Appendix L Health Impact Assessment

Shaping Future Dunedin Transport Project:

Health impact assessment

For the Local Advisory Group

Robert Quigley

Quigley and Watts Ltd.

20 April 2021

Table of Contents

Table of Contents 2
1. Introduction 3
1.1 Purpose and objectives 3
1.2 The three scenarios being assessed 3
2. Approach and methodology 6
2.1 Conceptual framework 6
2.2 Geographic study area 6
2.3 Data collected and considered 7
2.4 Assessment and scoring method 8
3. Community profile 9
3.1 Introduction 9
3.2 Population 9
3.3 Demographics 10
3.4 Transport data 11
3.5 Population groups of focus for this assessment 11
3.5.1 Older people 11
3.5.2 People with disabilities 12
3.5.3 Tertiary students 13
3.5.4 Hospital staff 13
4. Assessment of programmes 15
4.1 Do minimum: 15
4.1.1 Rationale for score 15
4.2 Programme 1 (P1): 18
4.2.1 Rationale for score 18
4.3 Programme 2v3 (P2v3): 23
4.3.1 Rationale for score 23
5. Health and wellbeing outcomes potentially affected by these programmes 30
6. Suggestions to increase potential positive effects and avoid potential negative effects 32
7. Conclusion 33
8. References 34
Appendix 1: Statistical areas with study area 35

1. Introduction

Shaping Future Dunedin Transport is a collaborative partnership between Waka Kotahi NZ Transport Agency, Dunedin City Council and Otago Regional Council. The Local Advisory Group has a wider membership, including Southern Partnership Group, Ministry of Health, Southern DHB, University of Otago, Otago Polytechnic, Otago Regional Council, Te Rūnanga o Ōtākou, Otago Mayoral Forum and the Workforce Group (MBIE).

The Local Advisory Group asked for a health impact assessment (HIA) on the Shaping Future Dunedin Transport project (hereafter project).

The project is a review of Dunedin's central city transport system. The project is in response to the new Dunedin Hospital (NDH) development which is being built between two State Highway 1 roads. The project is about re-thinking the future of Dunedin's central transport system to see if it can be used to support major developments, such as the NDH and better enhance the central city for everyone.

The HIA assessed three roading scenarios: Do Minimum, Programme 1, and Programmme 2v3. The three roading scenarios are presented in more detail in Section 1.2 below. Additional project details can be found on the Waka Kotahi NZTA website.

1.1 Purpose and objectives

The purpose of this assessment is to judge the potential health effects of the two proposed road scenarios against the Do Minimum scenario, including both potential positive and negative effects. The assessment suggests ways to minimise potential negative effects and maximise the uptake of potential health benefits.

The objectives are to:

- Draw from and build upon the outputs of the regulatory planning and assessment process (e.g. other assessments) and collect bespoke data from stakeholders
- Identify and describe any potential health effects (positive or negative) from the scenarios
- Make evidence-based suggestions to maximise positive effects and minimise negative effects.

1.2 The three scenarios being assessed

Table 1 (below) outlines the characteristics of the three scenarios.

Table 1. Programme characteristics

Do minimum characteristics	Programme 1 (P1) characteristics	Programme 2v3 (P2v3) characteristics
• Permanent Barnes Dance crossings at Albany/SH1 intersections. • George Street 10km/h for four blocks (Albany Street to Moray Place). • Tertiary area 30km/h on side streets (Union, Clyde and Forth Streets and Harbour Terrace)	Do minimum plus: • Harbour Arterial upgrade (peak travel time is similar to the Do Minimum paired SH1 route) • Parking management will prioritise shoppers and hospital users over long term parking • More frequent and more direct bus services with a low flat fare • Two park and ride sites (Burnside and Mosgiel) • Cycle and pedestrian network gaps improved • SH88 relocated from St Andrew Street to Frederick Street to allow a pedestrian focus on St Andrew Street • Pedestrian priority at signals on hospital frontage • Provision of additional cycle routes connections on Albany Street and St Andrew Street	• Same as Option 1
No change to existing: Pair of SH1 one-way arterials retained at 50km/h	Pair of SH1 one-way arterials retained, but at 40km/h. 1. Northbound arterial stays one way and two lane. This road is the front door to the hospital, and the western-most SH1 arterial ie. closest to the city centre. 2. Southbound arterial stays one way and two-lane. This road is at the back of the hospital, and the eastern-most SH1 arterial. The SH1 one-way arterials will have slightly improved amenity for pedestrians (e.g. Barnes Dance crossings at intersections, amenity planting, greater separation from traffic), improving north-south and east-west pedestrian movements	Pair of SH1 one-way arterials changed: 1. Northbound arterial changes to a two way local road at 30km/h. Not a State Highway. This road is the 'front door' to the new hospital. 2. Southbound arterial changes to a two-way State Highway Arterial at 50km/h (now only one road is a State Highway instead of two) The local road will have a significantly improved level of amenity, people-friendly, pedestrian focus, cycle friendly and safe for people of all abilities. It will be a spine for all north-south movement of pedestrians, bus users and people who cycle. It will also support accessible routes east-west better than Programme 1. The two-way State Highway Arterial will have few improvements to amenity, be a primary vehicle route, have no cycle facilities and will not have mid-block crossing for pedestrians, but will have improved pedestrian safety at intersections (Barnes Dance crossings).

•

Do minimum characteristics	Programme 1 (P1) characteristics	Programme 2v3 (P2v3) characteristics
No change to existing: The authority to make decisions about allowable land uses on the existing SH1 pair sits with multiple agencies (e.g. Council, NZ Transport Agency) due to it being a State Highway	The authority to make decisions about allowable land uses on the existing SH1 pair sits with multiple agencies due to it being a State Highway	The local road allows a greater proportion of the central area of Dunedin to be under Council authority: This significantly increases opportunities for residential living and supportive business environments all the way back to the city core.
No change to existing: Number of on-street parks unaffected. Commercial parking buildings to support new hospital are expected.	Number of on-street parks reduced slightly to accommodate amenity improvements. Commercial parking buildings to support new hospital are expected.	Parking removed from the new SH1 arterial to accommodate extra vehicle lane. Parking on local road retained and where possible expanded. Commercial parking buildings to support new hospital are expected.
Vehicle speed limits retained at current levels except for George Street and Tertiary area side-streets (as above).	Vehicle slow zone of 30 to 40km/h from Jetty Street (in the south; warehouse precinct) to St David Street (in the north; tertiary precinct), including existing pair of SH1 arterials (40km/h)	The new SH1 arterial is 50km/h. A vehicle slow zone of 30km/h from Jetty Street (in the south; warehouse precinct) to St David Street (in the north; tertiary precinct)
No change to existing: Dedicated cycleways on the existing paired SH1 arterial retained, supporting confident cyclists.	Dedicated cycleways on existing paired SH1 Arterial retained and extended; supporting confident cyclists.	The new two-way SH1 Arterial will have no dedicated cycling facilities, but similar amenity value to the Programme 1 SH1 arterial. The cycling spine will shift to the local road and will support two-way travel and less confident people who would like to cycle.
No change: Pedestrian connection between bus hub and new hospital is retained in its current state.	Pedestrian connection between bus hub and new hospital is improved via Barnes Dance crossings, is indirect, but supports all types of abilities.	Pedestrian connection between bus hub and new hospital is greatly improved via Barnes Dance crossings and signalised mid-block crossings, is direct and supports all types of abilities.

•

2. Approach and methodology

2.1 Conceptual framework

Health impact assessment (HIA) is the most common framework used in New Zealand and internationally to analyse, monitor and manage the health consequences of development. HIA can inform the choice of options and design of projects/programmes.

The International Association of Impact Assessment (2006) describes how interventions (such as a proposed change to a road) might affect health through intermediaries, or what are described as the determinants of health. These include:

- Individual determinants (genetic; biological; sex; dietary intake; personal safety; tobacco use; activity; employment status; housing status; personal income; educational status; etc)
- Social and environmental (Access to health services, education, employment and other social services; Quality of air, water and soil; Distribution of wealth; Community norms and attitudes; Urban design; Local transport options available, etc.)
- Institutional factors (capacity, capability and jurisdiction of Government, Local Government and NGOs to provide frameworks for action, services and infrastructure).

However, HIA cannot start with a checklist of potential impacts but must identify what to assess from an awareness of the project and an understanding of how the project might affect what is important to the project's stakeholders. Fortunately, contextual information is available regarding the roading options and data is available about the local communities. Also, site and stakeholder specific information was considered to further understand the proposals and what might be important to stakeholders via:

- Discussions with Local Governance Group
- Discussions with project team
- Alignment with assessment criteria for Strengthening Future Dunedin Transport's Multi Criteria Analysis
- Site visits
- Maps of the region.

Taken together, the above information was used to provide a conceptual basis for this assessment, by answering the key question - Whether there may be any health effects:

1) Arising from the two roading scenarios versus the Do Minimum
2) On access to health services, safety, pollution, activity (via mode shift), connectivity within the CBD, and sense of place
3) Arising from being an older person (Dunedin and/or outer center such as Oamaru); a hospital staff member; a university student; or person with disabilities?

