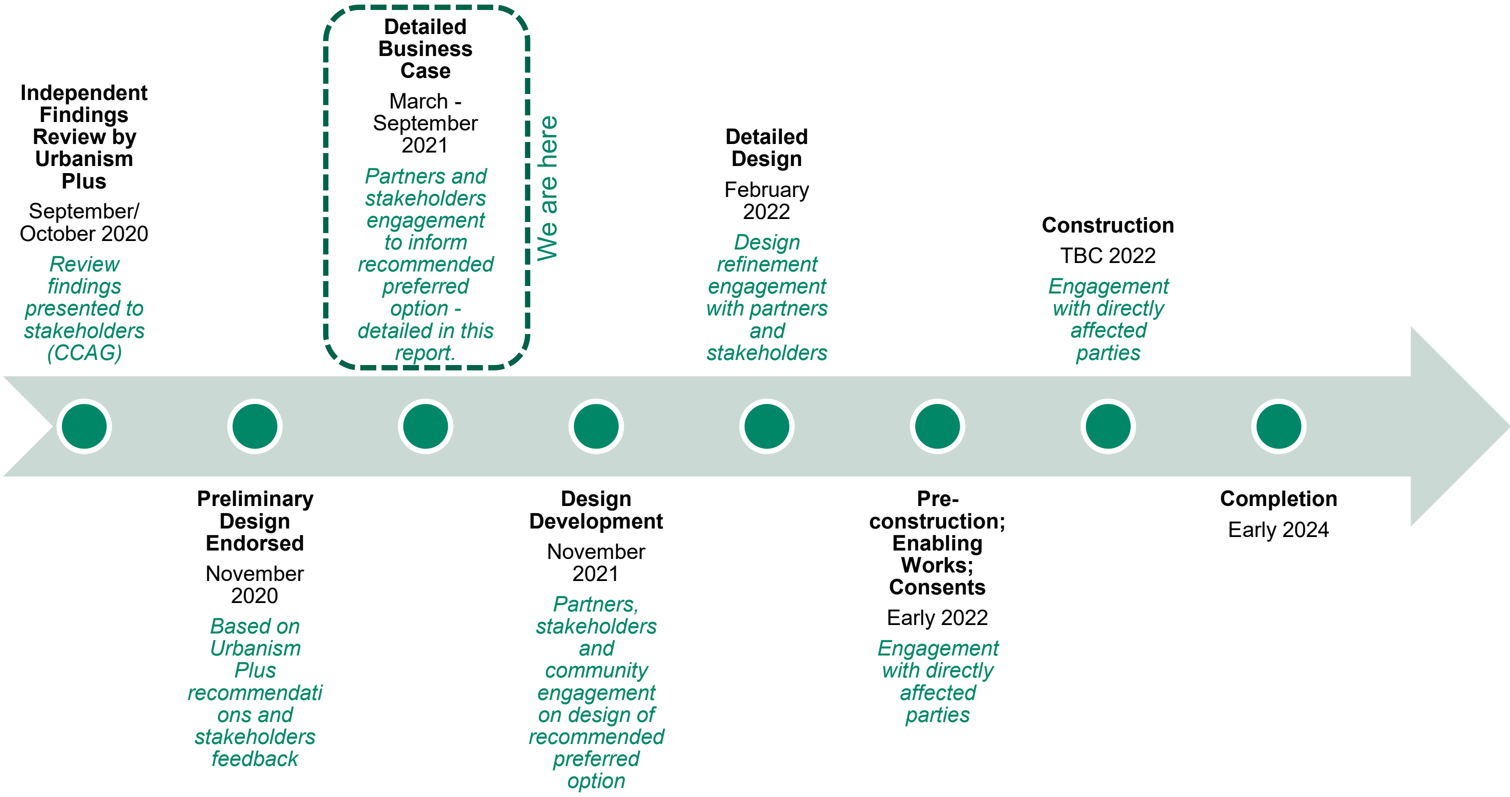


Figure 2-1 Engagement timeline

2.1.2 Key messages

Figure 2-2 provides examples of key messages communicated consistently across affected parties, partners, and stakeholders during DCC's Retail Quarter project's enabling works and construction phases. The complete list of key messages for the Retail Quarter project as outlined in section 9 of the *Retail Quarter upgrade – Communication and Engagement Strategy and* can be found in Appendix A of this report.

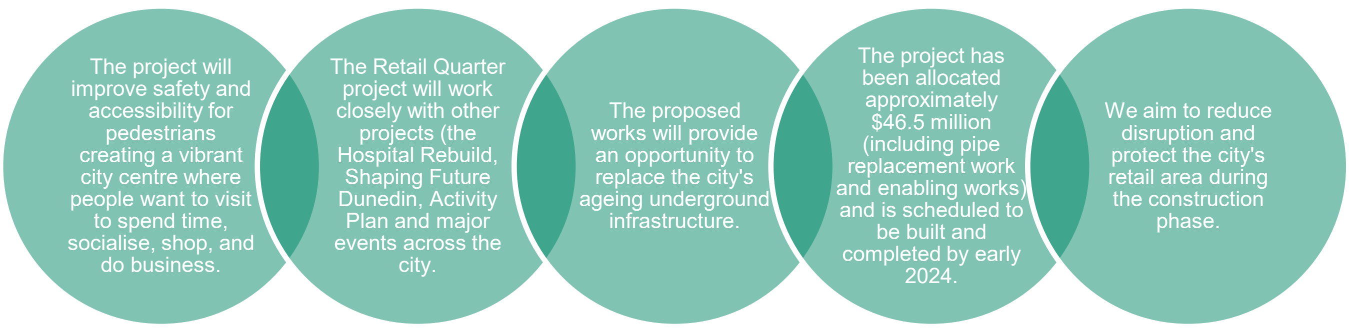


Figure 2-2: Examples of key messages communicated throughout the project to affected parties, partners and stakeholders

2.2 Approach to the DBC engagement phase

A range of contemporary approaches to engagement, associated communication, and engagement activities have been drawn upon in the Retail Quarter upgrade – Communication and Engagement Strategy, which aligns with the International Association for Public Participation (IAP2) principles.

Due to partners and stakeholders' availability restrictions, the project team has been consistently proactive in reaching out and communicating with partners and stakeholders. This has included regular updates regarding progress, sending meeting/workshop invitations in advance, and offering alternative times and online workshop options.

Covid-19 context

A contingency plan is in place to address any cancellation or limitations on group sizes under the New Zealand Government Alert level framework, notably under Level 2 to Level 4 restrictions.

While for most of the DBC phase engagement could continue on a 1:1 face to face meeting basis, the project team encouraged remote interactions for project continuity via phone calls, virtual group and individual meetings, reinforcing the use of written submissions and proactive emails to request and remind project contributors for their feedback.

At the time of writing, the rise in Covid-19 alert level impacted engagement on a single occasion at the early stage of the DBC phase and led to a postponed meeting. With the range of alternative engagement methods and a flexible approach, the project team remains confident that the quantity and quality of the feedback received has been minimally impacted and reflects an appropriate and collaborative decision-making process.

2.3 Methods

Whilst the evaluation of the options was undertaken by partners and CCAG members, the Retail Quarter upgrade required a public-facing element. The DCC Retail Quarter (George Street) Upgrade programme, therefore, ensured to have dedicated web pages (https://www.dunedin.govt.nz/council/policies,-plans-and-strategies/plans/central-city-plan/retail-quarter) on the DCC website. This platform allows the wider community to keep updated on the Retail Quarter project's progress, the next steps, and answers to frequently asked questions. An activity plan will be prepared to encourage the wider community to continue visiting the central city during construction and help minimise any commercial impacts to businesses.

Engagement activities with partners and stakeholders were developed and calibrated for the level of feedback sought at the DBC option assessment, as shown in Figure 2-3. It was important for the project team to reinforce that no option designs had been confirmed at this stage and that further engagement activities would take place during the developed and design phases.

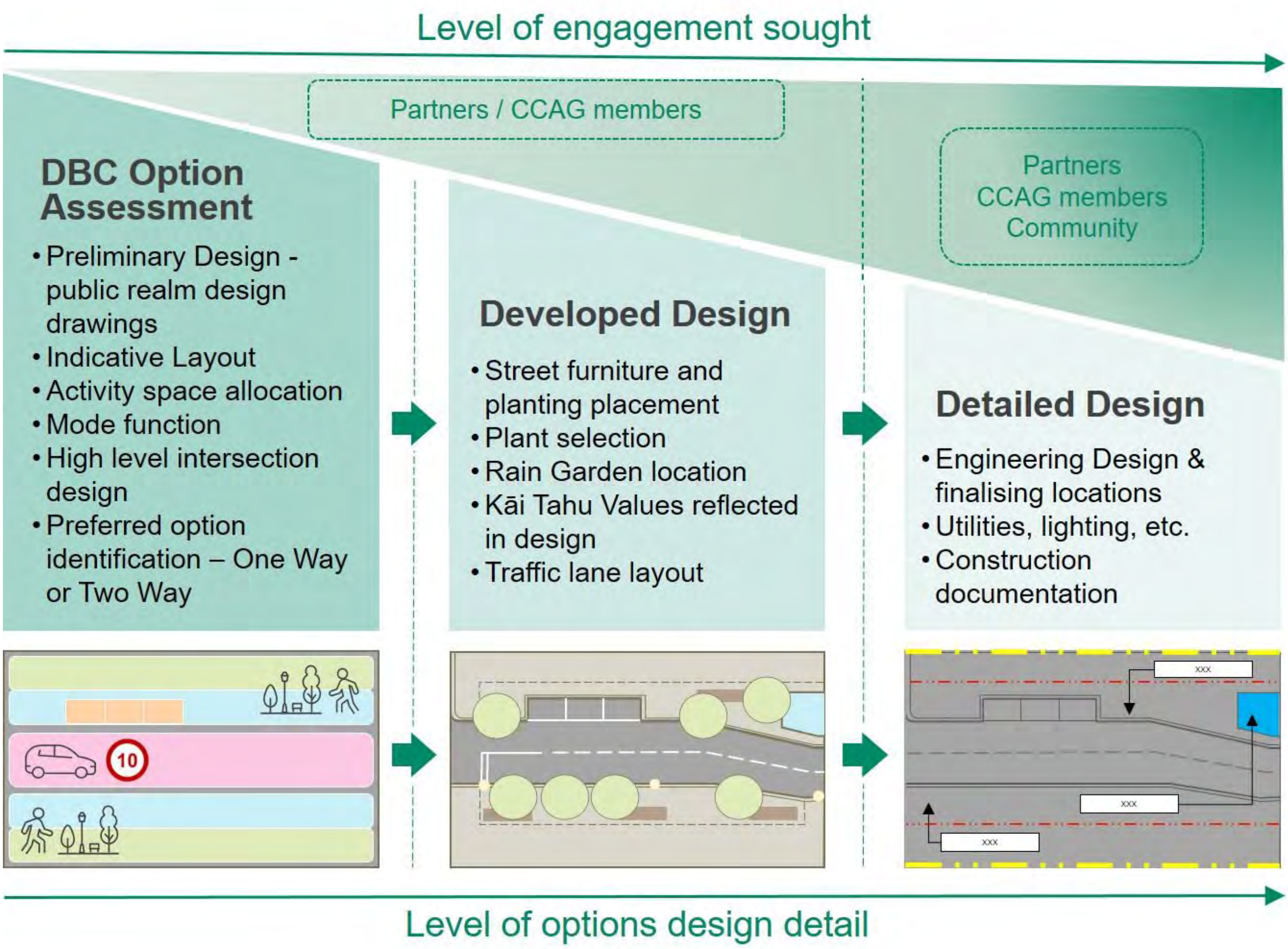


Figure 2-3: Relation between level of detail in option development and level of engagement

While section 3.0 of this report provides a complete list and a brief description of the Retail Quarter project's partners and stakeholders, Table 2-1 summarises how each key group was engaged.

Table 2-1 Engagement methods

Whom we engaged	IAP2 level	How we engaged with them
Partners	Involve / Consult	**Activity:** • Workshops / Hui • Drop-in session • Phone calls • Email correspondence • DCC Intranet **Channel:** • Face to Face • Collateral • Online
Elected members	Empower	**Activity:** • Briefing / Reporting **Channel:** • Face to Face

		• Council formal papers
Stakeholders (CCAG)	Consult	**Activity:** • Cup of tea meetings (1:1 interviews) • Workshops • Drop-in session • Questionnaire • Phone calls • Email correspondence • Retail Quarter project website **Channel:** • Face to Face • Collateral • Online

All partners and key stakeholders are recorded in Appendix B.

3.0 List of partners and stakeholders engaged

The purpose of the engagement to date has been for partners, stakeholders to be involved in developing options and identifying solutions to deliver an excellent project for the local community.

3.1 Project partners

Dunedin City Council

Dunedin City Council (DCC) is one of the Retail Quarter project's key partners and has responsibility for endorsing a preferred option and funding the Retail Quarter project. The engagement with DCC, including elected members, executive leaders and staff, was managed and led internally by DCC's Retail Quarter Project Director and DCC's Project Engagement and Communications Lead. The DBC project team have communicated and worked collaboratively with DCC staff in the development of the DBC.

Waka Kotahi New Zealand Transport Agency (Waka Kotahi)

Alongside DCC, Waka Kotahi is one of the key Retail Quarter project partners as a potential co-investor. To secure Waka Kotahi co-investment for the transport elements of the Project, and to ensure DCC gets the most benefit from its investment in infrastructure and amenity, this DBC process is required.

As one of the project partners, DCC has led the engagement with Waka Kotahi.

Otago Regional Council

Otago Regional Council (ORC) is a Retail Quarter project partner who is responsible for providing technical input and insight with regard to Dunedin's public transport network and infrastructure.

DCC has led the engagement with ORC.

Mana Whenua

Ngāi Tahu is the largest iwi in the South Island and the main iwi of Ōtepoti Dunedin. In the local te reo Māori dialect, it is often referred to as Kāi Tahu, which will be used for the purpose of this report.

Throughout the engagement, Kāi Tahu has been represented by Aukaha. Aukaha is an organisation that provide a link between Māori groups and local government. Aukaha will be the facilitator that links Māori and Pasifika owned businesses with other businesses and sectors in the Otago region.

It is important to identify that Aukaha is classified as both a partner and a member of CCAG. Based on the IAP2 spectrum, best practice ensures Aukaha as representatives of Mana Whenua sit at the partner level, but as an organisation also representing the interests of Māori and Māori owned businesses, it is also important Aukaha are involved in CCAG engagement.

3.2 Project stakeholders

3.2.1 Central City Advisory Group (CCAG)

The Central City Advisory Group (CCAG) is a collective of key organisations that make up and contribute to Dunedin's central city. This includes, but is not limited to business groups, transport groups, community groups and emergency services. Together, CCAG provided representation for Dunedin's central city community and the wider community by advocating for the different interests and communities in the area.

To provide context, each organisation/group which sits on the CCAG that has been involved in this engagement is outlined below, with a brief description of what they represent.

Age Concern

Age Concern is a charity dedicated to people over 65, their friends and whanāu. They promote dignity, wellbeing, equity and respect, and provide expert information and support services in response to older people’s needs.

The role of Age Concern throughout this engagement has been to provide expertise, representation and support for people over 65.

Automobile Association

The Automobile Association (AA) is an incorporated society that provides a range of services and advocates for vehicle users. The role of AA has been to provided representation for vehicle users and identify ideas and solutions to support a positive outcome.

Bus Go Dunedin

Bus Go Dunedin is a bus user support group for Ōtepoti Dunedin, with the mission statement: “Advocacy for bus users and supporting and promoting fast, clean, efficient, low-cost public transport in Ōtepoti Dunedin”.

They support both the users and providers of public transport in Dunedin and provide insight regarding Dunedin’s public transport.

CCS Disability Action

CCS Disability Action is a long-standing organisation that provide advocacy and information in the disability sector nationally. They partner with disabled people and their families to enable them to have choice and control in their lives and use this when connecting with councils and the public to identify and remove barriers that prevent people from achieving their goals.

CCS Disability Action has been involved throughout the engagement; however, they have significantly contributed to providing insight into the consideration of disabled people in the option development and assessment.