2.2 Geographic study area

Given this is a transport project, a study area had previously been defined by Waka Kotahi. This area encompasses the roads proposed to be changed and the communities around them (see Figure 1 for Study Area). The study area encompasses the area between the Oval (in the south) and Botanic Gardens (in the north) and several blocks east of Princess Street, the Octagon and George Street. These areas happen to match two Statistic New Zealand Census Area Units (Campus South and Dunedin Central-Harbourside).

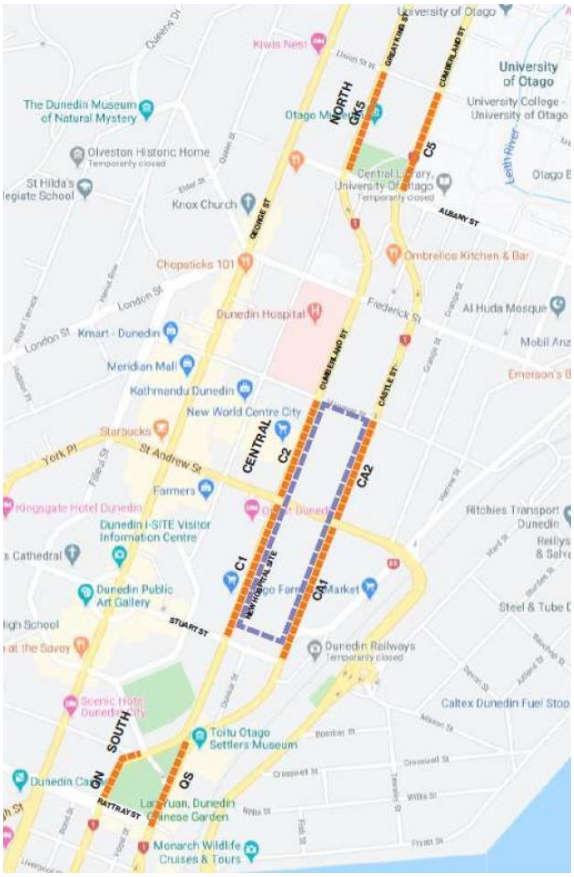

Figure 1. Study area

2.3 Data collected and considered

Beyond the information sources listed in Section 2.1 above, the methods of gathering information about the existing situation and potential health effects were:

Undertake scans of the literature to understand the empirical evidence about how these topics might impact on health outcomes. Literature reviews are available from the author for:

- Access to health services
- Safety
- Mode of travel and connectivity
- Sense of place
- Pollution.

Engage those with most experience in such matters, such as topic experts from stakeholder agencies; or those who will experience the intervention, such as community members from within the study area. Using predominantly telephone interviews and focus groups, 66 people/organisations were engaged by the health assessor:

- People with disabilities and advocates (18)
- Students (11)
- Hospital staff (12)
- Older people and advocates - North Otago and Oamaru (18)
- Shaping Future Dunedin Transport team and multi criteria analysis authors (6)
- New Dunedin Hospital (1).

Review existing reports, including the Multi Criteria Assessments, the Public Engagement summary and the online social pinpoint analysis.

-

2.4 Assessment and scoring method

Data were considered by the assessor to determine whether a health effect had the potential to occur or not. Both positive, negative and neutral effects were considered. Where effects were concluded to potentially occur, the effect was scored using the same scale as the Multi Criteria Analysis (See Figure 2.)

Description	Definition	Score
Significantly positive	Significant positive impact, likely resulting in substantial and long-term improvements or enhancements	+3
Moderately positive	Moderate positive impact, which may provide improvements or enhancements, and new opportunities of short, medium- or long-term duration.	+2
Slightly positive	Minor positive impact, may be confined to limited area, possibly only short term	+1
Neutral	No discernable or predicted positive or negative impact	0
Slightly adverse	Minor adverse impact, probably short-term, which can be mitigated	-1
Moderately adverse	Moderate adverse impact, may be short, medium or long term, and impact will most likely be able to be mitigated or managed	-2
Significantly adverse	Significant and serious adverse impact with serious long-term effects on the physical, economic or social environment.	-3

Figure 2. Assessment scoring matrix

3. Community profile

As described above, the study area matches closely to three statistical areas: Campus South; Dunedin Central; and Harbourside. Data for these areas are described below. Maps are presented in Appendix 1.

3.1 Introduction

Dunedin City sits within the Otago Region on the east coast of the South Island of New Zealand. Dunedin City is a harbour city but also has a large geographical area to the south, west and north totalling over 3,300 km^2 (See Figure 3).

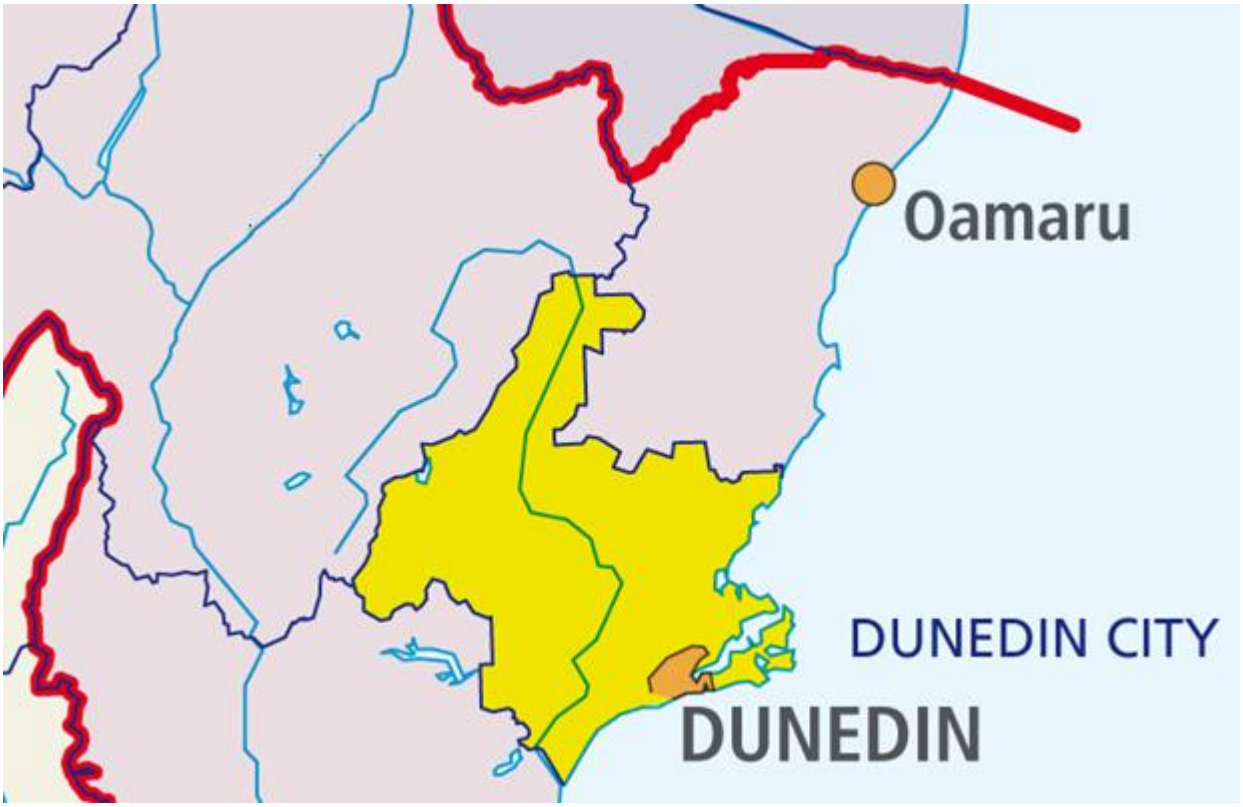

Figure 3. Map of Dunedin City (yellow)

Within the urban centre, Dunedin City boasts retail, hospitality destinations and access to high quality services, be that education, health or arts, etc.

The rural areas within Dunedin City boundaries are those that can be experienced all over New Zealand. Lightly populated, zoned rural, and a predominant agricultural land use.

3.2 Population

The 2018 Census showed Dunedin City had a resident population of 126,255, with population growth of 6.4 percent from the 2006 Census. The 2020 estimated population is 134,100 (a further 6.2 percent increase in just two years) (see Table 2).

Harbourside has a very small and declining resident population (45 in 2018), reflecting the industrial nature of the area.

The population in Campus South has decreased by 7 percent to 2,031 in 2018. In contrast, the Dunedin Central population has increased by 2.3 percent over the same time, but this is about one-third of the increase experienced by Dunedin City as a whole (see Table 2).