Central City Business Group

The Dunedin Central City Business Group is a collective of a majority of the businesses which are located in Dunedin’s central city. This group is a CCAG member to provide collective representation for the businesses within the affected area and to identify issues and solutions in relation to the Retail Quarter project.

Chamber of Commerce

The Otago Chamber of Commerce has provided representation for the businesses in Dunedin’s central city. They are dedicated to promoting and actively encouraging business growth and opportunity.

Disabled Persons Assembly

The core function of the Disabled Persons Assembly (DPA) is to help engagement the New Zealand disability community, to listen to the views of disabled people and articulate these as we work with decision-makers.

Similar to CCS Disability Action, DPA has been involved throughout engagement; however, they have significantly contributed to providing insight into the consideration of disabled people in the option development and assessment.

Fire and Emergency New Zealand

Fire and Emergency New Zealand is a single, integrated fire and emergency services organisation with a mandate to provide a wide range of services for communities.

Throughout the engagement, they have provided their expertise to support the technical team to understand what potential considerations are required from a fire and emergency services perspective, such as the location of fire hydrants and the road width for emergency vehicle access.

Generation Zero

Generation Zero is a youth-led climate action organisation, who mobilise New Zealanders to engage with decision-making and campaign for intergenerational climate justice.

Golden Centre

The Golden Centre Mall is Dunedin's central city main retail hub. Tthe centre's manager, has provided representation for the Golden Centre and its retailers.

Grey Power

Grey Power is an advocacy organisation that promotes the welfare and wellbeing of all those citizens in the 50 plus age group. They monitor what the government is doing and how that will affect those citizens, then provides them with a voice in matters such as the Retail Quarter project.

Throughout the engagement, Grey Power has identified matters which may affect the members of the community over 50 and presented recommendations to contribute to the option design.

It is important to note the same individual represented Grey Power and the South Dunedin Business Association.

Hospitality New Zealand

Hospitality New Zealand works on behalf of its members to promote the industry, partner with the government to prevent restrictive legislation, protect commercial interests and to spearhead innovation for a sustainable future.

There are several restaurants, cafes and hospitality providers located in the project area, and the role of Hospitality New Zealand is to represent their interests and needs.

New Zealand Police

New Zealand Police is working with the community to make New Zealanders be safe and feel safe. Their vision is for New Zealand to be the safest country, which they seek to achieve through partnership with communities and public sector agencies.

Throughout the engagement, they have provided insight into how the Retail Quarter project can deliver safer outcomes for the community, including recognition of Crime Prevention Through Environment Design (CPTED) and the enforcement of speed limits. They also identified to the project team areas which are unsafe or where crime is high.

Otago Polytechnic Students' Association

Otago Polytechnic Students' Association (OPSA) is an independent organisation within the Polytechnic and is run by students for students. OPSA promotes and supplies services, facilities and amenities for students and also represents their views & concerns while promoting the advancement of education.

As Dunedin has a high student population, OPSA along with the Otago University Students' Association, has identified matters of importance and representation for students.

Otago University Students' Association

The Otago University Students' Association (OUSA) represents the students of the University of Otago. Their vision is "every student has the ultimate student experience while at the University of Otago.

As Dunedin has a high student population, OUSA along with the OPSA have identified matters of importance and representation for students.

Pacific Trust Otago

Pacific Trust Otago is an independent community provider of health, education, and social services to Pacific peoples. We work within a holistic framework to improve the health and wellbeing of our community.

They have provided representation for Dunedin's Pasifika community and identified how the Retail Quarter project could support and improve their daily life.

Plunket

Plunket is a charity and New Zealand's largest support service for the health and wellbeing of children under five and their families. They provide a voice for New Zealand's youngest community and advocate for them.

Throughout the engagement, Plunket has provided feedback with regard to how the Retail Quarter project can support children and considerations which the project team should be aware of.

South Dunedin Business Association

The South Dunedin Business Association is an organisation who are working to make South Dunedin a place where businesses want to be, to encourage new businesses to arrive, and support existing businesses to prosper.

Similar to the Central City Business Group, South Dunedin Business Association is providing representation in engagement for the businesses in South Dunedin.

It is important to note the same individual represented the South Dunedin Business Association and Grey Power.

Urban Access Dunedin

Urban Access Dunedin is a recently established incorporated society established to engage with local authorities to ensure access within Dunedin City works for all users. Their mission statement is: "through a commitment to engage with local authorities, we will work with and provide representation on behalf of the public to ensure transportation decisions do not unnecessarily hinder access within our city".

Urban Access Dunedin provided feedback regarding how users access Dunedin City and what the Retail Quarter project can do for all users.

Other CCAG members

The CEO of Mitre 10 MEGA Dunedin and the chairman of the Chamber of Commerce and the Business South Board of Directors provides representation from a business perspective with regard to the Retail Quarter project.

An independent retailer and the store owner sits on CCAG providing representation from a retailer perspective for the stores located along George Street. A landowner and property developer and has been put forward to represent the views of landowners and property developers in the central city.

4.0 Engagement activities

The engagement period for this phase of work took place between June 2021 and September 2021. During this time, the project team actively carried engagement activities collaboratively and analysed feedback continuously for project partners and stakeholders to understand the impact of their feedback on the possible Retail Quarter project outcomes. Overall, the feedback from all these groups has been used to build knowledge, understand potential risks, and influence Retail Quarter project development.

Over the course of the engagement period, 35 pieces of feedback were received from the CCAG members, including:

- Ten CCAG cup of tea interviews; and
- Three CCAG workshops resulting in 26 questionnaires being completed by 19 individual organisations/groups. Due to some stakeholders not being available at the time of these workshops, individual online meetings were held to capture their feedback and questionnaire responses later.

Additionally, one partner workshop was undertaken to proceed with the Multi-Criteria Assessment (MCA) scoring.

At the end of the engagement period, we have advised partners and stakeholders we will come back to engage with them following the 21 September Council Committee meeting and confirm the Council's decision on the preferred option and the next steps for the project.

The following sections summarise the activities and type of engagement undertaken with the projects' partners and stakeholders.

4.1 Partners engagement activities

4.1.1 Partner options assessment workshop - 28 July 2021

On Wednesday, 28 July 2021, a workshop was undertaken with project partners, including various representatives from DCC Departments, Mana Whenua, Waka Kotahi NZ Transport Agency (Waka Kotahi) and Otago Regional Council. The workshop occurred virtually with project partners assembled in Council Chambers in DCC building while the project team joined the meeting via Teams from their respective home organisation offices.

This workshop principally aimed at introducing the MCA framework that would assist in the decision-making process and how it applied to the Retail Quarter project. Additionally, the workshop aimed at:

- Providing partners with the opportunity to understand how different options compare against a set of standard and grouped criteria
- Capturing the diverse mix of knowledge/perspectives within the group to challenge and inform the assessment conversation; and
- Gaining agreement within the group on what is being assessed in the MCA and how to measure it.

The group were presented an overview of the technical assessment of the options and discussion focused on measuring the impact of the options against the investment objectives as well as criteria to assess implementability and assessment of effects. It was noted that qualitative scoring was not be applied to all criteria.

While the workshop did not conclude with final scoring of the options, the criteria were refined and valuable feedback was captured to be able to complete the MCA scoring. The MCA scoring spreadsheet was circulated to partners for commentary and their scores. Key engagement discussion points and the project team response were recorded and outlined in Table 4-1 below. The MCA results and summary are provided in the DBC.

Table 4-1 Project partner workshop - Summary of comments and responses

Comment topics	Project Partners comments / questions	Project Team response and actions taken
Presentation and technical input	Modelling diagrams are difficult to understand.	Project team to provide more 'digestible' content during the presentation and meet individually or in group with partners and stakeholders who are particularly interested in reviewing the traffic modelling input.
	Concerns over traffic model showing a reduction in through-traffic volume. Need further explanation otherwise, it could be perceived negatively.	Traffic diverts to the parallel corridors of Great King and Filleul Streets as is the intent of the enabling works. A key objective of the project is to reduce through traffic to free up the street for people want to visit the Retail Quarter. . Additional concerns could be alleviated by adding a slide outlining some of the FAQs on the modelling.
Investment objectives	Can we integrate a measure relating to commercial activity in the investments objectives KPIs?	The project outcome can influence the visitation rates however cannot influence sales and other retail activity of selling goods and services to visiting consumers. It is recognised that the street layout should enable and support the function and this measure might fit into the benefits realisation plan.
	A Do Minimum plus option was raised by Waka Kotahi to test the direct impact of transport improvements.	Several meetings have been held with Waka Kotahi and this issue has been resolved.
	Measuring reduction in through traffic could be done with select link modelling analysis rather than selecting a representative block..	Select link analysis has been used to score IO2.
	<u>IO3</u> Some issues with the specificity of the scoring method. Questions surrounding whether this should be more of a subjective process. A narrative of the user of experience may be a way of explaining the story behind the sense of place Space for pedestrians represents an opportunity for placemaking – does not have to be pedestrian-related.	Perception of safety and improved sense of place and quality of experience measurement been changed to include the opportunity for retail investment and spending in the George Street. The scoring criteria adapted to include consideration of level of service at the 5 arm intersection and a subjective measure of significantly adverse to significantly positive.

Options design and layout	Is the carriageway layout sufficient for emergency vehicles to park and breakdowns?	Yes. Fire and Emergency are happy with the carriageway layout and the design team have the specific measurement to adequately accommodate the largest emergency vehicles to include in the developed and detail design.
	How is the traffic flow intended in between blocks?	To meet the investment objectives, the design will discourage through movements the length of the corridor. Access will be maintained to all blocks for all modes expect buses which divert to Great King Street.
	What is the proposed design for kerb shift when entering a block?	George Street will be raised at one level so vehicles will ramp up on to it from the cross roads. The east west parallel street intersections will be the same level to ensure efficient movement of cross town movements.
	How are the options dealing with potential cyclists travelling opposite the vehicle flow?	As a shared space cyclist can move in either direction adhering to the 10km speed limit.
Transport Modelling	Was any modelling done on the overall network for the 'smart street' configuration?	No, modelling is completed at peak hour when it is unlikely to close sections of the street.

4.2 Stakeholders engagement activities

Two rounds of engagement were undertaken with Retail Quarter project stakeholders during the DBC development phase. The first round of engagement was 'Cup of Tea' meetings with each CCAG member to capture the feel and sentiments of each party on the current state of the Retail Quarter and George Street short list options, while the second round was three workshops across two days which captured the level of support and opposition to the proposed short list options.

4.2.1 CCAG initial meetings - Tuesday 8 June 2021 to Thursday 10 June 2021

From Tuesday 8 June to Thursday 10 June 2021, the project team invited and hosted cup of tea format meetings with each member of the CCAG at the Harvest Court Mall in Dunedin Centra. These meetings aimed to capture individual groups specific feedback and feelings regarding the current state of the Retail Quarter and George Street.

Appendix C shows the event's run sheets, and notes template (with the semi-structured interview-style questions list) used during these meetings.

Across the three days, ten meetings were held with different CCAG members. These initial meetings aimed at reviewing the short list of options, including the option preferred by Council (One-way with the possibility of going two-way in future, a two-way option assessed during the Indicative Business Case (IBC) and a Smart approach design which allowed for the flexibility for certain blocks along George Street to be closed to traffic temporarily on weekends or evenings for events or activities.

During those meetings and to support the process, aerial maps were on display, and the CCAG members were able to use post-it notes to share their thoughts and identify areas where problems were and where potential opportunities exist.

Overall, these meetings were positive and provided useful feedback and suggestions, which informed the refinement of options. Table 4-2 provides a summary of the key themes which came from this round of engagement and also the response from the project team to this feedback when developing the options. The table highlights key features CCAG identified they would like to see in the Retail Quarter project, including space for pedestrians and maximisation of parking, while also shaping the Retail Quarter into an environment for the community and visitors to enjoy. The complete record of those initial meetings has been appended to this report.

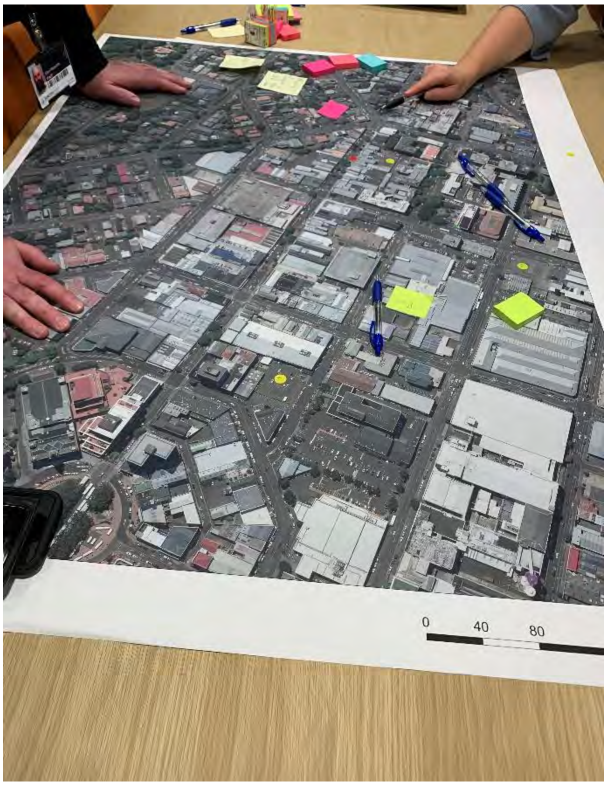


Figure 4-1: Material displayed during the cup of tea meetings

Table 4-2 Summary of themes from CCAG initial meetings

Key themes from the CCAG initial meetings		How the feedback influenced the option development
	Access and safety – particularly Kaumatua and vulnerable communities in mind, as well as the business community	George Street all at the same level – no height differentiation between the road and footpath providing inclusiveness and ease of access
	Maintain as much parking as possible – a key barrier to accessing town → this includes improving mobility parking	Most parking has been retained – more accessibility and short parks for pick up and drop offs
	Make it a destination – including the consideration of seasonal activities/events to draw diverse groups to the CBD	Maximising space for pedestrians and activity (including seats, art and cultural expression)
	Maximise space for pedestrians – the space needs to be more inclusive and open with greening and street furniture, and minimise crossing time of vehicle lanes	

Key themes from the CCAG initial meetings		How the feedback influenced the option development
	Sustainability and environmental innovation – future proof for the benefit of future generations	
	Make all options 'smart options' – flexibility for all options, including flexibility to cater for couriers and service vehicles	The 'Smart street' approach could apply to any of the options and be implemented on the 'preferred option.'

4.2.2 CCAG workshops – Monday 2 August 2021 & Tuesday 3 August 2021

The options developed during the DBC were presented to all stakeholders during a series of workshops held at the Auditorium at Toitu Otago Settlers Museum in Dunedin central.

To better manage and optimise stakeholders input and feedback, the CCAG was split into three smaller groups, each being allocated a workshop date and time on either:

- Monday 2 August 2021 9 am to 12 pm; or
- Monday 2 August 2021 1 pm to 4 pm; or
- Tuesday 3 August 2021 1 pm to 4 pm.

Due to changing circumstances, a few CCAG members could not attend the above dates. The project team, therefore, provided additional workshops via MS Teams. Two workshops were run on 6 August 2021 with representation from the Chamber of Commerce, Grey Power, Hospitality Association Dunedin, and South Dunedin Business Association. Aukaha who attended the partners workshop, were asked to provide on behalf of Mana Whenua a response to the CCAG questionnaire.

The project team engaged with stakeholders in each session (in-person and via MS Teams) to capture the local community's breadth of knowledge and experience, including those with a commercial interest in the Dunedin central city area. The workshops allowed the project team to showcase some of the indicative street layouts for all options.

All stakeholders were encouraged to share thoughts and provide written feedback via the questionnaire handed in at the start of the workshops. The questionnaire was designed to capture what elements of each design each individual group supported and which were opposed to.

A copy of the questionnaire is provided in Appendix E.

Overall, all CCAG members who attended the sessions provided positive feedback on the level of technical assessment undertaken to develop the DBC options. There was a consensus amongst attendees in recognising the necessity for such work to occur as soon as possible. The cost was overall found to be acceptable, and the level of detail provided was commensurate with the feedback sought by the project team.

Most attendees also mentioned they felt their previous feedback had been meaningfully considered during the process and they could see how the options had evolved with their input.

At the end of each session, attendees were asked to complete a questionnaire. All results from those questionnaires have been summarised in Section 5.2 of this report.

Figure 4-2: CCAG workshop (Tuesday 03 August 2021)

4.3 Elected Members engagement activities

At the date of writing, engagement activities have not taken place with Elected Members. A workshop/briefing is scheduled on 28 September 2021. Some Elected Members have attended DCC update meetings whilst the DBC was being drafted. Their presence and input into the Retail Quarter project have been valuable and have helped shape an understanding of key community concerns.

5.0 Engagement feedback

The engagement carried out during the DBC option assessment will significantly impact the recommendations the project team will make to Dunedin City Council Elected Members on the 28 September 2021. The following subsections outline the findings of each engagement session with project partners and project stakeholders.

5.1 MCA scoring and commentary

Table 5-1 provides a summary of the scoring of the MCA. The complete MCA framework, including scoring scale and scoring guidance, is included in the DBC.

Table 5-1: MCA Summary - Options Assessment

Option	Criteria	Commentary
Do-Min	IO	• Neutral score against IO1 and IO3, as retaining the existing layout will not reduce frequency/severity of incidents, nor improve place quality • Lowest score against IO2 due to an increase in through traffic
	Feasibility	• Joint lowest score against feasibility criteria primarily due to worst BCR.
	Stakeholder	• Lowest scoring option for stakeholder acceptability, as perceived to be a wasted opportunity
	Environment	• Overall neutral score against environmental effects, due to no change in street design, meaning no improvement to arts, culture, amenity, activity space, provision of raingardens, or improvement to accessibility
One Way Northbound	IO	• Joint highest score against IO1, as crossing distance is significantly reduced compared to existing. • Score highly against IO2 due to significant reductions in through traffic • All options, apart from the do-minimum option, positively score against IO3 due to increased pedestrian space and place making opportunities.
	Feasibility	• Joint lowest score with high levels of disruption and high level of surface treatments. Highest BCR of the one-way options.
	Stakeholder	• Primarily a positive sentiment towards the one-way option but a notable proportion of stakeholders gave this option a significantly adverse score. Highlights the varying levels of acceptability for this option.
	Environment	• Joint highest score with southbound option due to greatest opportunity to increase space for amenity, activity, culture, and environmental benefits.
One Way Southbound	IO	• Joint highest score against IO1, as crossing distance is significantly reduced compared to existing. • Scores highly against IO2 due to significant reductions in through traffic • All options, apart from the do-minimum option, positively score against IO3 due to increased pedestrian space and place making opportunities. • Additionally, Southbound option enables the removal of a signal phase at the 5-arm, contributing to decrease in total cycle time.
	Feasibility	• Joint lowest score with high levels of disruption and high level of surface treatments. Lowest BCR of the one-way options.
	Stakeholder	• Primarily a positive sentiment towards the one-way option but a notable proportion of stakeholders gave this option a significantly adverse score. Highlights the varying levels of acceptability for this option.
	Environment	• Joint highest score with northbound option due to greatest opportunity to increase space for amenity, activity, culture, and environmental benefits.

Option	Criteria	Commentary
Two Way	IO	• Low positive score against IO1 due to two way traffic and minimal reduction in crossing distance. • Scores highly against IO2 due to significant reductions in through traffic • All options, apart from the do-minimum option, positively score against IO3 due to increased pedestrian space and place making opportunities
	Feasibility	• Higher level of surface treatment compared to do-minimum. • The two-way option has the highest BCR, which is the primary contributor to an overall less adverse score
	Stakeholder	• Highest scoring option for stakeholder acceptability, with less variability in the scores from stakeholders.
	Environment	• An overall minor positive score against these criteria, due to an increase in space that allows for amenity, activity, culture, and environmental benefits, but to a lesser degree compared to the one-way options.

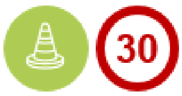
5.2 CCAG Questionnaire summary

The questionnaire handed in during the CCAG workshop sessions asked each respondent to identify elements of the design they like and do not like for each option (Question 1 & Question 2) as well as if the option would encourage them to visit the Retail Quarter (Question 3) and finally a rating of how acceptable the option is to each of their individual organisation (Question 4).

The following sections provided a summary of the above outlined questions for each DBC option. It is important to note that to align with the DBC MCA framework and for the purpose of consistent reporting, the question 4 scoring scale (1 to 7) has been converted to the MCA scoring scale of -3 to 3 as it represents the *Stakeholders acceptability* criteria outlined in the MCA.

5.2.1 Do Minimum

The Do Minimum option involves replacing three waters infrastructure with th retention of the existing design and layout on George Street. Minor improvements include replacement of pavers. This option retains the existing speed limit at 30km/h.



Three waters replacement and replacement of George Street to existing design and layout with minor improvements such as replacement of pavers (30km/h speed limit).

Figure 5-1 shows the response of CCAG members to the Do Minimum option in the questionnaire in response to question 4 *Please provide a rating between 1 and 7 of how acceptable this option is to your organisation.*

Figure 5-1: CCAG response to Do Minimum option

Overall, respondents showed little to no support for the Do Minimum, with the largest portion of respondents being opposed to this option.

Based on the questionnaire responses, the key comments were extracted to identify what elements of the Do Minimum are supported or opposed by the CCAG members. These comments are shown in Table 5-2**.**

Table 5-2: Comments associated with Do Minimum

	Associated comments
Element of support	• Currently works for traffic • Allows more money to be spent on other infrastructure • Familiar for emergency personnel accessing • Bus service may be retained along George Street both ways
Element of opposition	• Two-way traffic creates more risks and removes space from pedestrians and amenities • Yuk! • Upgrade George Street now when the roads need digging up • Current streetscape looks tired • Does not further enhance the CBD • Upgrade is long overdue • Insufficient pedestrian space • Not innovative, wasted opportunity

Overall, many respondents recognised that the current function of George Street works. However, there was generally a shared agreeance that it would be a wasted opportunity not to upgrade the area while the three waters infrastructure is being upgraded and causing the road to be uplifted.

5.2.2 Option 1

Option 1 is one of two one-way options. With this option, George Street would be changed to a one-way northbound traffic flow with a speed limit of 10km/h.. This option was previously identified as one of two of DCC's IBC preferred options from the Council resolution.

George Street to be made One Way Northbound with a 10km/h speed limit.

Figure 5-2 shows the response of CCAG members to Option 1 in the questionnaire in response to question 3 *Please provide a rating between 1 and 7 of how acceptable this option is to your organisation.*

Figure 5-2: CCAG response to Option 1

Figure 5-2 shows a range of responses for Option 1; however, overall, more respondents were in support.

Based on the questionnaire responses, the key comments were extracted to identify what elements of Option 1 are supported or opposed by the CCAG members. These comments are shown in Table 5-3.

Table 5-3: Comments associated with Option 1

	Associated comments
Element of support	• Reduces in vehicle traffic (as discourages through traffic) • Speed reduction will reduce any cost (social) associated with crashes • User friendly environment • More friendly retail area which provides a better customer experience and encourages people to spend time in CBD (particularly elderly) • More spacious, which allows for other activities • Enhances amenity • Attractive pedestrian friendly environment • Improves safety • Improved access (to Meridian carpark)

	• More accessible for Pacific and disabled communities
Element of opposition	• 10km/h difficult to enforce • Strongly dislike – too many restrictions • Traffic congestion • Reduces parking • Impedes convenience for people shopping • Does not retain two-way flow (how will southbound traffic move southwards)

Overall, the comments in response to this option were mixed. Several respondents raised concerns with the implementability of a speed limit of 10km/h, however, respondents also identified numerous benefits to this option, particularly in regard to safety and amenity. It is important to note that a few of the respondents identified Option 1 as preferred to Option 2, which is very similar, due to the northbound option being more accessible for Pacific and disabled communities.

5.2.3 Option 2

Option 2 is one of two one-way options. With this option, George Street would be changed to a one-way southbound traffic flow with a speed limit of 10km/h.. This option was previously identified as one of two of DCC's IBC preferred options from the Council resolution.

George Street to be made One Way Southbound with a 10km/h speed limit.

Figure 5-3 shows the response of CCAG members to Option 2 in the questionnaire in response to question 3 *Please provide a rating between 1 and 7 of how acceptable this option is to your organisation.*

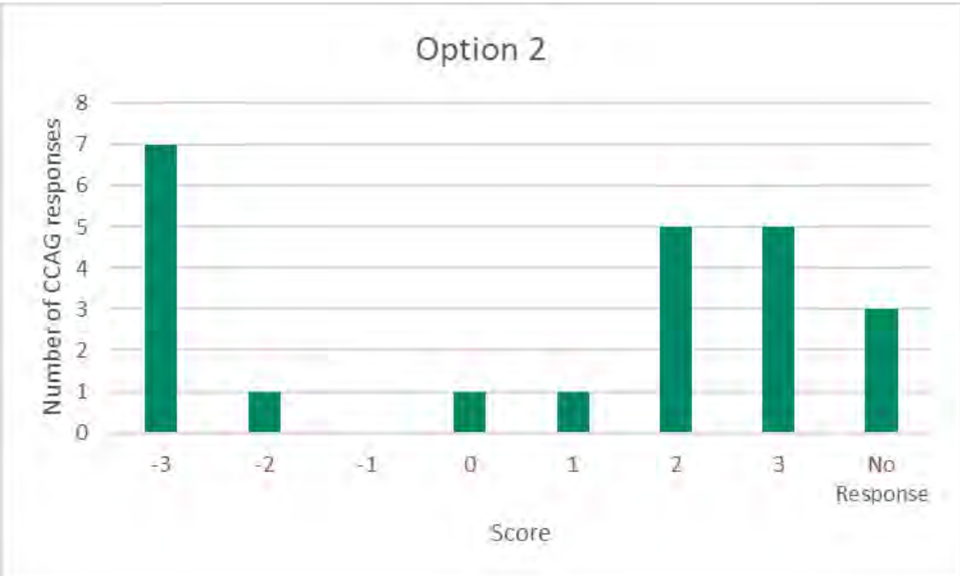


Figure 5-3: CCAG response to Option 2

Figure 5-3 shows a range of responses for Option 2; however, overall, more respondents were in support.

Based on the questionnaire responses, the key comments were extracted to identify what elements of Option 1 are supported or opposed by the CCAG members. These comments are shown in Table 5-4.

Table 5-4: Comments associated with Option 2

	Associated comments
Element of support	• Reduces in vehicle traffic (as discourages through traffic) • Speed reduction will reduce any cost (social) associated with crashes • User friendly environment • More friendly retail area which provides a better customer experience and encourages people to spend time in CBD (particularly elderly) • More spacious, which allows for other activities • Enhances amenity • Attractive pedestrian friendly environment • Improves safety
Element of opposition	• 10km/h difficult to enforce • Too many restrictions • Reduces parking • May cause traffic congestion • One-way option limits travel options around the CBD • Does not retain two-way flow (how will northbound traffic move southwards) • No provision for bus access and makes any bus service on George Street unviable • Separation of cyclists/e-scooters required

Overall, there was a range of comments in relation to this option. Several respondents raised concerns about the implementability of a speed limit of 10km/h. However, respondents also identified numerous benefits to this option, particularly in regard to safety and amenity.

5.2.4 Option 3

Option 3 involves retaining the two-way flow of George Street while implementing a speed limit of 10km/h..

George Street to be retained as a Two Way with a 10km/h speed limit.

Figure 5-4 shows the response of CCAG members to Option 3 in the questionnaire in response to the question, p*lease provide a rating between 1 and 7 of how acceptable this option is to your organisation.*

Figure 5-4: CCAG response to Option 3

Figure 5-4 shows a range of responses for Option 3; however, overall, more respondents were in support.

Based on the questionnaire responses, the key comments were extracted to identify what elements of Option 3 are supported or opposed by the CCAG members. These comments are shown in Table 5-5.

Table 5-5: Comments associated with Option 3

	Associated comments
Element of support	• Creates more space for pedestrians and activities • User friendly • Better and safer traffic flow • Easy and convenient access • Parking readily available • Allows enhancement to streetscape • Increases pedestrian space • Easier accessibility for mobility and sight impaired
Element of opposition	• 10km/h difficult to enforce • Difficult to navigate in comparison to one-way • Increased risk to pedestrians • Less pedestrian space • One-way option safer for children • Poor use of space • Prioritises traffic over people

Several respondents identified option 3 as their preferred option as they felt it would result in better traffic flow; however, most did oppose the speed limit of 10km/h. Many respondents who opposed this option felt that it was a poor use of the space and prioritised vehicles over people.

5.2.5 Question 3

Question 3 of the questionnaire asked respondents whether each of the options, excluding the Do Minimum, would encourage them to visit the Retail Quarter. Figure 5-5 shows the response from all respondents.

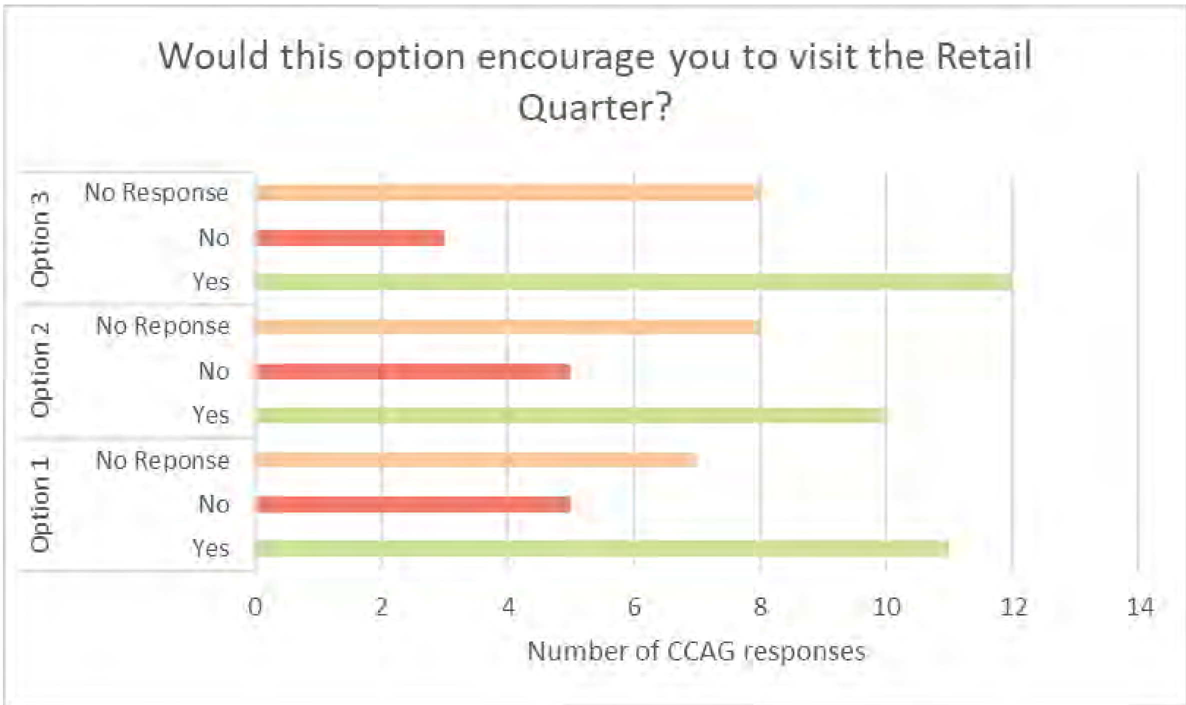


Figure 5-5: CCAG response to Question 3

Overall, across all the options, there were very few 'No' responses, while several respondents did not respond to this question at all. Of the three options, Option 3 scored highest with 12 respondents identifying that this option would encourage them to visit the Retail Quarter. This was closely followed by Option 1 with 11 respondents and then Option 2 with 10 respondents.

5.3 Themes

All discussions undertaken with stakeholders (CCAG members) had recurring themes across the engagement period. However, some themes were more prominent than others depending on the organisations represented during the meeting and workshops.