Table 2 – Population data (*Statistics NZ, 2021*)

	Population by Census			Population per cent change
	2006	2013	2018	2006 to 2018
Campus South SA2	2,184	2,046	2,031	-7.0%
Dunedin Central SA2	1,902	1,914	1,962	+2.3%
Harbourside SA2	60	48	45	-25.0%
Dunedin City	118,683	120,249	126,255	+6.4%

3.3 Demographics

Table 3 continues to show the differences between Campus South and Dunedin Central compared with Dunedin City. Campus South and Dunedin Central have very low proportions compared with Dunedin City for those aged 65+ years, income and house ownership. Campus South and Dunedin Central also reflect a more diverse ethnic population, where Dunedin City has 13 percent non-European, compared with more than double that in Campus South (31 percent) and Dunedin Central (30 percent). These data reflect classic student and inner city populations and demonstrates these populations are quite different from 'typical' Dunedin City residents.

The average population per household varied, with Dunedin City at 2.40, Dunedin Central at 2.33, and Campus South at 3.92 people per household. The higher Campus South average reflects the student population in the area who are, nearly all, flatting (house ownership of 2%).

The very small sample size of Harbourside makes the presentation of demographics prone to error, so it is not reported from this section forward.

Table 3 – 2018 Census demographics (Statistics NZ, 2021; Massey University, 2021)

Area	Aged 65+ (per cent)	Median income	Per cent Maori/European[1]	House ownership[2] (per cent)	Average population per household	NZ Deprivation Index[3]
Campus South	0.3	$6,900	12/69	2	3.92	9
Dunedin Central	3.0	$17,400	9/70	16	2.33	8
Dunedin City	15.9	$25,500	9/87	67	2.40	N/A

[1] People can self-identify with more than one ethnic group and not all ethnic groups are shown, so totals do not sum to 100

2 Owned, partly owned or held in a family trust

3 The NZ Deprivation Index combines census data relating to income, home ownership, employment, qualifications, family structure, housing, access to transport and communications. Meshblocks (the smallest geographic area from census data) are grouped into deciles, where 1 represents the areas least deprived and 10 the areas most deprived.

3.4 Transport data

Table 4 continues to show the diversity in the two statistical areas compared with Dunedin City, with:

- High (80.5% in Dunedin Central) or very high (96.6% in Campus South) proportions walking or cycling as their main way to travel to education
- Campus South and Dunedin Central have a four to five times the proportion of people walking or cycling as main means to travel to work when compared to Dunedin City
- About one-third of people use a vehicle as main means to travel to work (in Campus South and Dunedin Central) compared with nearly three-quarters in Dunedin City.

Again, demonstrating these populations are quite different from 'typical' Dunedin City residents. Simply, the vast majority of these residents do not rely on vehicles to travel to work or education and instead use walking (predominantly) and cycling. Public transport usage remains relatively low, as per the rest of Dunedin City.

Table 4 – Transport related Census demographics (Statistics NZ, 2021)

Area	Vehicle as main mean to travel to work (percent)	Walk or cycle as main means to travel to work (percent)	Bus or train as main means to travel to work (percent)	Walk or cycle as main way of travel to education (percent)	Car, truck or van as main way of travel to education (percent)
Campus South	37.1	48.1	2.8	96.6	0.2
Dunedin Central	31.0	57.7	4.4	80.5	12.0
Dunedin City	73.4	12.0	3.4	43.3	43.6

3.5 Population groups of focus for this assessment

Additional data about the five groups of focus is presented below.

3.5.1 Older people

Older people are one-quarter of Dunedin's population, but as seen in the Census data above, proportionally, very few live in the CBD. Therefore, most older people travel to the city centre to engage with it. Focus group and interviews identified older residents of Dunedin use their gold card on buses, catch a lift with a friend or drive a private vehicle to travel to the city centre Taxis are rarely used due to cost.

Older people have strong desire to travel to the city centre to meet their friends, volunteer and do daily tasks. When in the city, older people from Dunedin usually do several things each time they come into the city, rather than just coming in for one reason and then leaving again. This provides a solid connection to the city centre for these older people. Older people from Dunedin regularly move about the city (several blocks) on foot. This is confirmed by the NZ Travel Survey which shows that older people are walkers - they walk for more minutes than at any other stage/age in their life.

Older people do travel to the city centre for hospital appointments and the literature is clear that older people have a higher need than average for access to hospital-level/outpatient health services. Transport is their number one barrier for accessing services.

For those who drive, the focus groups and interviews identified that they do not like driving on the one-way system, finding the heavy vehicles and speed intimidating, and rarely venture onto the one-way system on foot. They say the State Highway intersections are dangerous due to vehicle speed and turning

-

traffic. This is confirmed via Waka Kotahi's Community at Risk Rating system, where Dunedin City has the highest risk rating, nationwide, for intersections, and third highest risk rating for older road users.

When North Otago older people must come for a hospital appointment, they either get a lift, come in by shuttle or bring a private vehicle. A medical appointment is an in-out appointment, meaning they only come for that reason, and then leave again. Parking is a common concern for medical appointments, especially as appointments sometimes take several hours (beyond parking restrictions); parking is sometimes quite a distance for these older people to walk; and the drop-off zones mean the driver must leave a (typically) unwell person alone while the driver attempts to find a suitable park. Park and ride options for people arriving from the North were seen as one potential solution to this parking dilemma.

In contrast, when older people from North Otago choose to come to Dunedin City for other reasons, such as visiting friends, family, shopping or window-shopping, entertainment, they've planned their day. They usually arrive by vehicle, and move about within the city, mostly by vehicle. People from Oamaru had a higher expectation of being able to park at a venue, and as such typically chose places to visit that were not available in Oamaru, had attached parking and typically these venues were on the fringe of the city. Unlike older people from Dunedin, they seldom parked in the city and walked throughout the CBD.

According to interviewee's (advocates for older people), the experiences of older people from North Otago are similar to those of older people from Central Otago (Wanaka, Cromwell, Queenstown) who also arrive from the north for medical appointments. These travellers often take State Highway85 (via Ranfurly/Palmerston) over State Highway8 (via Roxburgh/Milton).

3.5.2 People with disabilities

People with disabilities are one-fifth of population, and according to interviewee's and focus group participants the proportion living in the CBD is low. This is said to be due to the relatively inaccessible nature of inner city residential buildings, and cost. Popular suburbs for people with disabilities are instead, for example, South Dunedin which is flat, close to the city and more affordable.

Therefore, most people with disabilities travel to the city centre to engage with it. Focus groups and interviewees identified that people with disabilities use buses as the most common mode. The fully accessible buses are critical, but of course they do not work for all. Issues remain regarding ease of access to the bus stop, access on/off the bus, and the length of time/amount of energy needed for a bus trip. Next most common modes were private vehicle and disability taxi. However, disability taxis were said to be expensive, do not operate beyond 6PM, and experiences with operators were sometimes negative. In contrast to others, power wheelchair users regularly powered in from South Dunedin, eschewing all other modes. For those who drive, parking was a issue, with the number, quality and location of disability carparks.

People with disabilities come to the city for a rich variety of reasons and uses: Education, shopping, entertainment, meeting friends and family, volunteering and of course, work, to name a few. When in the city, people with disabilities usually do several things each time they come into the city, rather than just coming in for one reason and then leaving again. This provides a solid connection to the city centre for these people. People with disabilities regularly move about the city, on foot or wheeling themselves. Several focus group members moved large distances, from the Octagon to university and back again. Movement was the rule rather than the exception. However, several people with disabilities described the need to take safe routes, and that these routes are not usually the shortest routes. The block sizes in Dunedin are relatively large. Some people with disabilities (and their carers) can only walk/wheel/push about one block due to fatigue. Regardless of relative ease of mobility, direct routes e.g. from public transport stops or mobility car parks are highly valued to minimise effort/time of movement.

Certainly, the literature describes multiple barriers in urban environments. Focus group/interview participants describe Dunedin City as "OK" from a disability perspective for most people with disabilities, but they also added that many places in the city need substantial improvement. In contrast, some of the interviewee's and some in the focus group described substantial barriers to moving about Dunedin City

centre. These people described an unwelcoming space for people with severe disabilities, and numerous obstacles in the environment.

Zebra crossings don't work well for visually impaired people or for those who are less confident/able movers. Such people only use signalised intersections or signalised mid-block crossings.

Regarding hospital appointments, the literature shows people with disabilities have a higher than average need to access hospital-level/outpatient health services and that transport is also their number one barrier. The literature tells us that people with disabilities die younger than the general population and are more likely to be socially isolated.

3.5.3 Tertiary students

There are about 25,000 university and polytechnic students and another 5,000 staff (23% of total population). The students have a high demand for health services too, but the vast majority of that is delivered by Student Health on campus. However, several university buildings, for example the Hunter Centre, are separated from the main campus by both State Highways meaning students regularly cross those roads.

Most students admit to mid-block crossings and acknowledge the danger of that, especially for those out-of-town who are not used to one-way systems. Students with disabilities can only safety cross at signalised intersections, of which there are relatively few.