Table 5-6 demonstrates how some of the key themes were repeated across the entire engagement period:

Table 5-6 Key themes outlined during the various meetings and workshops

CCAG Initial meetings [March – 21 June]

CCAG Workshop [Monday 02 August AM]

CCAG Workshop [Monday 02 August PM]

CCAG Workshop [Tuesday 23 August PM]

The key themes recorded during the stakeholders' discussions and workshops have been outlined further in Table 5-7 against the Dunedin City outcomes. This forms a comparison point to evaluate how well the CCAG feedback aligns with the city outcomes.

Table 5-7 Key workshops & discussions themes in relation to Dunedin City vision and community outcomes

Retail Quarter Vision and outcome	Themes – What we heard during the workshops	Verbatim *("Quotes")*
 ***Putting people first***, by: - Improving the pedestrian experience of the city - Improving safety - Celebrating our walkable city - Creating meeting and resting points - Increasing pedestrian space in the central city	**Pedestrianisation** – a place for people to walk safely with traffic encouraged to use surrounding streets. **Safety**- for pedestrians **Access**- for all ages and abilities to come, rest and celebrate our city by foot **CTPED (Crime Prevention through Environmental Design)** – make this a safe place for people to walk at any time of the day	*"Shared space is good and so is one-way – safer for everyone."(Emergency services)* *"For us pedestrianising George Street is what we support. I can't speak for all students mind you!"(Otago Polytechnic Student Association)*
 ***Creating an Ōtepoti Dunedin sense of place, by:*** - Celebrating Dunedin's distinctive heritage, culture and character - Enhancing the city with input from its residents - Reflecting Dunedin's past and develop its future  ***Streets as places***, by: - Promoting George Street as a destination - Creating a memorable and distinctive place; an accessible city; and places for people to meet	**Sense of place –** refers to street activities and culture – celebrate Dunedin's unique heritage and growing diverse culture. **'Instagramable'** – make it a place where people want to take Instagram photos, like the Wynyard Quarter in Auckland. **Create a vibrant city centre for everyone**- where there's ongoing activity to attract people to the area. **A place that is appealing where people want to go and spend time** - create a destination.	*"Create a buzz in Dunedin's central city."(Chamber of Commerce)* *"We should have a central city we are proud of, that is New Zealand leading in their accessibility and inclusivity." (Disabled Persons Assembly)* *"With creating a space embedded with manaakitanga, an opportunity for mātauraka and other community events it becomes a destination rather than a pathway."(Aukaha / Mana Whenua)* *"It's the simple things for me, I work in the Octagon and I walk out to the cafes and they're buzzing, that's what I'm looking forward to." (Age Concern)*

 ***Greening the city*, by:** - Creating a green network of trees and plants in the central city to reduce carbon emissions - Greening the streets to contribute to stormwater improvements - Restoring wildlife corridors and habitats for birds and insects	**Future-proofing for the next generation**- Ensure this is an adaptive street that is flexible enough for the needs of the next generations	*"We have to think of this project from the perspective of future generations and what's going to be better for them! We want people to come here and that this space serves their needs." (Students and youth)*

6.0 Emerging preferred option

The recommended option to the DCC Planning and Environment Committee on 28 September 2021 is a balancing recommendation between the MCA scoring outcomes and the CCAG initial meeting and workshops feedback.

6.1 MCA conclusion – Overall preferred option and rationale

In conclusion, there is no emerging preferred option as a result of the MCA for the following reasons:

Table 6-1 MCA preferred option

MCA Option assessment summary	Performance against investment objectives	Performance against Implementability	Performance against Assessment of effects
Option Preference and rational	One way Southbound is the preferred against the IOs as slightly higher safety outcomes as a result of being able to remove a signal phase at the 5 arm intersection.	One way Northbound scores is the preferred in terms of implementabilty (very marginally) due to a slightly better BCR.	Both one way options are equally preferred due their increase ability to accommodate accessibility, mana whenua values, arts, culture and amenity.
MCA Conclusion	No clear conclusion. This will be a decision made by DCC Councillors.		

6.2 CCAG Questionnaire results

From the 19 organisations and groups engaged during the stakeholder's workshop in early August 2021, 23 questionnaires were received. Various organisations and groups submitted multiple questionnaires which had identical option preferences and key themes outlined. These organisational duplicates were accounted as a single and unique submission to reflect the selection process fairly.

There was a split preference between Option 2 - One way Southbound and Option 3 – Two way from CCAG members as shown in Table 6-2 below. It should be noted that several organisations identified one way as their preference, but did not have a preference of which direction. These votes were put into one way South as the most popular one way option.

Table 6-2 CCAG preferred option

Emerging preferred option from CCAG consultation	
Do minimum – Three waters replacement and minor design improvements. Speed remains at 30km/h	**0 (0%)**
Option 1 – One-way northbound. Speed is reduced to 10km/hr	**4 (18%)**
Option 2 – One-way southbound. Speed is reduced to 10km/hr	**9 (41%)**
Option 3 – Two-way. Speed is reduced to 10km/hr	**9 (41%)**

<u>Option 3 (Two-way. Speed is reduced to 10km/hr).</u> This option was favoured by retailers, landlords, the hospitality industry, bus users and accessible groups as it would retain much of the current configuration with minimal impact to, car parking and convenience for shoppers to George Street. Despite the scoring and the slight preferences, many felt the options were similar, and they could see the merits of both the one way and two-way options.

<u>Option 2 – One-way Southbound. Speed is reduced to 10km/hr.</u> A significant proportion of individuals part of accessibility groups and the Pasifika community living in South Dunedin, thought this option

would provide a convenient connection onto the state highway for most southbound travellers from George Street.

It should be noted that Hospitality Association Dunedin, did not wish to provide a response to the questionnaire, as individual members had diverse interests, views and concerns, therefore a collective response was challenging to provide. All members were aware and given every opportunity to provide individual responses through their Regional Manager.

6.3 Recommended option

The split preference between Option 2 and Option 3 reflects a desire from individual members to retain existing convenient access to commercial areas to retail, hospitality and parking along George Street; while others want to see a enhancement in access and safety for pedestrians in this area. Overall, there was a common desire to create a Retail Quarter that is vibrant and instragrammable, inclusive and progressive.

7.0 Next Steps

The Retail Quarter project is currently at the development of the DBC phase, as shown in Figure **7-1**. The DBC will be finalised in the coming weeks to be presented to DCC Elected Members on 28 September 2021.

Following the review and endorsement of the funding by DCC Planning and Environment Committee on 28 September 2021, the early works projects will then commence, along with face to face engagement. The programme for this engagement is identified in the *Enabling Works Tactical Plan*.

The project team continues to engage and respond to questions gathered during the development and subsequent delivery of the DBC.

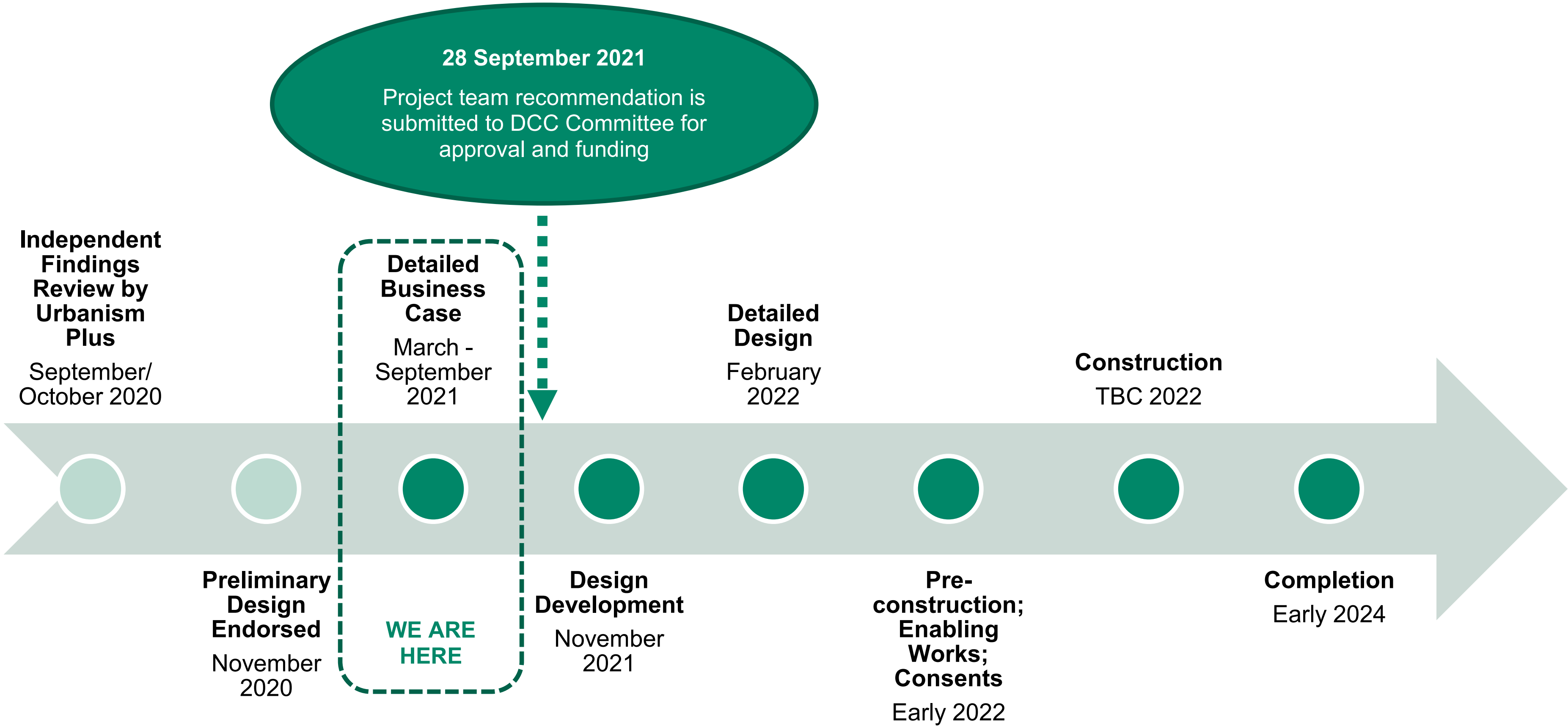


Figure 7-1 Retail Quarter upgrade project timeline – next steps

Appendix A

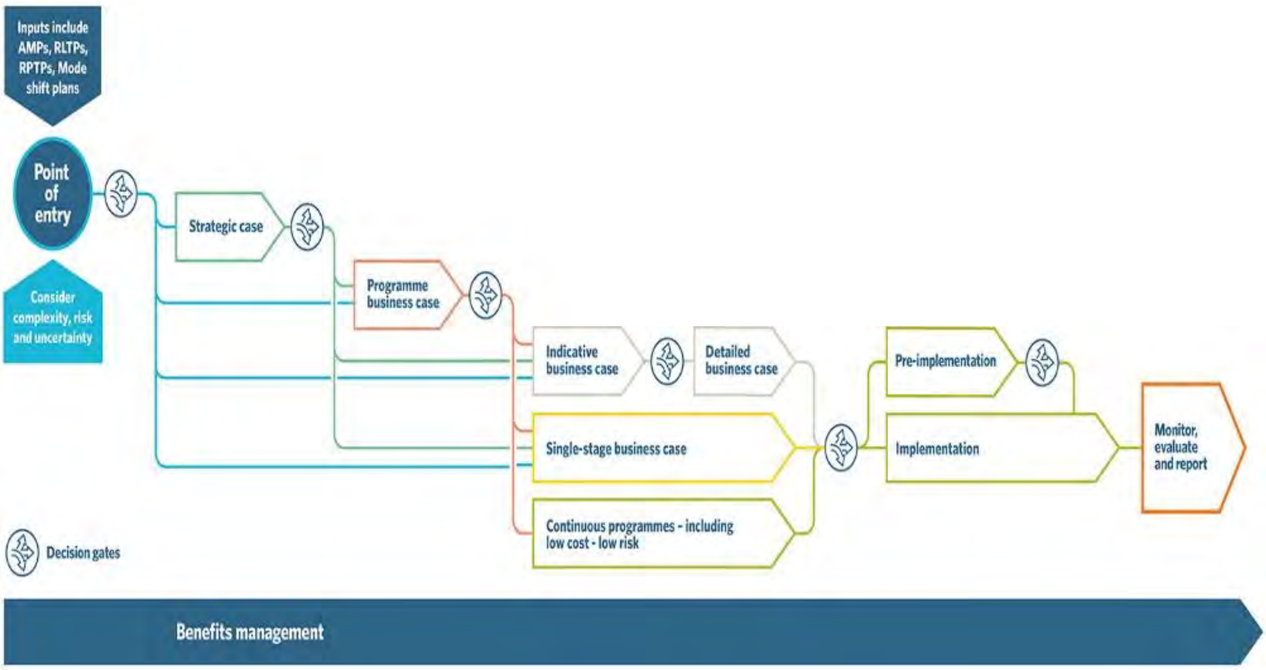
Retail Quarter Upgrade – Engagement Key Messages

KEY MESSAGES

- For use both internally and externally to ensure consistency and continuity in all of the Project messages, across all media and by all involved
- Educate and inform bring people on the journey – 'Let them see and hear the big picture' – and show that we are listening to their needs: provide confidence and reassurance i.e. we want to get this Project right for Dunedin.

Detailed Business Case specific
In order to secure Waka Kotahi (New Zealand Transport Agency) co-investment for the transport elements of the project and to ensure the DCC is maximising its benefits from investment in infrastructure and amenities, we have been undertaking a two-stage business case process. To find out more, go to Download the detailed business case document information guide [DOCX, 1.2 MB]

An outline of Waka Kotahi's Business Case Benefits Management process is outlined in the following diagram (refer to the figure below).



- The purpose of the Detailed Business Case is to compare the benefits, costs, and risks of each option to provide a clearer basis for determining which one best meets the desired outcomes and is most effective in solving the identified problems.
- The DBC process helps to clarify the following:
  - Is this th right investment, is it affordable and provides value for money?
  - Will it deliver the outcomes identified?
  - puts in place plans for successful delivery
- The DBC also focuses on the costs associated with delivering the selected option and the construction approach to be taken.

- The first stage (the initial Indicative Business Case) was completed in 2020. In November 2020 following peer-review of the IBC by Kobus Mentz of Urbanismplus, the elected members of DCC resolved the following: Approves proceeding to detailed business case and developed design with a one–way design with flexibility to go to two-way shared street design for the Dunedin Retail Precinct George Street upgrade
- DCC staff are working with AECOM (part of the Ō3 Collective – our consultant team) to advance the Detailed Business Case (DBC). This includes further targeted engagement, particularly with the Central City Advisory Group (CCAG), made up of a range of stakeholders and directly affected parties with interests in the Retail Quarter – George Street upgrade.
- To ensure the of the DCC's preferred option is well-evaluated and its investment justified, the Detailed Business Case is comparing it against other options to understand benefits and costs of each more clearly. The options being evaluated in the DBC are:
  Option 1: One way northbound
  Option 2: One way southbound
  Option 3: Two-way slow street
  Option 4: Two-way flexible street
  Option 5: Do minimum (replace as-is, with minor safety improvements)
- Once the Detailed Business Case and an independent peer review have been completed, the findings will be presented to DCC for its confirmation or reconsideration of its preferred option.
- This Detailed Business Case will then be submitted to Waka Kotahi to consider their level of investment.
- With all of this information in hand, DCC staff will seek approval to proceed to the detailed design of the approved option and programming replacement of infrastructure and upgrade of transport and amenity assets in the area.
- It is expected phased construction of the George Street component of the Retail Quarter works will commence in 2022.

Enabling works

- The DCC is planning works in Great King Street and Filleul Street to support the infrastructure, transport, and amenity upgrades of George Street.
- The enabling works are not dependent on any specific design option on George Street, but focus on improving vehicle movement through both Filleul and Great King streets, including improving access to parking buildings and with a specific focus on allowing the bus movements in Great King Street.
- The intent of these works is to:
  - Reduce the transport impacts of road closures during the upgrade of infrastructure and amenity on George Street
  - Improve east-west connectivity and reduce the impacts of the construction of the new Dunedin hospital on the central city transport network
  - Provide alternative options to George Street for through movement, to assist in making that a more people-focused place in the longer-term
- The enabling works are being planned in parallel with the DBC for the Retail Quarter and their impacts will be factored into designs for George Street

- It is expected construction of these changes will commence in late 2021, breaking for December-January to ensure as little disruption in the Xmas-New Year period as possible.