Dunedin is unique in that the Campus South and Dunedin Central areas have extremely high rates of walking or cycling to education (97% and 84%). These rates are the highest in the country. Walking and cycling are active modes, contributing to health and wellbeing outcomes such as mental health and maintenance of a healthy weight to name just two of many.

Much of the student's movement is within the university site itself, but students regularly move all over the city and particularly the CBD. The students have a very strong attachment to Dunedin Central: the ability to live close to the university and the city, to be close to other students and the vibe of the city. Also, several expressed an interest in living in the CBD rather than the student area.

Students who cycled were confident cyclists and despite that, describe cycling in the city as '*downright dangerous.*' This was due to gaps in the cycle network, the need to veer across traffic on the one-way system and merging at intersections.

Dunedin has the third highest risk rating for pedestrians and fifth highest for cyclists out of 67 Territorial Authorities according to Waka Kotahi's Communities at Risk Rating.

3.5.4 Hospital staff

Dunedin Hospital is a Level 1 hospital with approximately 2,800 staff and 2,100 inpatients, outpatients and visitors. Hospital services make a direct contribution to wellbeing through diagnosis, treatment and management of illness and accidents.

Staff wellbeing is important and is regularly considered by the DHB due to demanding nature of the work (capacity, and the level of difficulty of presenting patients is increasing) so anything that can improve the working environment is welcomed.

Similarly, patients and visitors are typically unwell and/or highly stressed so high quality urban spaces are highly valued.

Staff mostly use a private vehicle to get to work (80%), though 5% bus, 5% cycle and 10% walk. But of those who use private vehicles, a large proportion would consider shifting modes. A hospital staff travel survey identified fifty percent would consider using a bus if it was direct to the hospital (and safe) and sixty percent would consider using free park and ride. Such mode shift has many positive contributions to

health, for example, extends life expectancy, halves the risk of heart disease, lowers stress levels, and reduces the risk of diabetes. Many have already used the Wakari to Hospital shuttle.

However, rather than concern about themselves, staff are primarily concerned about their patients and visitors. The focus group participants wanted to ensure that that their patients have equitable access to their service i.e. patients can get to the hospital using whatever mode they need/are able to.

Hospital staff also voiced their concern about vehicle pollution arising from vehicles. The literature is clear regarding negative effects on all-cause mortality, cardiovascular disease, some cancers, chronic and acute respiratory diseases, to name a few.

4. Assessment of programmes

This section presents the findings for Do Minimum, Programme 1 (P1) and Programme 2v3 (P2v3).

4.1 Do minimum: Overall score of -1.25, minor negative

The overall score is made up of an average from the individual scores for each determinant of health assessed, presented in the table below:

Determinant	Do minimum score
Access to health services	-1
Safety	-2
Modes of access to/from city; and connectivity within CBD	-1
Sense of place	-1
	-1.25 (Average score)

4.1.1 Rationale for score

Of the 66 people who participated in the engagement aspect of this assessment, zero preferred the Do Minimum scenario.

4.1.1.1 Access to healthcare (score of -1; minor/slight negative)

The New Dunedin Hospital (NDH) is sited between two State Highways at existing 50km/h speeds with many untreated intersections creating unsafe and challenging access to health services for all people across these roads, but especially for older people and people with disabilities. Under Do Minimum the high community risk rating for Dunedin city remains for all modes/population groups and may get worse as traffic volumes rise. The NDH sits within this existing environment.

Rural, low income, older people, people with disabilities and minority ethnic groups are more likely to have transport problems when accessing healthcare.

Without public transport improvements under Do Minimum and with only small improvements in physical infrastructure, access to the city and the NDH has the potential to remain constrained for those without vehicles, but especially for older people and people with disabilities. This compounds the empirical evidence which shows that for people with disabilities who are non-frequent users of public transport, medical appointments are the second most common purpose for using public transport.

The empirical evidence around transport and access to health shows that transportation affects every step in the healthcare journey. Transport is:

- a major reason for delay in seeking healthcare
- a major reason for cancelling or missing appointments
- the most common reason people withdraw from treatment.

Quotes from participants

"*The central city isn't a great place for me because of my disability, so any changes under option 1 or 2 would have to be a big improvement* "(Person with a disability).

"Having the one ways around the hospital will make it inhospitable (Student).

"*There's not much point in going to the city if you can't move around it. So I only go in when I need to. For a hospital appointment, I'd usually leave straight afterwards*" (Person with a disability).

4.1.1.2 Safety (score of -2; moderate negative)

The safety performance of the existing network is poor. Dunedin has the 7th highest risk rating out of the 67 Territorial Authorities and Unitary Councils in NZ. On top of that, Dunedin's risk profile is the third highest for pedestrians, third highest for older road users, fifth highest for cyclists, and has the highest risk rating in NZ for intersections. While the Do Minimum does lower vehicle speed in a small number of streets, safety issues largely remain unaddressed.

Just taking two examples, mid-block crossing on the State Highways continue in the university precinct and throughout the city; and many unsafe intersections remain. These are key factors for university students, older people and people with disabilities. Within the focus groups, hospital staff who cycle are confident cyclists, but even so, at times they fear for their lives. For the hospital staff who didn't cycle, safety was a major reason not to.

The empirical evidence confirms the obvious: Road traffic injuries and death are bad for people's health. Injuries and death happen across all transport modes to all age groups, though there are notable inequalities. Pedestrians and cyclists are more vulnerable road users because they can withstand only relatively gentle impacts. The fatality risk for pedestrians increases sharply beyond 30km/h.

The empirical evidence also shows that one way systems are typically less safe than two way. The existing one way system in Dunedin City is part of the environment and currently Dunedin City has a poor safety risk rating compared with other Territorial Authorities in New Zealand. One question from the Local Advisory Group was whether airports, with their one way vehicle systems, might be exemplary design for the NDH. The answer is no, because of the different characteristics between an airport and the NDH:

- Airports are on the fringes of the city whereas the NDH is in the city centre
- Airports are primarily accessed by vehicles, often travelling at 100km/h on the airport route
- Airports typically have little to no pedestrian or cycle infrastructure along that airport route, and so airports are primarily dealing with vehicles, and passengers of those vehicles
- When a vehicle arrives at an airport, the road design is often one way, but the one way system 'kisses' one side of the airport only. The airport is not ringed by roads on four sides as per the NDH.
- To enable safe pedestrian drop-off/pick-up and safe access by pedestrians from carparks, an airport one way system has significant treatments to slow vehicles, typically to 30km/h in the airport vicinity, then to 10km/h at the terminal itself. Dunedin Airport uses (very high) raised pedestrian crossings; Melbourne Airport has resorted to 'people with stop/go signs' as the volume of traffic and pedestrians is too high.
- As such, one way vehicle systems at airports can promote safe access, but at very low speeds. There is no proposal for such speeds at the NDH.

For those people with disabilities who drive to the city, car parking on the one-way is not plausible due to the design of the cycle path barriers, which prevent the people exiting from the 'footpath side' of the road. This means these people need to enter/exit their vehicle on the traffic side. This is too dangerous for most.

None of the programmes discuss the 5-street roundabout of St David, Regent, Park and George Street. This was considered a dangerous intersection by nearly all participants at the student focus group.

Quotes from participants

"My wheelchair was stuck! I couldn't go forward. I couldn't go back. A man on a motorcycle had to stop and help me out of the traffic lane" (Person with a disability).

"Bicycles are all mixed in with cars at the intersections and it's really confusing. Really dangerous. I really worry about hitting them" (Older person, driver).

"This option does nothing to improve the issues with the one way system" (Student).

"I have 'jay-walked' in my power chair, but only very very occasionally. It's really not safe!"

"The Do Minimum is no advantage for anyone" (Disability advocate).

4.1.1.3 Modes of access to/from the city and connectivity within the city (score of -1)

Multi modal access (vehicle, public transport, cycling, walking, taxi, shuttle) for journeys to/from the city and pedestrian/ cycling movement within the city remain constrained under a largely, business as usual approach. Existing roadways and intersections would become harder to cross over time as traffic volumes increase, especially for older people and people with disabilities.

Do Minimum has no major investment in public transport and vehicle travel times do not change. Combined with small improvements in physical infrastructure these will signal that vehicles will remain the dominant form of transport and remain attractive. This has the potential to undermine mode shift for hospital staff, older people and people with disabilities. The health benefits of active transport may not be unrealised.

The majority of the tertiary precinct is unchanged, and so the safety of students is potentially compromised in the face of increasing vehicle numbers.

The empirical evidence from the NZ Household Travel Survey shows that time spent walking is highest for those aged 15-24 years (18% of all travel time), 65+ years (15%) and 75+ years (19%) (Ministry of Transport, 2021). These age groups reliance on walking is undermined by little to no investment in pedestrian infrastructure.

Quotes from participants

"The camber of the roads, the curbs, the lip edges, traffic management fencing. You're just waiting for the next moment your path will be blocked" (Person with a disability).

"It'll be better for walking around George Street" (Student).

"Not much incentive to use PT is there?" (Hospital staff).

"As a person with a disability, I actively avoid travelling into and around the central city" (Person with a disability).

4.1.1.4 Sense of place (score of -1; minor/slight negative)

Under Do Minimum, feelings of safety and comfort for older people and people with disabilities have the potential to improve substantially on the four blocks of George Street; and for university students on the four streets in the tertiary precinct. This is because of reduced vehicle traffic and amenity improvements.

However, these people-focussed areas of the city remain small and disconnected for these population groups. Overall, without any other interventions, place quality slowly declines for these population groups because increased trips on the network are dominated by vehicle trips.

The State Highways constrain development opportunities around housing for potential inner city residents and businesses because of the (existing) shared authority of the State Highways, and so potential positives of density of population, vibrancy of the street space and eyes on the street are less likely to be realised.

Despite good efforts, the city urban environment is not truly welcoming to people with disabilities. Similarly, living spaces in the CBD are not well designed for people with disabilities or those with mobility issues. Therefore, very few older people or people with disabilities currently live in the CBD and this has little chance to change under Do Minimum.

Sense of place is not advanced, neither is amenity, nor feelings of safety.

Quotes from participants

"Dunedin will be less pedestrian friendly and less commutable than other cities in New Zealand" (Student).

"The central city has a few places which are welcoming to people with serious disabilities, but there is improvement needed in many areas. This wouldn't change much under Do Minimum" (Person with a disability).

"If you don't have experience of driving in Dunedin the one way street layout is confusing. The city is busy, it's stressful. On top of that is the worry about finding a carpark that's close enough for me to walk" (Older person, Oamaru).

"If you're in a disability van or shuttle, odds are it's because you can't move very far. There needs to be lots of these drop-off zones in different parts of the city so I can access different parts of the city" (Person with a disability).

4.2 Programme 1 (P1): Overall score of +0.75, slight/minor positive

The overall score is made up of an average from the individual scores for each determinant of health assessed, presented in the table below:

Determinant	Do minimum score
Access to health services	0
Safety	+1
Modes of access to/from city; and connectivity within CBD	+1
Sense of place	+1
	+0.75 (Average score)

4.2.1 Rationale for score

Of the 66 people who participated in the engagement aspect of this assessment, three preferred P1.

4.2.1.1 Access to healthcare (score of 0; neutral)

A number of potential effects are common to P1 and P2v3. These have the potential to create positive outcomes for access:

- The Barnes Dance crossings on key intersections (not just those close to NDH) and the slow speed zone have the potential to improve access for nearly all people, including older people, people with disabilities, university students and hospital staff.
- Improved public transport has the potential to support access to health services for those without vehicles, of which older people, people with disabilities and university students have higher proportions than other groups. The empirical evidence confirms the importance of public transport, because for those people with disabilities who are non-frequent users of public transport, medical appointments are the second most common purpose for using public transport. The literature also describes how public transport is only used when services are appropriate, match appointment times, and match an ability (health/energy wise, and supportive urban environment) to walk/move at either end of the public transport trip. About half of older people in New Zealand metropolitan areas use public transport.
- A pedestrian focus on St Andrew Street is important for linking the hospital to the northerly Southern DHB buildings e.g. Professional Learning Centre.

However, there are also some potential negative effects, common to both P1 and P2v3, regarding access to health services:

- For older people from Oamaru, the most common access to the hospital is either self-drive (if a confident long distance and city driver), get a lift from friends (who are also usually older people as well) or family, or take the door-to-door shuttle. Parking is the main concern for those who drive. A few people do other tasks while in the city, depending on their age/wellness and length of medical appointment. Carers/friends typically stay with the older person throughout the whole journey. Shuttle users have good access, being a door to door service, though the day is long. As such, there is little to differentiate the programmes regarding access to NDH for older people from Oamaru. The empirical evidence supports the above, showing most health service visits in New Zealand are taken in a private vehicle. However, for older people and people with disabilities, car ownership is low and ability to drive reduces sharply with age. Therefore, the evidence describes a greater reliance on friends, family, taxis and shuttle services. Asking people for a lift to attend medical appointments is considered appropriate (compared with say, to go shopping). Also, the literature describes how older New Zealanders with vehicles are generally happy to drive within their rural town but are reluctant to drive longer distances.
- The mid-block crossings on the State Highway at the ‘back door of the NDH’ to the east of the city, are unsafe for hospital staff and visitors who park their vehicles to the east and walk to the hospital.

Several characteristics which have potential negative effects regarding access to health services are specific to P1:

- The NDH is sited between two state Highways at 40km/h speeds.
- The two-lane State Highway on the city-side (western side) has the potential to reduce access compared with P2v3's local road.
- The uncontrolled mid-block pedestrian crossings to the NDH (across either State Highway) are likely to be less safe for older people or people with disabilities, potentially forcing routes which will take longer (time, distance and the person's energy).
- Heavy vehicles remain on both sides of the hospital, potentially contributing to noise, smells (from stock trucks), pollution and reducing feeling of safety. A positive hospital environment contributes to the wellbeing of staff and visitors and P1 is less likely to contribute to such an environment.

Quotes from participants

"It wouldn't be great for the hospital to be marooned on an island between the State Highways. Whether it's the city getting the most out of the NDH, or the NDH getting the most out of the city", we need the best possible connection" (Southern DHB representative).

"Better, but not great (Student).

4.2.1.2 Safety (score of -1; minor/slight negative)

A number of potential effects are common to P1 and P2v3. These have the potential to generally, create positive outcomes for safety:

- The Barnes Dance crossings on key intersections (not just those close to NDH) and the slow speed zone have the potential to improve safety for nearly all people, including older people, people with disabilities, university students and hospital staff. Similarly, the St Andrew Street calming is important for a safe linkage between the hospital and the northerly Southern DHB buildings for hospital staff, visitors and patients. Where intersections do not use Barnes Dance crossings the safety benefits are not as high.
- Some heavy vehicles divert from the State Highway to the Harbour Arterial route, leading to a small safety improvement for the Southern and Central sections of the State Highway. However, these diverted heavy vehicles re-join the State Highway at the university precinct (Frederick Street), leading to a small decrease in safety in this area.
- Mid-block pedestrian crossings to the New Dunedin Hospital (out the back door) are not safe for older people or people with disabilities and these groups will need to continue to use the intersections (Barnes Dance crossings) to cross safely
- Outside the hospital, if more parking is required near the Harbour area, this will increase the number of pedestrians crossing from the east on the arterial route to access the hospital and CBD. This is true of both programmes
- The slow speed zone from Jetty St to Union Street, and including the State Highway 1 pair, addresses vehicle speeds for a relatively large area (but not beyond Union Street in the tertiary precinct).
- The international literature is clear that one-way traffic flow is less safe than two way. However, because speeds are lower in P1 than P2v3, the effect in Dunedin is more likely to be neutral.

Several characteristics which have potential negative effects regarding safety are specific to P1:

- The State Highway 1 cycle lane is extended and provides safety benefits for confident cyclists for parts of the route. However, several dangerous situations where cyclists cross/merge with vehicle traffic remain on this route. Public Engagement supported removal of the cycle lanes from the State Highway from a safety perspective.
- Mid-block pedestrian crossings to the New Dunedin Hospital (across either State Highway) are not safe for older people or people with disabilities,
- Heavy vehicles remain on both sides of the hospital, contributing to reduced feelings of safety.
- The potential for all-mode conflict remains due to unchanged access to big-box retail in the south and fast food outlets in the north.

-

- In the tertiary precinct, there is additional potential for accidents for students which may arise from a greater number of heavy vehicles on Frederick St (via Harbour Arterial), the installation of mid-block crossings on the State Highway arterials, and from the slow speed zone stopping at Union Street - therefore not including high-student foot traffic areas: residential and popular fast food restaurants. The additional potential for accidents is offset somewhat from the reduced speed of the two State Highway routes, so overall the risk tends neutral.

Overall - Several health benefits accrue, are substantially better than Do Minimum, but do not reach their full potential.

Quotes from participants

"Barnes Dance's are great" (Person with a disability).

"I still wouldn't cycle around" (Student).

"I can't park on one side of the one way as I'd have to get my wheelchair out of the car while facing a lane of traffic" (Person with a disability).

"This is not enough of a change" (Hospital staff).

"Parking on the one-way sucks now anyway" (Student).

"Please remove the cycle lanes from the State Highways!" (Hospital staff member).

"People are afraid of the State Highway one-ways" (Disability advocate).