- On 17 November 2020 DCC's Planning and Environment Committee endorsed and agreed to go ahead with the DBC for the Retail Quarter – George Street to assess Council preferred option - a one–way design with flexibility to go to a two-way shared street design.

- The DBC is a detailed document and will take some months to complete. We are currently aiming end of August 2021 for its completion. To ensure the final selected option delivers optimal safety outcomes, the DBC compares the Council's preferred option adopted on 17 November 2020 with other options so we can also quantify those areas identified where options differ from each other. The DBC will also outline a 'Do Minimum' option.

- The DBC is expected to go to Council later this year for endorsement before it goes to Waka Kotahi to determine how much they might contribute to the project.

- Since November 2020, the underground infrastructure has been the project team's current focus. The below-ground technical matters we are currently focused on are:
    - Replacing the city's three waters infrastructure (i.e. the management of water, wastewater, and stormwater in Dunedin)
    - Dealing with a range of new infrastructure standards
    - Potentially installing a district energy scheme
    - Addressing known flooding issues
    - Looking at how we connect the many buildings along the street to our new infrastructure, all while avoiding other services in the area, archaeology, and providing continued service to those in the street.

- This project has a high degree of complexity and there are a number of technical matters that need resolving. DCC are determined to make sure we can get in to get construction underway so we can get out as quickly as possible. For us to do this, we need to remove as many unknowns behind.

- As part of the Detailed Business Case (DBC) process, we will be engaging with affected stakeholders to capture their thoughts and ideas on the options being assessed.

- We will be commencing consultation as part of the DBC process from 6 June 2021 and expect to have this completed by early/mid-July. The feedback captured will sit alongside the technical assessment of the options for endorsement by DCC in late August 2021.

- We will keep the wider public informed of the progress of the project and Detailed Business Case process and next steps to construction delivery.

- To find out more about the project go to https://www.dunedin.govt.nz/council/policies,-plans-and-strategies/plans/central-city-plan/retail-quarter or contact 03 477 4000.

- We have public displays on George Street at the selected shop front and in the foyer of our front entrance if you want to see what we have achieved so far, the current stage of the project and next steps.

High level messages about the project

Above and below ground infrastructure on George Street is old and needs to be replaced. The development of George Street focuses on upgrading this infrastructure and at the same time, improving the safety and accessibility of the central city's public spaces. Through this project the DCC aims to create compelling, attractive spaces where people want to spend time while at the same replacing storm and wastewater pipes.

The Retail Quarter – George Street upgrade project aims to achieve the following outcomes and vision of making Dunedin the 'best small city" in the world:

Putting people first by

- Improving the pedestrian experience of the city;
- Improving safety;
- Celebrating our walkable city;
- Creating meeting and resting points; and
- Increasing pedestrian space in the central city.

Creating an Ōtepoti Dunedin sense of place through

- Celebrating Dunedin's distinctive heritage, culture, and character;
- Enhancing the city with input from its residents; and
- Reflecting Dunedin's past and develop its future.

Greening the city by

- Creating a green network of trees and plants in the central city to reduce carbon emissions;
- Greening the streets to contribute to stormwater improvements; and
- Restoring wildlife corridors and habitats for birds and insects.

Streets as places by

- Promoting George Street as a destination; and
- Creating:
    - a memorable and distinctive place
    - an accessible city
    - places for people to meet

FREQUENCY ASKED QUESTIONS

**These are to be revised at each milestone and Project phase.*

What is the Dunedin Retail Quarter (George Street) Upgrade Project?

- Dunedin City Council are planning major improvements to the city's main retail area in George Street, from Moray Place to Albany Street, as identified in the Dunedin City Council (DCC) 10-year plan 2018-2028.
- The city's 150-year old underground wastewater and pipes need significant work, at the same time the project aims to improve safety and accessibility for pedestrians making a vibrant city centre where people want to visit to spend time, socialize, shop, and do business.
- The project has been allocated approximately $28 million (excluding the pipe replacement work which is funded separately) and is scheduled to be built and completed by late 2022.
- Community engagement through the Central City Advisory Group (CCAG) membership will support us with the next phase of the project.

How will the project affect parking?

This will be determined by the final design. Parking will be disrupted during construction.

What is the cost of the project?

Dunedin's 10-year plan allocates $60 million for the Central City Plan developments. The cost of the development of George Street is expected to range between $18m to $28m, depending on the final design.

How is it being funded?

The New Zealand Transport Agency and Dunedin City Council have contributed to funding of the Central City Plan.

Detailed Business Case specific

What is happening now?

We are consulting on the options as part of the Detailed Business Case (DBC) phase. This starts from early June 2021 and we aim to deliver the DBC for DCC approval in late August before it goes to Waka Kotahi (NZ Transport Agency) to consider what level of investment they may contribute towards the transport aspects of the project.

What is the Detailed Business Case (DBC)?

In order to secure Waka Kotahi (New Zealand Transport Agency) co-investment for the transport elements of the project and to ensure the DCC is maximising its benefits from investment in infrastructure and amenity, we have been undertaking a two-stage business case process. Go here to find out more about the DBC process https://www.nzta.govt.nz/planning-and-investment/learning-and-resources/business-case-approach-guidance/single-stage-business-case/detailed-business-case/

The first stage (the Initial Business Case) was completed in 2020. In November 2020, following peer-review of the IBC findings by Kobus Mentz of Urbanismplus, the elected members of Council resolved the following: *Approves proceeding to detailed business case and developed design with a one–way design with flexibility to go to two-way shared street design for the Dunedin Retail Precinct George Street upgrade*

Who is leading the DBC process for DCC?

DCC Council staff are working with AECOM (part of the Ō3 Collective – our consultant team) to advance the Detailed Business Case. This includes further targeted engagement, particularly with the Central City Advisory Group, made up of a range of stakeholders with interests in the Retail Quarter.

What options are being assessed as part of the DBC?

To ensure Council's preferred option is well-evaluated and its investment justified, the Detailed Business Case is comparing it against other options to understand benefits and costs of each more clearly. The options being evaluated in the DBC are:

1) One way northbound
2) One way southbound
3) Two-way slow street
4) Two-way flexible street
   Do minimum (replace as-is with minor safety improvements)

What's the next steps for the project when the DBC process ends?

With all of this information in hand, DCC staff will seek approval to proceed to detailed design of the approved option and programming replacement of infrastructure and upgrade of transport and amenity assets in the area.

Decision making confidence

We don't have confidence in DCC Council will not change their mind on the preferred option identified through the DBC process?

DCC staff's role is to ensure that detailed information around the findings of the DBC technical assessment and how each option performs against the investment objectives is presented to elected members for consideration and decision making. The engagement feedback captured during the DBC process is also included to provide further information around the views of stakeholders on the tested options.

As decision makers, elected members will choose to select the option they believe best represents the interests of their community. If you are concern about this, you should take the opportunity to discuss this with your elected representative.

Enabling works specific questions

What enabling works is planned?
The DCC is planning works in Great King Street and Filleul Street to support the infrastructure, transport, and amenity upgrades of George Street.

Are the enabling works part of the Retail Quarter – George Street upgrade design?
The enabling works are not dependent on any specific design option on George Street, but focus on improving vehicle movement through both Filleul and Great King streets, including improving access to parking buildings and with a specific focus on allowing the bus movements in Great King Street.

What is the purpose of the enabling works?
The intent of these works is to:

- Reduce the transport impacts of road closures during the upgrade of infrastructure and amenity on George Street
- Improve east-west connectivity and reduce the impacts of the construction of the new Dunedin hospital on the central city transport network
- Provide alternative options to George Street for through movement, to assist in making that a more people-focused place in the longer-term.

When will the enabling works begin?

The enabling works are being planned in parallel with the Detailed Business Case for the Retail Quarter and their impacts will be factored into designs for George Street

It is expected construction of these changes will commence in late 2021, breaking for December-January to ensure as little disruption in the Xmas-New Year period as possible.

When will construction begin?

Physical work is expected to begin in early 2022, underground works and investigations will commence from June 2021 with major stormwater works to take place before the end of 2021.

When is construction expected to be finished?

The George Street development is expected to be completed by mid-2023 but a final timeframe will not be known until a design is complete and a contractor is appointed.

How will the DCC minimise disruption?

We aim to reduce disruption by talking to those landowners and businesses who will be affected by construction and closely monitoring the project once it is underway.

Contractors will work closely with retailers and building owners to minimise disruption during construction.

We will ensure the work is completed to the appropriate standard and timeframe.

DCC will be providing regular updates on progress.

How will the DCC maintain access to buildings?

The appointed contractor will work with affected landowners and businesses to ensure access is maintained during construction.

How will this affect inner city residents?

Alternative pathways will be provided to direct traffic away from the construction area. Construction will be carried out at appropriate times to minimise noise disruptions.

I don't want the DCC to spend money on this project. Who gave it the go ahead?

We are committed to undertake this project through the Long-Term Plan 2015/16 – 2024/25.

Which quarter will you focus on when George St is completed?

It is expected that the next project will focus on the creative quarter including Princes Street and Exchange Square.

Will this project help animals and insects?

Planting trees and shrubs along George Street will improve and attract more birds and insects to George Street.

Will upgrading George St reduce carbon emissions?

Promoting walking and cycling, increasing pedestrian space, planting trees and plants all contribute to improving the air quality in the street

Will our heritage buildings be retained?

Yes, many buildings along George Street are scheduled heritage buildings and as part of the project we will be actively encouraging building owners to restore and improve their buildings

When finished, will it worsen traffic congestion in the CBD?

The project team is undertaking data collection and transport modelling to ensure traffic congestion does not worsen.

Why is the whole of George Street being pedestrianised?

There is no mention of pedestrianisation in anything the Council has communicated over George Street.

We don't want trees to block out the sun or hide our heritage buildings. Will large trees be planted along George Street?

Particular care will be taken in selecting the appropriate species and size of trees and shrubs for planting along George Street for the reasons stated and for the safety of pedestrians, vehicles, cyclists, and other modes of transport.

Where can I find a copy of the Preliminary Design Concept for George Street?

The Preliminary Design Concept for George Street was presented to Council on Monday 25 May 2020 as part of the Central City Plan George Street update Reports. A PDF of Urban Design Preliminary Design Report is available for viewing or downloading on the DCC website, please go to https://infocouncil.dunedin.govt.nz/Open/2020/05/CNL_20200525_ATT_1391_EXCLUDED_WEB.htm

For all of the other reports please see:

https://www.dunedin.govt.nz/council/policies,-plans-and-strategies/plans/central-city-plan/retail-quarter

Appendix B

Client Relationship Management (CRM) Stakeholders

Organisation	Key Contact Person
Internal	
Dunedin City Council	
Dunedin City Council	
Grow Dunedin Partnership	Chris Staynes
Iwi	
Partners	
Waka Kotahi New Zealand Transport Agency	
CCAG	
Dunedin City Council	Mayor Aaron Hawkins
Dunedin City Council	Jim O'Malley (Chair Infrastructure Services Committee)
Dunedin City Council	David Benson-Pope (Chair Planning and Environment Committee)
Dunedin City Council	Andrew Whiley (Deputy Chair Economic Development Committee)
Dunedin City Council	Sandy Graham (CEO)
Dunedin City Council	Simon Drew (General Manager Infrastructure Services)
Dunedin City Council	Robert West (General Manager City Services)
Grow Dunedin Partnership	Chris Staynes (Chair)
Chamber of Commerce	Dougal McGowan (Chief Executive)
Central Dunedin Business Group	Neil Gaudin
Aukaha	Nicola Morand (Acting CEO)
New Zealand Automobile Association	Barbara McDonald (Otago District Council Chair)
Heart of Dunedin	Nina Rivett
Dunedin Youth Council	Narayan Shastri (Chair)
OUSA	Jack Manning (President)
Generation Zero	Jenny Coatham (Co-president)
Otago Polytechnic Students Association	Nathan Laurie (President)
Disabled Persons Assembly	Chris Ford
New Zealand Police	Nick Turner
New Zealand Police	Craig Dinnissen (Prevention Senior Sergeant)
Fire Emergency New Zealand	Craig Geddes (Assistant Area Manager)
External	
Aukaha	Nicola Morand, Simon Cairn and Caron
Heart of Dunedin	Nina Rivett
Generation Zero	Finn Campbell
New Zealand Automobile Association	Malcolm Budd
Otago Polytechnic Students Association	Ezra Tamati
Otago University Students Assocation	Michaela Waite-Harvey
Hospitality Association Dunedin	Mark Scully
Chamber of Commerce Retail	Neil Finn-House
Chamber of Commerce	Nicky
Fire Emergency New Zealand	Laurence Voight/ Craig Geddes (2IC)
Dunedin Youth Council	Blake Armstrong
Disabled Persons Assembly	Chris Ford
New Zealand Heritage	Nick Dixon

New Zealand Police	Craig Dinnissen
Age Concern Otago	Debbie George
Urban Access Dunedin	Alan Race
Grey Power Otago Inc	Jo Millar
Central Dunedin Business Group	Neil Gaudin
BusGo Dunedin	Peter Dowden
Pacific Trust Otago	Llyod Moele
Araiteuru Arae Council	Tania Williams
CCS Disability Action	Mary O'Brien
Plunket	Catherine Caley
South Dunedin Business Association	Craig Waterhouse
Greater Green Island Community Network	Larnaca McCarthy
Hospitality Association Dunedin	Darelle Jenkins
The Valley Project NEV	Tess Trotter
Individual	
Individual	Brent Weatherall
Property Developer	Jason LaHood
Property Developer	Francis Whittaker
Oakwood Properties	David Marsh
Individual	Tony Clear
Media	
Otago Daily Times	

Appendix C

Run Sheet for CCAG Cups of Tea Meetings

AECOM New Zealand Limited
121 Rostrevor Street
Hamilton 3204
PO Box 434, Waikato MC
Hamilton 3240
New Zealand
www.aecom.com

+64 7 834 8980 tel
+64 7 834 8981 fax

RUN SHEET

DUNEDIN CITY COUNCIL RETAIL QUARTER – GEORGE STREET UPGRADE

CCAG INTIAL MEETINGS

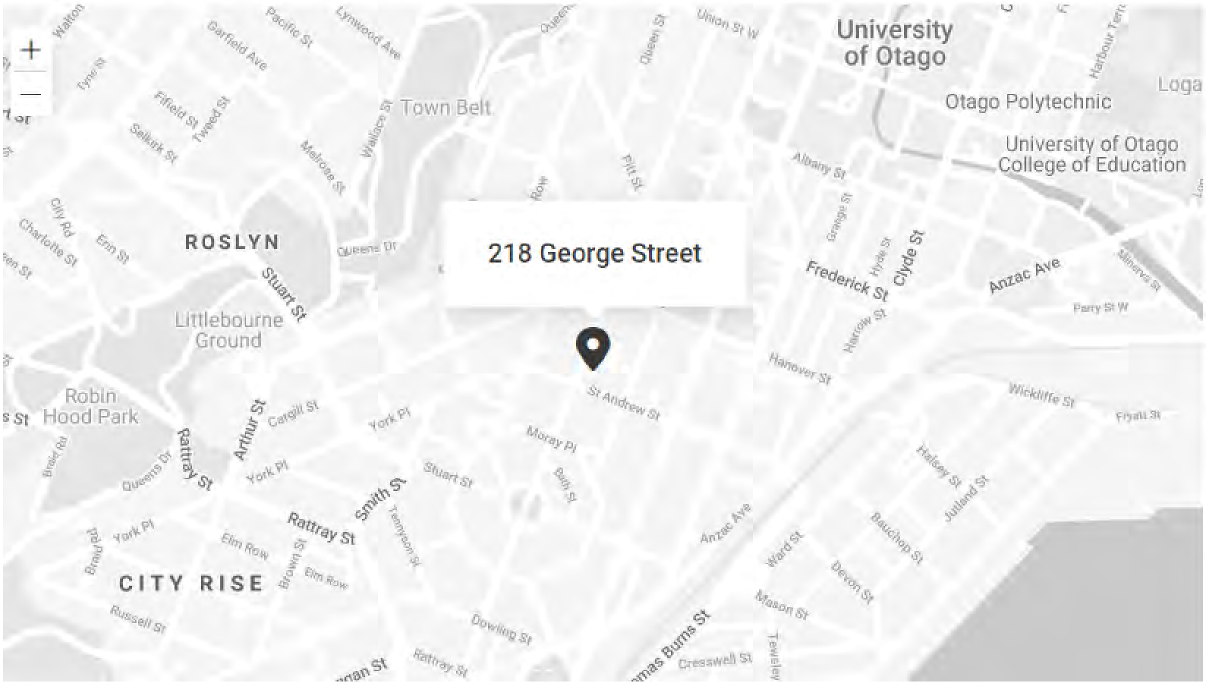
Dates	Tuesday 8 June 2021 – Thursday 10 June 2021
Venue & location	Regas, Harvest Court, 218 George Street, Dunedin Central

Note: project team turn up at least 1 hour before meeting commences to set-up.

Please comply with Covid-19 regulations for the current alert level setting.

Also, please wear tidy, warm and comfortable clothing. It is recommended that you wear flat, comfortable and covered footwear.

Location of the venue
The Google maps link to the market is included here.
https://www.regus.com/en-us/new-zealand/dunedin/harvest-court-mall-4609



Our event site is located at the Harvest Court mall, on the First Floor, 218 George Street, Dunedin Central.

Please call Glenda on 027 214 6261 or Nick if you have any questions 021 888 602
if you have any difficulty finding our site.

AECOM

Schedule of events

10.00am **10.30am**	Project team arrive to help with set up. Health and Safety run through, run through schedule, roles, responsibilities and proposed questions to activate engagement. **AECOM staff must sight and sign SWMS.** Please use the COVID-19 Tracer App. Please use the Covid-19 sign in register. Please use the hand sanitiser regularly and comply with all Covid alert level requirements as applicable. Encourage our visitor to do the same upon arrival. We are currently at Alert Level 1, please note if this changes the meetings will likely be moved online to MS Teams.	**Attending:** Glen Hazelton (DCC) Nick Bristed (Aecom) Geoff Prince (Aecom) Robyn Hyde (Aecom) Sian Marek (Aecom) Glenda Dobbyn (Aecom) Edward Jolly (Jasmax)
Tuesday 8 and Wednesday 9 June our first meetings start at 11.00am **On Thursday 10am our first meeting starts at 9.00am**	CCAG embers will drop-in at scheduled meeting times. Please refer to the spreadsheet for those times. Upon arrival tea/coffee/water and light morning/afternoon tea (biscuits or muffins) will be available for our guests. Please welcome all guests, introduce them to team members present and offer refreshments before sitting down for an informal discussion.	**DBC technical team**

AECOM

	Please run through quickly Health and Safety procedures – evacuation points etc. *Seating set up will be café style. The aerial map and post-it notes will be available for CCAG members to put down any thoughts. This will be captured at the end of the day by Sian and Robyn. An engagement team member will have a station and will meet and greet people as they arrive at our site. The engagement team will capture attendee information, run through health and safety, hand out information packs and direct people to the information and feedback areas. The technical team should be stationed at the options posters for each corridor and provide background information, show maps, links and discuss treatment options. Please direct people to provide feedback at the designated area where engagement staff members will capture feedback on Social Pinpoint or provide support to those who want to provide a hardcopy response. ***Please help us to capture images and videos on your smartphone from this event.**	
Our meetings end on Tuesday 8 June and Wednesday 9 June at 6.00pm	Our last meetings on Tuesday 8 and Wednesday 9 June end at 6.00pm. On Thursday our last meeting ends at 4.00pm.	All team members to help with pack down please.

AECOM

Thursday 10 June our last meeting ends at 4.00pm	Please wait until all attendees have left. Glenda will let everyone know when to commence pack down. We need to leave the venue tidy and any rubbish disposed of.	**Thank you for making this a successful event!**

AECOM

Stakeholder Landowner Meeting Record

Stakeholder Details	
Organisation	Attendee names
Location of Organisation (if relevant)	
Meeting Date/Time/Location	**Project Team Attendees**
Preferred contact method	**Contact details (email/mobile/post)**

Prompt discussion points
Intro – go through presentation
General discussion points (use if required): • What do you like about the existing layout of George Street? • What do you see are the current issues on George Street? • What do you think of the current processes which have been carried out to determine the changes? • What do you think of the Council Resolution for George Street and how do you think it will impact you and your business? • What would you like to see changing in the Retail Quarter to encourage more visitors? • What change would you support? • What changes to George Street would make this an attractive place to retain your business here/would you still stay on George Street if changes were made? • Do you think there are safety issues on George Street which need addressing? • What do your customers think of the changes • Are you strongly opposed to one way/two-way traffic? If so, why?

Meeting Notes

Key Themes (specify details if possible)	
Sentiment rating 1 to 5 (with 1 being very negative, 3 neutral and 5 being very positive)	1 2 3 4 5 (select one) Comment:
Parking	
Buses	
Active modes	
Public realm	
Engagement to date	
Perception of council	
Specified preferred option	
Economic impacts to retail	
Views of the wider network	
OTHER (please specify)	

Next steps/outcomes and actions	
Would they like a copy of the meeting notes to be emailed?	Yes/No

Appendix D

Engagement feedback received from CCAG Cups of Tea Meetings

CCAG Cups of Tea Meetings

This report summarises stakeholder engagement for the Central City Plan Retail Quarter Two-Staged Detailed Business Case (DBC) between the period **8 June 2020 to September 2021.**

Dunedin City Council's is a project seeking to achieve the following outcomes and make Dunedin a distinctive destination and one of the world's great small cities.

Dunedin City Council, Waka Kotahi NZ Transport Agency and Mana Whenua are partners in this project.

The City Centre Plan is focused along George Street and surrounding streets. Dunedin is unique that the city centre is the main retail area for Dunedin, it's distinctive heritage and culture is a place of pride.

Project objectives/vision for the Retail Quarter is to:

- Improve the health of the community by increasing active mode and public transport uptake and reducing harmful emissions
- Reduce dependency on private vehicles by increasing the uptake of active and public transport travel modes
- Reduce harm to the community by reducing deaths and serious injuries

Improve access to and perceptions of active travel modes and public transport. ***Putting people first***

By:

- improving the pedestrian experience of the city
- improving safety
- celebrating our walkable city
- creating meeting and resting points
- increasing pedestrian space in the central city.

Creating an Ōtepoti Dunedin sense of place

By:

- celebrating Dunedin's distinctive heritage, culture, and character
- enhancing the city with input from its residents
- reflecting Dunedin's past and develop its future.

Greening the city

By:

- creating a green network of trees and plants in the central city to reduce carbon emissions
- greening the streets to contribute to stormwater improvements
- restoring wildlife corridors and habitats for birds and insects.

Streets as places

By:

- promoting George Street as a destination
- creating:

- a memorable and distinctive place
- an accessible city
- places for people to meet.

This report focuses on the engagement undertaken during the development of the Two-Staged DBC for the Central City Plan Retail Quarter project. Partners and stakeholders both internal and external through the CCAG group, a nominated group of diverse stakeholders were asked the following questions:

- Provide their concerns, insights and ideas on the draft options being considered for the study area. This was to confirm if the problems and benefits identified as part of the Indicative Business Case were still appropriate and captured appropriately.
- Review draft shortlisted options for the Retail Quarter and to identify the design they believe would best deliver against the investment objectives, and to explain why.

Specific questions were asked on the following areas

- What are your accessibility and safety concerns?
- Parking locations and current use/patterns?
- Commercial impacts of each options
- What would encourage people to come to the city centre?
- Which option do you think best responds to the issues or concerns you experience or are aware of in this area? Why?
- Do you have any other comments?

ENGAGEMENT STRATEGY TACTICS

- **Email and initial phone calls** to set up cups of tea meetings with the DBC project team
- **Face to face cups of tea (café style 1-1.5 hour) meetings at Regus** or **via MS Teams** interactive meeting with CCAG members including presentation and map of study area to capture comments, ideas and insights

FEEDBACK GATHERED FROM SOCIAL PINPOINT AND HARDCOPY QUESTIONNAIRE

- **34 CCAG members** attended these meetings and feedback was captured by the DBC project team.

- **Approximately 89 comments** were captured that were relevant to the questions asked.

It should be highlighted that not all respondents indicated an option preference, in most cases they provided general comments about the options and issues, but many stakeholders also preferred not to state a preference as they understood options feedback will occur next once these were further developed based on their initial comments. .

Overall, feedback from partners including Mana Whenua, and stakeholders show strong support for the project and a strong desire ‘to progress the project quickly.”

Feedback indicated a need to apply the Smart 'flexible option' to most of the being assessed – both one-way and two-way design approaches and to prioritise active mode access and safety.

There was a common acknowledgement that the issues and challenges at the Retail Quarter and George Street are worsening due to a heavy reliance of private car use and a declining desire for people to use other modes of transport - bike, walk or take the bus. This sentiment of improving safety and accessibility along this area was a common theme.

KEY FEEDBACK THEMES - OVERALL

Feedback from partners, stakeholders focused on the key areas, including:

1. **Active mode priority and access**
   - Senior access and safety – infrastructure and design discourages seniors from using this area.
   - Separated (off-road) cycleways, along with priority for active modes in the road corridor and at intersections, are strongly supported for efficiency and safety reasons and are thought to encourage more people to use active modes.
   - The conflict between other users (mainly drivers) and active modes, and the need for greater awareness of active modes and the facilities supporting the use of these i.e. reduce speed and sequencing of signalised crossings. .
   - The addition of shade, trees along corridors/routes and use of greenways/parks etc as part of the active mode network was supported as a way of increasing the appeal of walking and other modes e.g. cycling.

2. **Public transport priority**
   - Recommend a regular circular bus services along George Street if bus stops are removed from George Street.
   - Barriers to bus use include cost (fares too high) and indirect or long routes and access to bus stops/facilities (i.e. bus stop location and/or frequency, bus shelters etc).
   - Concerns about bus hub – social behaviour makes it an undesirable to use.

3. **Safety (primarily for active modes)**
   - The safety of pedestrians along the study area, particularly around conflict with traffic, the volume of traffic and its speed, primary concern.
   - Safety concerns with road crossing, including at 'controlled' intersections, due lack of crossings facilities and/or the layout and design of existing infrastructure and intersections, and the speed/volumes of traffic entering were highlighted in particular.
   - Unsafe journey experiences around the safety of respondents during their journey due to unsafe routes and crossings (lighting at night-time), anti-social behaviour and safety of pedestrians at non-formalised crossing areas need to be addressed.

4. **Access and connectivity**
   - Need to improve bus service availability and access.
   - Circular and regular bus service recommended for George Street .

5. **Behaviour change and social outcomes**
   - Cultural values to be reflected in design
   - Story telling important for sharing and making this a desirable destination
   - Heritage and distinctive central city is important for the city
   - Consider an events manager to attract people to the city centre e.g. Auckland
   - Toilet facilities and rest areas along George Street
   - Accessible toilet facilities important for those with limited mobility
   - Consider seasonal event activities
   - Positive benefits to the environment and people's health resulting from the increased priority and availability of efficient and safe active mode and public transport.
   - Consider where e-scooters fit into the picture – safety and access concerns.
   - Design should encourage natural surveillance, and discourage anti-social behaviour e.g. loitering and vagrancy
   - Future land uses, infill housing in particular, need to be planned and provided for and consider implications on parking, safety, and access
   - Parking buildings utilisation needs to consider current and future use .
   - Enhance 'green landscape' (more trees and greenfield pathways) to make active modes appealing and more pleasant.
   - Maintenance of flat, wide, smooth, clear pathways
   - Crossing facilities that allow time for seniors and those with accessibility challenges to cross safely
   - Pathway gradients e.g. by the library – a barrier to access for those with limited mobility
   - Parking configuration to consider those with accessibility, families and drop off and pick up (Uber and Courier) needs
   - Skateboards are prohibited in the Central City
   - E-scooters are a safety concern for senior users and GPS limits where they can travel around the central city.

The list of the shortlisted options for University Link are provided below:

- **Do Minimum option** – this is in essence will retain the current layout of George Street with some minor safety improvements. All the options are evaluated against the Do minimum to understand the relative additional benefits and costs.

- **Option 1** will test conversion of George Street to one-way slow street (10km/hr) in a Northbound direction, and **Option 2** in a Southbound direction. In November 2020 Council endorsed a one-way solution with the flexibility to go back to two-way in future.

- **The third option** to be tested will be a two-way slow street(10km/hr).

- **The project team have also developed a 'Smart Street' approach which can be used with any option to increase the flexibility and future proofing of the options**. The Smart Street approach will include the inclusion of automated bollards that will allow flexibility to close some or all blocks to create a fully pedestrianised environment at certain times of the day or year. This can be used for events, evening street dining or Sundays. Parking spaces will also have LED lights or similar to allow these spaces to be repurposed at certain times of the day if required.

*All options will include the use of one level surface (no kerbs) with the exception of the Do Minimum where kerbs will be retained.

NEXT STEPS

The feedback gathered from this engagement has been very informative to help shape the next stages. This feedback will be used to guide and inform further development of the options for finalisation and further engagement to identify the option that best delivers to the DBC's investment objectives and project objectives.

Timeline we are working to

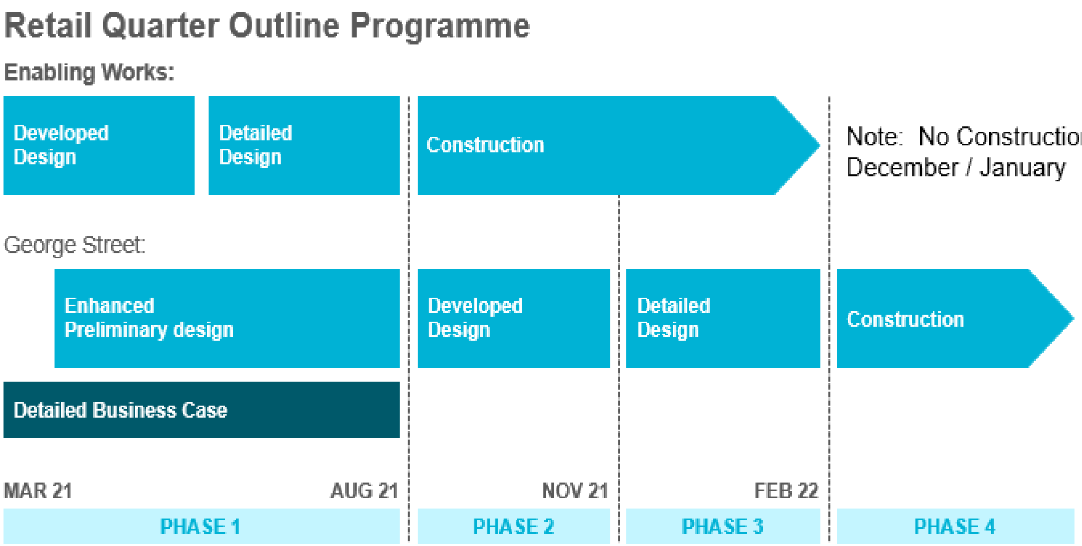


Figure 1 summarises the project timeline to date.

Stakeholder, Partner including Mana Whenua engagement continues at a programme level until the Two-Staged Detailed Busines Case for the Retail Quarter has been endorsed by Elected Members, due to happen in late August 2021 and following the Waka Kotahi NZ Transport Agency decision on funding, due September 2021.

Figure 1. Project timeline to date

Appendix E

CCAG Workshop Questionnaire

DUNEDIN CITY COUNCIL | Kaunihera a-rohe o Ōtepoti

FEEDBACK FORM: Dunedin Retail Quarter Options (George Street) upgrade Workshop, Toitu Otago Settlers Museum

Please complete and hand in to one of the project team at the end of the workshop.

Your comments will be considered as part of our feedback from a range of stakeholders.