4.2.1.3 Modes of access to/from the CBD and connectivity with the CBD (score of +1)

A number of potential effects are common to P1 and P2v3. These have the potential to create positive outcomes for mode of access and connectivity:

- Barnes Dance crossings on key intersections, along the whole route and not just those close to NDH, and the slow speed zone (30km/h), improve east-west and north-south connectivity for pedestrians, including people with disabilities, older people, hospital staff and students.
- Several changes are proposed (compared with Do Minimum) which may support mode shift, including parking management; public transport improvements, park and rides, cycle and pedestrian networks, and slow speed zones. These are projected to be major factors which underpin mode shift. Parking management is a key factor and the political appetite for increasing parking costs is often challenging at a local government level. Public Engagement supported all-day parking locations on the edge of the central city and acknowledged that inner city parking should be prioritised for people with mobility issues and short-stay retail. Public Engagement also strongly supported public transport improvements.
- There is a perception held by some that older people and people with disabilities do not take public transport. However, older people use their gold card to explore the city on public transport. The bus fleet in Dunedin is fully accessible, and nearly all points of interest are available through services. For those for whom money is an issue (including older and disabled people), the lower-cost fares increase the potential to use public transport.
- Both P1 and P2v3 do not allow cyclists to easily travel northbound if starting at the university. This is because of the circuitous nature of the P1 dedicated cycle lanes, and the two way cycle lane being on Great King Street for P2v3. In both situations, cyclists must travel west, cross Cumberland Street, to turn north at Great King Street. This could be alleviated by a Leith cycleway, connecting the university northwards.
- Public transport is described as the most common form of transport for people with disabilities in Dunedin (Disabilities Advocate). As such, improvements in public transport have a potential positive effect. The second most common mode is disability taxi, but the drop-off points are often dangerous, and cost is prohibitive. The existing fully accessible buses are critical for access for many people with disabilities. It gives additional mode choice over expensive taxis, or relying on families, or anxiety about parking if they drive themselves. For some people with disabilities, public transport is unlikely to work well. For example, one pariticipant described how she needed regular toilet stops, and the time required to take the bus, door to door, was simply too long.
- Park and rides were supported by older people, especially from Mosgiel, and from hospital staff. Because the existing park and ride options e.g. Wakari hospital shuttle, are not suitable for people in

-

a wheelchair, people with disabilities had low expectations that park and ride facilities would assist mode shift for them.

Several characteristics which have potential effects on mode and/or connectivity are specific to P1:

- P1 lowers the speed limit of the State Highway 1 pair to 40km/h. This has the potential to further support east-west connectivity across the one-way pair. Extending the State Highway 1 arterial cycle lanes will support cycling for confident users along that route.
- Fewer opportunities for mid-block crossings and/or the use of uncontrolled mid-block crossings have the potential to hamper east-west connectivity improvements for people with disabilities and older people.
- Car based modes are well provided for, and vehicle travel times are maintained into the future and remain attractive which will hinder mode shift somewhat.

Quotes from participants

"The investment in public transport would mean I could explore Dunedin better" (Student).

"Pedestrian priority outside the hospital would mean I'd be more likely to get to class on time" (Student).

"It's fine. Not much change for me as I drive anyway" (Hospital staff).

4.2.1.4 Sense of place (score of +1; minor/slight positive)

A number of potential effects are common to P1 and P2v3. These have the potential to create positive outcomes for sense of place:

- These programmes have capital budgets that can provide significant safety and amenity improvements to the urban environment compared with the Do Minimum. The Public Engagement summary describes how many people strongly support more seating and planting to improve the main walking routes so they are safer and easier for everyone to use, regardless of age or mobility. Improvements to the urban have the potential to make the central city more welcoming for people with disabilities and older people, if designed and implemented well.
- The Barnes Dance crossings on key intersections of both State Highways have the potential to contribute to gains in older people's and people with disabilities feeling of comfort, feeling of safety and improved safety while crossing the State Highways at intersections.

Several characteristics which have the potential to effect sense of place are specific to P1 alone:

- Development opportunities for additional businesses and inner-city residents are improved, potentially affecting density of population, vibrancy of the street space and eyes on the street. The monetised liveability benefit is a substantial $112 million per year. Older people's willingness to stop/rest/engage with what is on the street is potentially improved over the Do Minimum but lower than P2v3.
- P1 provides a lower speed limit on both State Highways (compared with Do Minimum) and these have the potential to contribute to gains in older people's and people with disabilities feeling of comfort, feeling of safety and improved safety while crossing at intersections.
- However, this is somewhat offset by having no mid-block pedestrian crossings across either State Highway, reflecting lower permeability of the State Highways for people with disabilities and older people (compared with P2v3).
- Also, heavy vehicles remain on both State Highways. This contributes to lower comfort (noise, smells, pollution) and lower feelings of safety. The one way system is frequently described as unsafe and car-dominated by older people and people with disabilities (and this is supported further by the Public Engagement comments, and by empirical evidence) and while mitigated somewhat by reduced vehicle speed, safety issues have the potential to remain.
- The empirical evidence confirms a one way system is more confusing for people than a two-way system for wayfinding, especially for those who are less frequent travellers to the city. For example, people from out of town visiting the NDH, or older people and students.
- The literature also shows one way systems typically lead to less positive outcomes for business development, liveability, crash rates, property values and crime.

Quotes from participants

"I try to go to the hospital as little as possible [laughs], but when I do go, I take a cab so there's not much difference between the options for me on that. But when I'm out and about in the city, option 2 [P2v3] would help me get about much better than option 1 [P1]" (Person with a disability).

"The one way system is really confusing for students when they first move here" (Student).

"I can't see how option 1 would significantly improve the way things are?" (Hospital staff).

4.3 Programme 2v3 (P2v3): Overall score of +2.25, moderate positive

The overall score is made up of an average from the individual scores for each determinant of health assessed, presented in the table below:

Determinant	Do minimum score
Access to health services	+2
Safety	+2
Modes of access to/from city; and connectivity within CBD	+2
Sense of place	+3
	+2.25 (Average score)

4.3.1 Rationale for score

Of the 66 people who participated in the engagement aspect of this assessment, 63 preferred P2v3.

4.3.1.1 Access to healthcare

A number of potential effects are common to P1 and P2v3 and these are described in P1 above. As described above, these common effects, generally, have the potential to create positive outcomes for access to healthcare and will not be repeated here.

However, several assessment findings are specific to P2v3 alone:

- For those who must attend hospital, barriers to access must be as low as possible no matter how people choose/are able to travel. P2v3 best supports the full suite of travel choices for people travelling to the NDH: walk, cycle, public transport, drop off, taxi, shuttle, private vehicle.
- The NDH is sited with a low speed high amenity local road at its 'front door' (to the city), and a two-way 50km/h State Highway at its back door. Mid-block pedestrian crossings to the New Dunedin Hospital (at the back door) are not safe for older people or people with disabilities; but are substantially safer and shorter on the local road. Older people (one in four New Zealanders) and people with disabilities (one in five New Zealanders) need to take safe routes and these are not usually the shortest routes. The block sizes in Dunedin are relatively large. Many people with disabilities, carers, and older people can only walk/wheel about one block due to fatigue. So direct routes, say from the bus hub to the hospital are highly valued. Visually impaired people will typically only use signalised intersections to cross a road and there is greater opportunity for signalised mid-block crossings to be installed in P2v3 than P1. There is also greater opportunity for creation and allocation of disability parking spaces when the local road is under Dunedin City Council authority than if it is State Highway 1.
- Removing heavy vehicles from the local road improves safety for nearly all people moving within the city. Also, this removal of heavy traffic from the local road creates a calmer hospital environment for visitors, staff and patients. The hospital's spine for people movement (visitors, patients, etc) matches the local road. The hospital's ancillary services spine (catering, energy, water, machinery) matches the noisier/busier State Highway. P2v3 therefore best matches the hospital design to support a health promoting environment for staff and visitors.
- Option 2 allows the hospital to be a more considered, purposeful healthcare destination. The P2v3 environment has the potential to support the NDH, rather than the NDH trying to work within what is a transport-dominated environment.

There is a substantial amount of empirical research about transport and access to health services in the literature, but most is about transport and primary care services rather than hospital level care. Two interesting findings from New Zealand research are:

- A new parking building constructed to ease parking difficulties at Waikato Hospital did not ease transport access for many patients because of its distance from the services, especially for those with mobility and respiratory conditions.

-

- One Maori provider has had success at breaking down transport barriers by picking people up directly and taking them to the service in a shuttle. This time in the shuttle built whanaungatanga and helped the service gain a deeper understanding of the patient's health needs, before their appointment.

There are some potential effects common to all three options regarding access to health services:

- Southern DHB perceives no issues for access by emergency vehicles under any of the three options.
- Across all three programmes, parking provision is similar. Lack of parking was mentioned by older people and people with disabilities when accessing the existing hospital. These groups voiced concerns about parking for the NDH, especially given the increasing demand for mobility parks with an ageing population and the more central location of the NDH. These groups require (and appreciate) mobility parks, drop-off zones, taxi-ranks and ask for a greater number of mobility parks, than currently available, from Southern DHB and Council. Guidelines for mobility parking are said to be poorly met quality wise. For example, adequate dimensions for increasingly common larger, van-type mobility vehicles; appropriate location and placement away from traffic streams; and appropriate nearby curbing to allow a person to alight from the vehicle and safely get to the footpath. Furthermore, the disability community have described the number of mobility parks available as being based on minimum requirements of guidelines, rather than based on an assessment of need.

Quotes from participants

"It's real tiring getting around by myself. It's tiring for my wife when she pushes me. Anything that can shorten the distance or make it easier to cross the road to the hospital is a big help" (Person with a disability).

"Less pollution around the hospital would be huge. You can smell the pollution as you stand at the corners. It's really bad for your health. There's so many studies showing that. We have lots of compromised people coming to our hospital and we expose them to that" (Hospital staff).

4.3.1.2 Safety

A number of potential effects are common to P1 and P2v3 and these are described in P1 above. As described above, these common effects, generally, have the potential to create positive outcomes for safety and will not be repeated here.

However, several assessment findings are specific to P2v3 alone:

- The local two way road at 30km/h will be substantially safer than P1 or Do Minimum. The international literature is clear that two-way streets are safer than one-way streets. Several high quality studies in peer reviewed scientific journals confirm a higher incidence of collisions and injuries on multi-lane one way streets than on their two-way counterparts – for motorists, bikes and pedestrians. So, while the State Highway in P2v3 will remain at 50km/h, it is unlikely to be any less safe than the one-way at 40km/h, especially since the peak time average speed of 35km/h is lower than the posted speed limit. U-turns at State Highway intersections would ideally be prevented to increase safety. For access to the fast food restaurants (university end of local road) and big box retail (southern end of local road), while these are high traffic areas (foot and vehicle) zones, the 30km/h vehicle speed and design will maintain safety in these areas.
- The safety aspects of the local road are expected to be high. The empirical evidence is clear that pedestrians and cyclists are more vulnerable road users because they can withstand only relatively gentle impacts. The fatality risk for pedestrians increases sharply when vehicle travel speed is beyond 30km/h. Not only will the local road be slow speed, but it will also draw increased numbers of people who walk and cycle from the State Highway system, effectively taking them out of harm's way. Further empirical evidence describes an often forgotten relationship with speed: The role of speed in crash likelihood is confirmed in numerous studies. For example, Nilsson (2004) and then Elvik (2013) demonstrated that lower mean traffic speeds in response to speed limit reduction results in reduced likelihood of casualty crashes. Literature describing a 'Safe System approach', says that in built-up areas where there is a mix of vulnerable road users and motor vehicle traffic, a 30km/h speed limit should be imposed.

-

- The movement of the cycleway to the local road will improve safety for all cyclists, except for a small number of very confident cyclists who will choose to cycle on a State Highway even without a cycleway. Most cycle users will likely use the new cycle spine on the local road. The movement of the cycleway to the local road supports most comments from the Public Engagement which wished to see the cycleway moved from the State Highway 1 pair to the local road for safety reasons.
- At the tertiary precinct under P2v3, the State Highway 1 arterial will have a higher volume of traffic (in two directions) than either road in the existing State Highway pair (both in one direction). As such, mid-block crossings, which are currently unsafe and not desired by authorities, will remain that way and have the potential to be less safe without further treatment, such as speed restriction on the P2v3 State Highway. Having said that, the actual vehicle speed on P2v3 on the state highway is likely to be lower than the posted 50km/h, as the current average speed is 35km/h at peak time. Ensuring speeds do not 'creep up or above' 50km/h at the tertiary precinct is likely worthwhile though. In contrast, the 30km/h local road is far safer to cross mid-block than P1's 40km/h State Highway arterial, and so my assessment is it's slightly safer overall in the tertiary precinct for those (unsafe and unwanted) east-west pedestrian mid-block crossings.
- People with disabilities and older people strongly advocate for removal of e-scooters from footpaths due to safety risks (accident risk from speed; difficult to hear e-scooters coming; trip hazard when poorly parked; many users are inexperienced/have a low skill level). The improved treatment of cycling in P2v3 presents the opportunity to move e-scooters onto the Dunedin City Council controlled cycle network and off footpaths.
- The opportunity to increase residential density via the local road would increase the 'eyes on the streets', making people feel safer (from crime) as they move about.
- P2v3 leads to few significant changes regarding vehicle travel time, with the largest being a 2 to 4 minute increase for those driving south to north at peak times, the full length of the study area (the Oval to Botanic Gardens). This correlates with NZTA research which describes that where vehicles potentially conflict with vulnerable road users, lower speeds over finite lengths of road would be expected to result in only small time losses (Frith, 2012). The study authors say this would arguably be of little consequence and could be economically discounted, while the safety benefits to the vulnerable road users are demonstrably real. Frith (2012) goes on to describe international research where urban travel speeds were, on average, well below posted speed limits. One example in the Netherlands showed major urban through roads with a 50km/h limit had an average speed up to 38km/h. Frith summarises that reductions in the posted speed limit in urban areas therefore may contribute comparatively little if anything in terms of increased travel times (Frith, 2012). The average travel speed at peak hour in Dunedin is about 35km/h.

There are some potential safety drawbacks to P2v3 however:

- The State Highway is proposed to remain at 50km/h which is a high speed for an urban area, and is not contributing to a 'Safe Systems' approach.
- Two way streets are typically safer than one-way streets, though in this case the 50km/h speed limit nullifies those potential gains.
- Safety for people who cycle improves overall, but not for those confident cyclists who will continue to use the State Highway
- Several participants, particularly those whose primary mode was vehicle, were concerned about congestion on the State Highway and the convergence of vehicles as the number of lanes reduces.
- Student safety remains neutral at the Tertiary precinct overall, but mid-block crossing remains an issue along the length of the State Highway, as does Frederick Street heavy vehicle use (though students acknowledge the safety gains elsewhere via the local road). The slow speed zone does not extend beyond the campus at Union Street, which is a residential area for students and includes the fast food restaurants. Offset somewhat by the safety of the local road and the Increased residential density arising from opportunities to develop the local road provides more eyes-on-street.

Quotes from participants

"The road closest to the university would be busier :-(" (Student).

"I'd feel safer. I'm a confident wheelchair user but these improvements would make it safer, less stressful, less scary for me" (Person with a disability).

-

"I'm worried about the cars bottle necking, especially as the highway drops lanes. That doesn't sound safe" (Hospital staff).

"We need to improve from what we have" (Hospital staff).

"I regularly push between around the Octagon, to parts of Moray Place, the Civic Centre and Library, down George Street and towards student-ville. Having a safer way to do that would be awesome" (Person with a disability).

"Those people [decision makers] are going to get old someday and they'll be grateful of it [P2v3] then" (Older person, Dunedin).

"I'm very concerned about heavy traffic using Frederick Street. I've had many near misses in this area as it is. It's very dangerous already" (Hospital staff).

"I always cross at the lights. It'd be amazing to have another safe option" (Person with a disability),

"Those things [e-scooters] are dangerous on the footpath. Some of the people in the Blind Foundation are using e-scooters to get around!" (Person with a vision disability).

4.3.1.3 Modes of access to/from the CBD and connectivity with the CBD (score of +1)

A number of potential effects are common to P1 and P2v3 and these are described in P1 above. As described above, these common effects, generally, have the potential to create positive outcomes for mode of access and connectivity and will not be repeated here.

However, several assessment findings are specific to P2v3 alone:

- The geographic area affected by the local road is large: 38 city blocks. The people who currently live in this area walk and cycle, predominantly, with extremely low vehicle use. This confirms that if densification occurs, it is plausible that future populations will also predominantly walk and cycle, further contributing mode shift and the health benefits arising from that. Under P2v3, the land use of the local road is much more likely to change due to the regulatory autonomy of Dunedin City Council, and due to the desirability created by the local roads urban space.
- To encourage travel to the city centre and within the city, barriers must be as low as possible no matter how people choose/are able to travel. P2v3 best supports the full suite of travel choices to and within the city for older people and people with disabilities: walk, cycle, public transport, drop off, taxi, shuttle, private vehicle.
- For all users, such as older people and people with a disability, pedestrian crossings and Barnes Dance crossings support mode shift. P1 has more limitations on installing these than P2v3.
- In the Public Engagement, many people supported joined up cycle networks, though some did not support cycle networks in any way. Ironically, those who do not support cycleways may prefer the removal of cycle lanes from the State Highway 1 arterials.
- P2v3 is particularly beneficial to support a cycling mode shift (for example university students and hospital staff) and power wheelchair users. P1 continues to mix people on bicycles and vehicles at busy intersections, on a noisy/high stress route only suitable for confident cyclists. Whereas P2v3 creates an active mode spine which has the potential to be safer, more pleasant north-south spine, for all cycling/power-chair abilities. The P2v3 pedestrian spine also provides better connectivity to George Street, the CBD and to the warehouse precinct. Several power wheelchair users power themselves to the CBD and back to their homes e.g. in South Dunedin. So direct routes and routes with calmed vehicle speeds are valued highly.
- Under P2v3, the mid-block cross between the bus hub and NDH can be signalised to allow people with all types of abilities another opportunity to cross the road to the NDH.
- There are two areas in P2v3 where there is complexity about crossing a single street east-west and these are discussed below. However, it remains that overall, east west severance is significantly improved in P2v3:
    - There is existing east-west severance on the current southbound State Highway 1 one-way arterial. Crossing is only safe at signalised intersections, such as at the existing desire line of St Andrews Street. The ability to cross mid-block is poor now (only for confident pedestrians during platooning of vehicles). Under P2v3 (two way State Highway1 arterial with three lanes), it is projected to be worse as there is no space for a median barrier, especially around the NDH. However, there is little in the way of desire lines either, as the only Castle Street hospital

entrance is near St Andrew Street, on the existing desire line, which is near a signalised intersection. For both P1 and P2v3, mid-block crossings are not helpful for less confident pedestrians. As such both programmes score poorly for accessible mid-block crossings on Castle Street near the new hospital.