Workshop Date: 2 August/ 3 August 2021 **Time of workshop: am / pm (please circle)**

Your Name:

Organisation:

Privacy Statement:
The Local Government Act 2002 requires submissions to be made available to the public. Your name and/or organisation will be published with your submission and made available in a report to elected members and to the public. Other personal information will be used for administration and reporting purposes only.

YOUR FEEDBACK:

Do Minimum – retain the current street layout and allocation of space

1. What do you like about this option?

2. What don't you like about this option?

3. Please provide a rating between 1 and 7 of how acceptable this option is to your organisation.

1	**2**	**3**	**4**	**5**	**6**	**7**
Don't like						*Really like*

Option 1 – One Way Northbound 10kmph

4. What do you like about this option?

5. What don't you like about this option?

6. Would this option encourage you to visit or not visit the Retail Quarter? **Yes/No**
   Why?

7. Please provide a rating between 1 and 7 of how acceptable this option is to your organisation.

1	**2**	**3**	**4**	**5**	**6**	**7**
Don't like						*Really like*

8. Does this option address some of the concerns you/your organisation have raised previously? **Yes/No**

   If No, why?

   If Yes, how?

9. Please provide any other suggestions in relation to this option.

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Option 2 – One Way Southbound 10kmph

10. What do you like about this option?

11. What don't you like about this option?

12. Would this option encourage you to visit or not visit Dunedin's Retail Quarter? **Yes/No**
Why?

13. Please provide a rating between 1 and 7 of how acceptable this option is to your organisation.

1	**2**	**3**	**4**	**5**	**6**	**7**
Don't like						*Really like*

14. Does this option address some of the concerns you/your organisation have raised previously? **Yes/No**

If No, why?

If Yes, how?

15. Please provide any other suggestions in relation to this option.

Option 3 – Two Way Slow 10kmph

16. What do you like about this option?

17. What don't you like about this option?

18. Would this option encourage you to visit or not visit Dunedin's Retail Quarter? **Yes/No**
    Why?

19. Please provide a rating between 1 and 7 of how acceptable this option is to your organisation

1	**2**	**3**	**4**	**5**	**6**	**7**
Don't like						*Really like*

20. Does this option address some of the concerns you/your organisation have raised previously? **Yes/No**

    If No, why?

    If Yes, how?

21. Please provide any other suggestions in relation to this option.

Preferred Option

- If you were to choose one option, which one would be your preferred option? (please tick).

- If you have more than one option you would support, please rank in order of preference?

Options	▪ Tick if you only have one preference. ▪ If you support more than one option, please rank in order of preference
Do minimum - retain the current street layout and allocation of space	
Option 1 – One-way Northbound 10kmph	
Option 2 – One-way Southbound 10kmph	
Option 3 – Two-way Slow 10kmph	

Appendix H

Enabling Works Technical Note

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Technical Note

To	Simon Gaynor	Page	1
CC	Hjarne Poulson, Kathryn Ward		
Subject	Retail Quarter Enabling Works		
From	Derek Walsh		
File/Ref No.		Date	09-Apr-2020

1.0 Purpose

This technical note sets out the work undertaken to inform preliminary design of the enabling works package for the Retail Quarter project.

2.0 Scope

The retail quarter project will include traffic calming measures which are forecast to result in a significant reduction in traffic volumes on George Street between the Octagon and Frederick / London Street. The majority of this displaced traffic is expected to make use of Filleul Street and Great King Street as diversion routes. As a result, a requirement to undertake enabling works to provide adequate capacity and mitigate adverse impacts of increased traffic on these diversion routes has been identified.

The scope of this enabling works package is illustrated in Figure 1 and includes:

- Great King Street (between St Andrew Street and Frederick Street);
- Frederick Street (between Great King Street and George Street);
- Filleul Street (between Moray Place and London Street); and
- London Street (between Filleul Street and George Street).

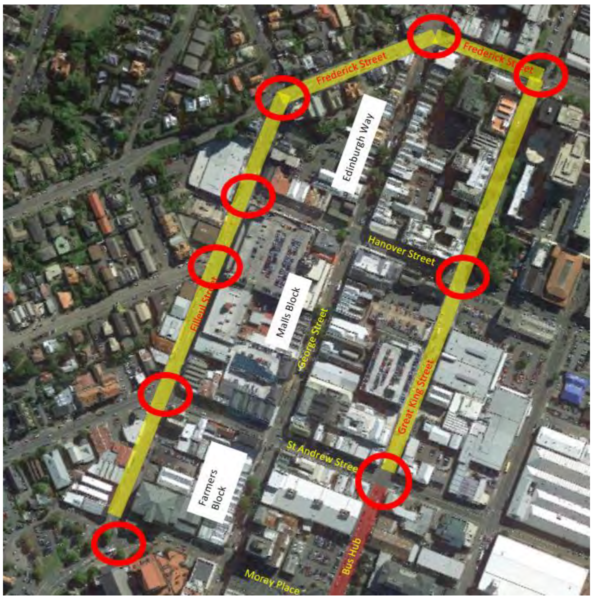

Figure 1: Scope

3.0 Traffic Volumes

Construction of the enabling works will need to be completed prior to construction of the upgrades to George Street to enable the diversion routes to function during any construction related closures of George Street. As a result, the enabling works have been expedited to progress preliminary design as quickly as possible.

In addition to traffic calming measures in the Retail Quarter, changes to travel patterns within Dunedin may also be greatly influenced by network changes associated with the new hospital. Connecting Dunedin will be undertaking network wide modelling to better understand the impacts of these changes.

In order to expedite the enabling works package, AECOM have adapted a pragmatic approach to making the best use of data available at the time to inform preliminary design. Once the Connecting Dunedin modelling is available, the designs will be re-tested and amended if required.
Future traffic volumes have been calculated based on existing traffic counts and George Street IBC Options Modelling undertaken by Jacobs in June 2019. The approach to determining future traffic volumes is detailed in Appendix A.

4.0 Design Approach

The enabling works preliminary design has been informed by a combination of site visit observations, discussions with DCC and intersection performance assessments using LinSig modelling software. Our approach has focused on:

1. Safety – safe operation of transport infrastructure, improving safety for vulnerable users such as pedestrians.

2. Priority – prioritising the movement of sustainable transport modes. Including: prioritising bus movements over general traffic movements on major bus corridors; prioritising pedestrian crossing movements through the use of Barnes Dance signal phasing and build-outs to reduce crossing distances; and prioritising the safety of vulnerable users through the identification and provision of safe road crossing facilities.

3. Efficiency – providing intersection and mid-block layouts designed to facilitate increased traffic flows.

5.0 LinSig Traffic Signal Model

Intersection performance has been assessed using LinSig software from the JCT Consultancy. LinSig enables traffic signal networks to be created and is based on traffic flows, road geometry and traffic signal phasing enabling detailed modelling of an intersection based on the operation of the traffic controller.

5.1 Limitations of modelling SCATS

Whilst LinSig models fluctuations in traffic flows, only a fixed sequence of traffic signal phasing for the traffic signal cycle can be input whereas in practice a SCATS controlled traffic signal network jumps around with somewhat “random” selection of phasing depending on minute to minute varying traffic demands. To overcome this in LinSig, a cycle of phasing that best represents the SCATS phases used in the hour is used, however this selected cycle of phases is not as efficient as the live dynamic SCATS phasing. Therefore the LinSig traffic model is under reporting capacity, i.e. for instance where it is stating a degree of saturation of 95% in practice under dynamic SCATS phasing the degree of saturation may actually be a more acceptable 85%.

The models have been designed to show the relative performance of options in comparison to the base model. For this reason, statistics such as traffic queue lengths should not be considered as absolutes, but should be viewed as being representative of the relative impacts of changes to the intersections. Minor changes have been required to be made to the traffic flows at some intersection arms to address in balances between flows at adjacent intersections.

5.2 LinSig Diagram Interpretation

LinSig is unable to cope with two signal groups acting on a single lane, e.g. left turning vehicles on red hold up the straight on traffic on green in the same lane. To overcome this a very short left turn lane is added to the LinSig model. Whilst this lane appears on the model, it does not represent an actual lane or proposed traffic lane.

The traffic signal phasing is also modelled to represent actual traffic movements and not necessary what aspect the traffic signals will be showing. Examples are a left green turn arrow but traffic cannot turn due to crossing pedestrians on a green man. This in LinSig is modelled as a red signal for turning traffic although in practice it will be a green left turn arrow. Conversely LinSig may also be coded to have a delayed start to left turning traffic but the diagrams will show the signals being on green.

5.3 Features of the LinSig Model

Key parameters applied to the performance assessment include:

- SCATS data has been used to understand existing phasing for the base models;
- signal cycle times of 90seconds have been used for all intersections, with exception of:
  - Filleul Street / Hanover Street where traffic volumes require a 108second cycle time; and
  - the 5-arm (George Street / London Street / Frederick Street / Pitt Street) where a 130second cycle time is required to make the intersection function;
- all intersections have been assessed with Barnes Dance signal phases

5.4 Summary of LinSig Output Terms

A summary of intersection performance assessment results is presented in each section below. In these summaries:

- Total Traffic Delay – this is the sum of the traffic volume times the average delays for each lane to give a total delay measured in Passenger Car Units (PCU) times hours (hrs);
- Level of Service (LoS) is a measure of delay for vehicles using the intersection and is banded into time periods as shown in Table 1; and
- Degree of Saturation (DoS) is how much capacity of the intersection is used, it is the ratio of actual traffic flow using the intersection to maximum capacity of the intersection or approach arm. DoS of over 100% shows the intersection will not work and values over 90% should be avoided as good design practice;
- Practical Reserve Capacity is a measure of overall spare capacity of the intersection. A negative number denotes the intersection is over capacity.

The levels of service used in the LinSig analysis are defined as follows:

Table 1 Levels of Service Delay Times

Level of Service	Delay
A	Up to 10 seconds
B	10 – 20 seconds
C	20 – 35 seconds
D	35 – 55 seconds
E	55 – 80 seconds
F	Over 80 seconds

These parameters are used to provide a summary comparison between the existing and proposed intersection designs and changes in traffic flows due to the proposed traffic measures on George Street.

The performance summary tables presented in this technical note cover:

- The existing performance of each intersection – based on traffic counts from 2018 / 2019; and
- The forecast performance of the preferred treatment for each intersection – based on forecast 2031 flows diverted as a result of the Retail Quarter upgrade.

6.0 Preliminary Design Outcomes

The following sections detail key site specific design considerations and provide summaries of intersection performance. Preliminary drawings and detailed LinSig outputs are included in Appendices B to D.

7.0 Filleul Street

The traffic corridor along Filleul Street and London Street to George Street north is forecast to be the primary diversion route for general traffic once traffic flows on George Street are restricted.

7.1 Mid Block Works

Key mid-block considerations for Filleul Street include:

Between Moray Place and St Andrew Street

- No significant changes required.

Between St Andrew Street and Hanover Street

- Meridian car park entrance
  - o Delineation of the footpath at the entrance / exit of the car park to improve driver awareness and pedestrian safety; and
  - o Facilitation of right-turn movements into the car park. AECOM were asked to include a design to enable right turn movements into the car park due to the “Meridian Roundabout” effect - where drivers travelling to the car park from the west tend to follow an anti-closkwise pattern around the George Street / Hanover Street / St Andrew Street block to access the car park.

    A design to facilitate the right turn has been developed, however there is considerable uncertainty relating to the existing and future split of demand between the right and left turn entries. There is a risk that facilitating the right-turn entry could result in excessive queuing and this entrance, or the resulting reduced capacity for left turn entries could worsen queuing for this entry. It has been agreed with DCC that the option to provide a right turn entrance into the Meridian car park will be retained for now, pending results of Paramics modelling.
- Provision of safe pedestrian crossing facilities (to be facilitated through upgrades to the Filleul Street / Hanover Street intersection)

7.2 Intersections

The potential future performance of the following Filleul Street intersections has been tested:

- Moray Place;
- York Place and St Andrew Street;
- Cargill Street; and
- Hanover Street;

Moray Place, Hanover Street and Cargill Street intersections are currently priority intersections. It is recommended that these intersections be signalised to provide safe pedestrian crossing facilities and balance levels of service between north-south and east-west movements.

Based on the model outputs, intersection approach lanes have generally been optimised and layouts have been amended to accommodate Barnes Dance crossings.

The following tables provide a summary of the performance assessment of the proposed intersection designs relative to the base model.

Table 2: Filleul Street / Moray Place Intersection Performance Summary

Filleul Street / Moray Place AM Peak		
Performance Indicator	**Existing Performance**	**Forecast Performance**
Estimated Traffic Flows (vehicles)	510	1029
Total Traffic Delay	0.3 PCU hours	8.3 PCU hours
LoS (average)	n/a	C
DoS (worst movement)	20%	77%
Practical Reserve Capacity	354.5%	17.2%
Filleul Street / Moray Place PM Peak		
Performance Indicator	**Existing Performance**	**Forecast Performance**
Estimated Traffic Flows (vehicles)	510	1019
Total Traffic Delay	0.5 PCU hours	7.2 PCU hours
LoS (average)	n/a	C
DoS (worst movement)	36%	64%
Practical Reserve Capacity	148.3%	40.5%

This intersection, if converted to a traffic signal intersection, would operate within capacity and can accommodate a Barnes Dance all pedestrian phase. A separate left turn lane has been modelled from Moray Place into Filleul Street to give redundancy in design although capacity wise this is not strictly necessary.

Table 3: Filleul Street / York Place / St Andrew Street Intersection Performance Summary

Filleul Street / York Place / St Andrew Street AM Peak		
Performance Indicator	**Existing Performance**	**Forecast Performance**
Estimated Traffic Flows (vehicles)	1000	1552
Total Traffic Delay	8.6 PCU hours	12.4 PCU hours
LoS (average)	C	C
DoS (worst movement)	57%	75%
Practical Reserve Capacity	57.3%	20.5%
Filleul Street / York Place / St Andrew Street PM Peak		
Performance Indicator	**Existing Performance**	**Forecast Performance**

Filleul Street / York Place / St Andrew Street AM Peak		
Performance Indicator	**Existing Performance**	**Forecast Performance**
Estimated Traffic Flows (vehicles)	1371	2238
Total Traffic Delay	10.4 PCU hours	22.9 PCU hours
LoS (average)	C	D
DoS (worst movement)	65%	80%
Practical Reserve Capacity	39.4%	10.1%

At this intersection the proposals are to provide a Barnes Dance pedestrian phase in place of the existing individual pedestrian phases across pairs of approaches. Additional modelling showed it was also possible to reduce the number of lanes northbound from two to one.

Table 4: Filleul Street / Cargill Street Intersection Performance Summary

Filleul Street / Cargill Street AM Peak		
Performance Indicator	**Existing Performance**	**Forecast Performance**
Estimated Traffic Flows (vehicles)	910	1643
Total Traffic Delay	0.7 PCU hours	13.1 PCU hours
LoS (average)	n/a	C
DoS (worst movement)	49%	80%
Practical Reserve Capacity	84.1%	12%
Filleul Street / Cargill Street PM Peak		
Performance Indicator	**Existing Performance**	**Forecast Performance**
Estimated Traffic Flows (vehicles)	1101	1757
Total Traffic Delay	0.6 PCU hours	21.6 hours
LoS (average)	n/a	D
DoS (worst movement)	35.4%	92%
Practical Reserve Capacity	154%	-2.5%

This intersection has been modelled with a Barnes Dance which prioritises pedestrian movements within the 108 second cycle time for the intersection. An alternative traffic signal phasing on a 90 second signal cycle providing separate pedestrian phases across Cargill Street and across Filleul St south was found to provide sufficient practical reserve capacity of 2.4% in the evening peak hour.

Whilst the Barnes Dance arrangement results in a lower level of service for motorised users, it represents a significant improvement for pedestrians.

Table 5: Filleul Street / Hanover Street Intersection Performance Summary

Filleul Street / Hanover Street AM Peak		
Performance Indicator	**Existing Performance**	**Forecast Performance**
Estimated Traffic Flows (vehicles)	730	1094
Total Traffic Delay	0.3 PCU hours	4.7 PCU hours
LoS (average)	n/a	B
DoS (worst movement)	27%	78%
Practical Reserve Capacity	231.9%	15.6%
Filleul Street / Hanover Street PM Peak		
Performance Indicator	**Existing Performance**	**Forecast Performance**
Estimated Traffic Flows (vehicles)	934	1514
Total Traffic Delay	0.3 PCU hours	8.0 PCU hours
LoS (average)	n/a	C
DoS (worst movement)	24%	66%
Practical Reserve Capacity	278.8%	35.5%

The conversion to a traffic signal controlled intersection from a priority intersection giving free flow to traffic on Filleul Street naturally results to the introduction of delay and lower level of service for motorised traffic on Filleul Street. Conversely, active users benefit from safe crossing facilities and a pedestrian friendly street environment.

7.3 Filleul Steet / London Street / Constitution Street Intersection

This intersection is particularly difficult due to its positioning on the brow of a hill which leads to poor sight-lines at some approaches. It is not proposed that this intersection be signalised as queuing traffic could result in safety concerns and the gradient of approach arms could make it difficult for some vehicles to stop and start again.

Proposed changes to this intersection include:

- Banning the right turn movement from London Street (westbound);
- Providing a pedestrian refuge on London street to facilitate safe crossing;
- Realignment of stop lines to improve sightlines.

8.0 George Street / London Street / Pitt Street / Frederick Street

Colloquially known as the “5-arm” intersection, this intersection currently performs poorly and provides a very poor level of service for pedestrians who need to cross more than one arm of the intersection. The performance assessment of this intersection has undergone numerous iterations to attempt to balance performance outcomes in terms of safety, priority and efficiency.

Key considerations for this intersection included:

- the need to make it easier for pedestrians to cross more than one arm of the intersection without excessive delay;
- the need to facilitate bus movements between George Street (north) and Frederick Street with minimal delay;

- understanding the relative performance of options currently being considered for the Retail Quarter upgrade (George Street northbound only, 2-way or closed to traffic entirely (at the 5-arm intersection).

5-Arm Iterations

The following options for this intersection have been assessed:

1. Existing – existing traffic flows and signal phasing;
2. George Street northbound only (between Hanover Street and Albany Street)
   - Two lane entry into the 5 Arm intersection, Pitt St no right turn (Option E6A);
   - One lane entry into the 5 Arm intersection, Pitt St no right turn (Option E6B);
   - One lane entry into the 5 Arm intersection, Pitt St no right turn, George Street northbound exit every other cycle (Option E6D) and
3. George Street two way with traffic calming (between Hanover Street and Albany Street), Pitt St no right turn (Option E6D2).
4. George Street (south) closed.

The Option numbers referred to above are those used in differentiating different LinSig modelling runs and appear on the LinSig output files.

The existing case was modelled using the existing phasing where pedestrians receive a separate green man phase for each arm of the intersection. Generally George Street north and south approaches share the same traffic phase but all other approaches have their own separate traffic signal phase. This is illustrated in the LinSig model extract shown below where signal groups 1 and 3 are George St north and signal groups 2 and 12 represent George Street south.

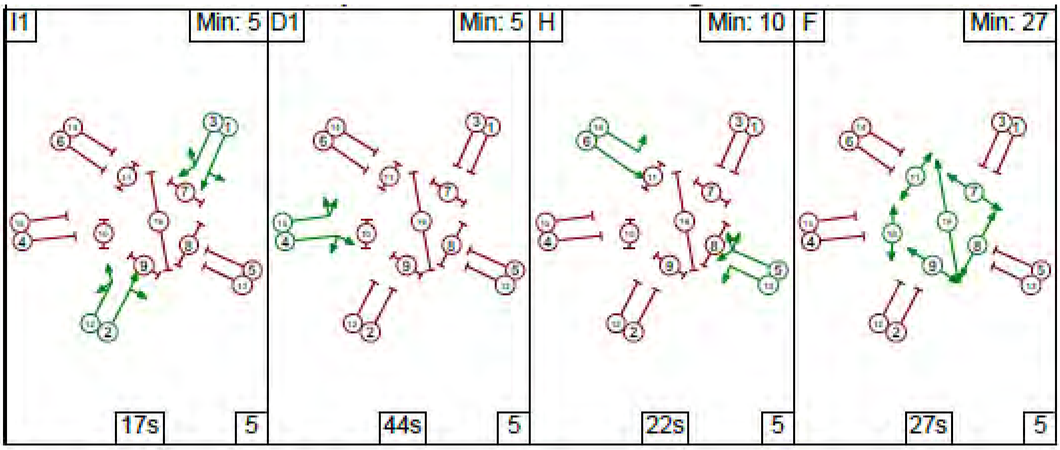

Figure 2 - LinSig Phasing - 5 Arm Intersection - Existing Layout

In the Future (Option) case all scenarios incorporate a Barnes Dance utilising the whole intersection. In initial traffic assessments, a combined phase of running Pitt Street together with Frederick Street was achieved by banning the right turn from Pitt Street into London Street and George Street.

With the introduction of phasing that favours the bus movements into and out of Frederick Street it is then no longer necessary to ban the right-turn from Pitt Street. Although shown on the current options as banned, permitting this option will have negligible effect on capacity as the phase runs unopposed.

Traffic flow forecasts informed by the strategic model show considerable variations between traffic flows on each arm of this intersection under the different scenarios for George Street. Within the strategic model outputs, there are also significant variations between traffic flows into and out of intersections. For example, in the scenario with George Street closed, there is forecast to be a

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substantial reduction of traffic flows on links leading into the intersection and a substantial *increase* in flows on links leading out of the intersection. To enable a more realistic comparison between these options we have increased traffic flows in the George Street closed option by around 10% in the AM peak and around 15% in the PM peak, however the total volume of traffic using the intersection remains significantly lower in both the George Street two-way and George Street closed options than in the northbound only option.

This phasing is illustrated in the LinSig model extract below, signal groups 1 and 11 are George St north and signal group 10 represent George Street south. Signal Group 3 is Frederick Street.

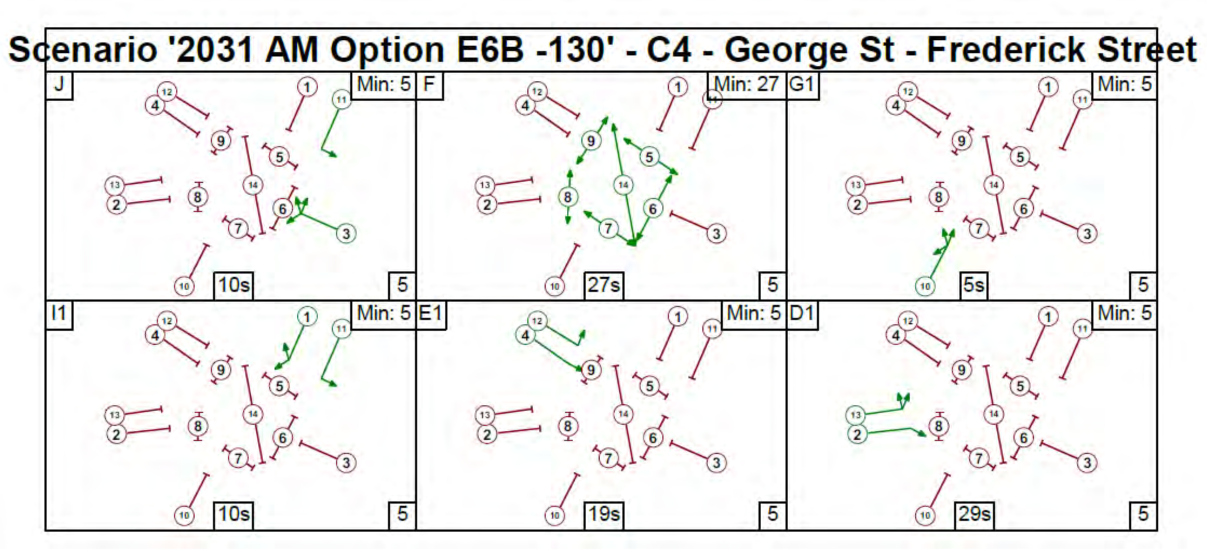

Figure 3 - LinSig Phasing - 5 Arm Intersection – Proposed Option Phasing Layout

The outcomes of this assessment are detailed in Appendix D.

Table 6 provides a summary of the comparative performance of options for the 5-arm. The summary suggests that the George Street 2-way option performs best, which is counter-intuitive. This is due to the lower overall traffic volumes applied to this option as a result of the strategic model outputs and differences in the balance of traffic flows on each arm of the intersection. The strategic model outputs result in considerably lower traffic flows on London Street, Frederick Street and Pitt Street for this option, which makes its comparative performance look better than that of the other options.

Table 6: 5-arm Intersection Performance Assessment

	5-arm AM Peak				
Performance Indicator	**Existing Performance**	**George Street Northbound only**	**G St One way, Northbound 2nd cycle**	**George Street 2-way**	**George Street Closed**
Estimated Traffic Flows (vehicles)	1,900	1,750	1,750	1,550	1,656
Total Traffic Delay	80.3 PCU hours	203.5 PCU hours	217.7 PCU Hours	129.5 PCU hours	142.2 PCU hours
LoS (average)	F	F	F	F	F
DoS (worst movement)	143%	141%	137%	123%	128%

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	5-arm AM Peak				
Performance Indicator	**Existing Performance**	**George Street Northbound only**	**G St One way, Northbound 2nd cycle**	**George Street 2-way**	**George Street Closed**
Practical Reserve Capacity	-59%	-56.7%	-51.6%	-37.0%	-42.4%
5-arm PM Peak					
Performance Indicator	**Existing Performance**	**George Street Northbound only**	**G St One way, Northbound 2nd cycle**	**George Street 2-way**	**George Street Closed**
Estimated Traffic Flows (vehicles)	2,000	1,550	1,550	1,450	1,450
Total Traffic Delay	50.4 PCU hours	110.4 PCU hours	68 PCU Hours	55.6 PCU hours	31.3 PCU hours
LoS (average)	F	F	F	F	F
DoS (worst movement)	102%	126%	106%	103%	105%
Practical Reserve Capacity	-13.8%	-39.8%	-18.2%	-14.6%	-16.8%

Due to the long diagonal walk time from the south east to the north of the intersection, a distance of 35 metres requiring a walk time of 27 seconds, the Barnes Dance operation and signal phasing reduces the capacity for other movements at this intersection. In addition, the provision of a priority phase for bus movements also reduces capacity for other movements.

9.0 Great King Street Intersections

9.1 Mid Block Works

Great King Street, from St Andrew Street to Frederick Street will become the primary bus diversion route once bus services are removed from George Street. Key mid-block considerations for Great King Street include:

Between St Andrew Street and Hanover Street

- Providing sufficient stacking capacity for vehicles accessing the parking building adjacent to Albion Lane
- Upgrading the existing courtesy crossing at Albion Lane / Centre City Mall;
- Restricting right-turn movements in / out of New World car park to reduce delays to traffic flow;

Between Hanover Street and Frederick Street

- accommodate a pair of double bus stops
- reduce existing build-outs to make sure buses can pass through

9.2 Intersections

The potential future performance of the following Great King Street intersections has been tested:

- St Andrews Street;
- Hanover Street; and
- Frederick Street.

Based on the model outputs, intersection approach lanes have generally been optimised and layouts have been amended to accommodate Barnes Dance crossings.

9.2.1 St Andrew Street and Great King Street Intersection

Although no changes are proposed at this intersection it was included in the LinSig traffic model to assess the impact that any changes in traffic volumes may have on the intersection.

The results of the modelling showed that the intersection performed well as shown in the following table.

Table 7: Great King Street / Saint Andrew Street Intersection Performance Summary

Great King Street / St Andrew Street AM Peak		
Performance Indicator	**Existing Performance**	**Forecast Performance**
Estimated Traffic Flows (vehicles)	809	940
Total Traffic Delay	5.8 PCU-hrs	5.5 PCU-hrs
LoS (average)	B	C
DoS (worst movement)	47%	42%
Practical Reserve Capacity	90.7%	117.0%
Great King Street / St Andrew Street PM Peak		
Performance Indicator	**Existing Performance**	**Forecast Performance**
Estimated Traffic Flows (vehicles)	1022	1364
Total Traffic Delay	10.5 PCU-hrs	10.5 PCU-hrs
LoS (average)	C	C
DoS (worst movement)	61%	68%
Practical Reserve Capacity	47.7%	33.0%

9.2.2 Hanover Street and Great King Street Intersection

This intersection currently operates with three lane approaches on Hanover Street east and west whereas on Great King Street both approaches are two lane. Whilst the LinSig traffic model diagrams in the appendices show short left turn lanes on Great King Street this is a quirk of the coding to represent left turning vehicles and does not in practice represent an additional lane.

To make the intersection more pedestrian friendly and encourage active modes of transport the preferred treatment which includes reducing the Hanover Street approaches to just two lanes on each approach together with incorporating a Barnes Dance phase was modelled.

A summary of the performance assessment of the proposed intersection design relative to the base model is shown in the following table.

Table 8: Great King Street / Hanover Street Intersection Performance Summary

Great King Street / Hanover Street AM Peak		
Performance Indicator	**Existing Performance**	**Forecast Performance**
Estimated Traffic Flows (vehicles)	780	1068
Total Traffic Delay	6.4 PCU-hrs	5.8 PCU-hrs
LoS (average)	C	B
DoS (worst movement)	58%	46%
Practical Reserve Capacity	55.4%	96.6%
Great King Street / Hanover Street PM Peak		
Performance Indicator	**Existing Performance**	**Forecast Performance**
Estimated Traffic Flows (vehicles)	1167	1332
Total Traffic Delay	16.3 PCU-hrs	8.8 PCU-hrs
LoS (average)	D	C
DoS (worst movement)	84%	61%
Practical Reserve Capacity	7.1%	47.0%

Existing Layout

As discussed in Section 5.1 SCATS is a dynamic system and the LinSig model is coded for a set sequence of traffic phasing that applies for all cycles.

A problem arises in attempting to accurately model the existing SCATS phasing at this intersection as that the right-turns are seldom called up but ignoring them in LinSig would result in the right turners never being able to move. As a consequence, the Existing Case in the LinSig model has included phases seldom called being called in every cycle, thus reducing capacity. The model is therefore significantly underestimating actual traffic signal capacity.

The underestimating of capacity in the LinSig model is evident in the comparison between the Existing Performance and the Forecast Performance. The forecast performance being based on a signal phasing that has fewer phases, i.e. less total intergreen time per hour. This results in the preferred treatment option having a much higher capacity. In reality the LinSig model is showing that both scenarios work, with the capacity of the existing case being underestimated.

9.2.3 Frederick Street and Great King Street Intersection

This intersection currently operates with a Barnes Dance. An option was considered whereby the lanes on the eastern approach would be reduced from three to two to aid east to south turning movements for buses. This option resulted in traffic queues blocking the upstream intersection with Cumberland Street and has been ruled out.

Table 9: Great King Street / Frederick Street Intersection Performance Summary

Great King Street / Frederick Street AM Peak		
Performance Indicator	**Existing Performance**	**Forecast Performance**
Estimated Traffic Flows (vehicles)	1033	1472
Total Traffic Delay	4.6 PCU hours	8.5 PCU hours
LoS (average)	B	C
DoS (worst movement)	38%	47%

Great King Street / Frederick Street AM Peak		
Performance Indicator	**Existing Performance**	**Forecast Performance**
Practical Reserve Capacity	150.3%	93%

Great King Street / Frederick Street PM Peak		
Performance Indicator	**Existing Performance**	**Forecast Performance**
Estimated Traffic Flows (vehicles)	1069	1553
Total Traffic Delay	7.6 PCU hours	10.4 PCU hours
LoS (average)	C	C
DoS (worst movement)	58%	54%
Practical Reserve Capacity	54.6%	66.7%

Again as with the Hanover Street and Great King Street intersection the LinSig is slightly under estimating capacity as Phase E, the right turn into Great King Street is not called up every cycle however within the limits of the LinSig model this is called every cycle thereby taking up unnecessary capacity.

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Appendices

Appendix A: Traffic Flow Estimates

Appendix B: Linsig Outputs – Filleul Street

Appendix C: Linsig Outputs – 5-Arm

Appendix D: Linsig Outputs – Great King Street

Appendix E: PRELIM TR-0100Series Drawings (Note, this appendix is issued as a separate file due to size constraints)