- In the tertiary precinct, existing east west severance across the current southbound State Highway 1 one-way arterial (turning into the two way State Highway 1 arterial) would improve slightly. Currently (and in P1), confident pedestrians can cross mid-block, across two one-way lanes, in-between platooning vehicles. Under P2v3 the ease of crossing mid-block (across the State Highway 1 two-way, one lane each way arterial), would be slightly improved. People would only have to deal with one lane of traffic at a time, stopping in a median zone. While the speed limit is higher in P2v3 (at 50km/h), the actual speed of vehicles is far slower (now) during peak times and will be slower again with the increased vehicle volumes under P2v3, maintaining the ability for confident pedestrians to cross mid-block.

- P2v3 performs better on four out of five key walking routes (and no difference on fifth) compared with P1. All routes have an east west component and most have a north-south component as well. These key routes link tertiary students to the health sciences campus and/or CBD; people/staff between the city, bus hub and the NDH; and strongly support connectivity to the employment and retail areas of George Street and the warehouse precinct. These improvements arise from additional signalised mid-block pedestrian crossings (for people with disabilities and older people), non-signalised mid-block crossing points (for confident pedestrians) and a reduction in traffic.
- There is a reduced level of pedestrian and cycling service along the new State Highway 1 arterial, however the connectivity assessment concludes the new spine (local road) will take its place because people will typically use the best path available, despite it being a little longer distance for a few north-south routes.
- For older people and people with disabilities who drive/park, there is improved mobility once they leave their car (and walk/move about) under P2v3 - for access to health services and the CBD.

Quotes from participants

"It's the only option that holds water in the long term" (Person with a disability).

"It's probably going to be harder to jaywalk on the two way state highway" (Student).

"We have to future proof our city. We've got a large older people's demographic arriving very soon in Dunedin" (Person with a disability).

"The linkages to the cycle spine really need to work well for this option to the harbour cucle network north and south, to Princess Street and South Dunedin, to North Dunedin. If the linkages are poor the cycle spine could be a stranded asset" (Hospital staff).

"This option could lead to better student housing options. Better than the crappy places we live in now. Other people would live here too if it was central and good quality" (Student).

"Getting cyclists off the state highway must be an improvement" (Hospital staff).

4.3.1.4 Sense of place

A number of potential effects are common to P1 and P2v3 and these are described in P1 above. As described above, these common effects, generally, have the potential to create positive outcomes for sense of place and will not be repeated here.

However, several assessment findings are specific to P2v3 alone:

- The local road is substantial in length, approximately 3.5km and affecting development opportunities for 38 city blocks. Development opportunities for additional businesses and inner-city residents are substantially improved by P2v3, in turn affecting density of population, vibrancy of the street space, eyes on the street and economic outcomes. For the university, it has the potential to increase opportunities for development along the local road. Inner city residents promote a socially cohesive environment, promote local employment and generally have excellent access to education, employment opportunities and services. NZIER's monetised liveability benefit for P2v3 is highly significant at $230 million per year. This is $118 million per annum greater than P1. Such value is created by extending the heart of the city east, to the new two-way State Highway, thereby opening up

the potential for development of approximately 38 city blocks compared with P1. NZIER's finding correlates with a New Zealand study (MacMillan, 2012) which modelled five different scenarios and identified the most effective approach, gaining greatest net benefit, was from: "… physical segregation on arterial roads (with intersection treatments) and low speed, bicycle-friendly local streets. We estimate that these changes would bring large benefits to public health over the coming decades, in the tens of dollars for every dollar spent on infrastructure."

- The local road has much lower traffic volumes, lower speed and fewer heavy vehicles over the entire length. This allows controlled and uncontrolled mid-block pedestrian crossings, complementing the Barnes Dance crossings on key intersections. Removing heavy vehicles from the local road improves feelings of safety for nearly all people moving about the city. These changes to the local road have the potential to create a calmer/quieter environment for all, encouraging nearly all people to safely explore knowing there are places of interest and places to rest nearby. The high potential for amenity improvements and activation of spaces on the local road means a high potential for gains in sense of place. The Public Engagement summary noted many comments about roads being unpleasant due to noisy and unsafe traffic.
- For people with sensory or cognitive disabilities, traffic noise is debilitating. The ability to move about or spend time in spaces without such noise is highly valued.
- The area outside the NDH on the local road becomes highly usable by NDH staff and allows staff, who are well paid relative to average incomes, to be able to access CBD businesses more easily.
- In the tertiary precinct, the State Highway 1 arterial is one lane each way at 50km/h. However, the two way nature of the road is judged by the Place Quality MCA to be an improvement for pedestrians regarding permeability (greater opportunities to cross), feelings of comfort (activation of space) and safety (safer opportunities to cross), over the 40km/h one way State Highway1 arterial. Their international literature, and the literature review carried out for this assessment, both conclude two way systems are typically safer than one way systems which in turn affects pedestrian permeability. Several well-controlled research studies have shown one way streets have higher crash rates, higher crime rates and lower property values than two way streets.
- Also, the literature describes one-way to two-way conversions that have occurred in various international cities: "it is difficult to find examples where the conversion did not result in increased business activity." This included revitalising city centres, increased numbers of jobs, economic growth and improved neighbourhood liveability. The authors attributed the change to exchanging vehicle speed with access brought about by the two-way circulation, liveability through streetscape design, activation of spaces, and increased property values. University student pedestrian desire lines are 'diagonal' from north of Albany Street, to get to the more easterly campus from the city. The diagonal desire line is better supported by P2v3 than P1 because of the greater permeability of the two-way State Highway 1 arterial compared with a one-way State Highway1 arterial.
- Tertiary students have a pedestrian desire line from their halls of residence, down Cumberland Street to New World. P2v3 has Cumberland Street as the local road, substantially improving that component of the journey for these residents.
- University students have embraced small-powered devices such as scooters and skateboards. These modes of transport are better supported by P2v3 because the spine/connectedness/legibility of the cycle-way is improved. With few gaps, the cycle network has the potential to encourage small-powered devices off the footpaths and onto the cycleway if designed accordingly. P2v3 has the potential to future proof for the eventual increase in small-powered devices. Older people and people with disabilities strongly desire the removal of small-powered devices from footpaths.
- The positive outcomes outlined above are somewhat offset by a reduction in pedestrian benefits and place quality on the three-lane two way State Highway 1 arterial in the CBD. This is due to the extra traffic lane (to three lanes) meaning there is neither ability to separate traffic from pedestrians, nor an easy way to cross mid-block, nor an ability to create substantial amenity planting.
- However overall, combined with the positive aspects presented above, there is a substantial improvement over Programme 1 and the Do Minimum.

Quotes from participants

"Less traffic noise on Great King Street, where I live, is very appealing!" (Student).

"When you plan for people with disabilities, you plan for everyone" (Disability advocate).

"This would be my preferred option, but for the different number of lanes on the state highway. That's way too complicated. But I really like the idea of one less State Highway" (Hospital staff).

-

"When I go to the city I meet people for work, eat out with my wife, go to the library, have a beer with friends, go to a show – that sort of stuff" (Person with a disability).

"It's much safer to cross at the student quarter" (Student).

"I prefer the local road is under local control. More chance for trees, seats, better things for the people of Dunedin rather than for people who just drive on through" (Hospital staff).

"That option would make it much easier for me when I wheelchair push […] Yeah. I push from the Octagon to the university fairly often" (Person with a disability).

"Lots more choice about where I could live" (Student).

Being able to personalise a space like that, to make it inviting on a practical level and welcoming, that's huge" (Person with a disability).

"There'd be a better chance of getting more university facilities on the local road" (Student).

5. Health and wellbeing outcomes potentially affected by these programmes

Firstly, the number of people potentially affected by these outcomes is very large, being either thousands, or tens of thousands of the population of Dunedin City (134,100 people in 2020):

- Older people – approximately 34,000 people (25% of the city's population)
- People with disabilities – approximately 27,000 people (20% of the city's population)
- Tertiary students – 25,000 university/polytechnic students and 5,000 staff (22% of the city's population)
- Hospital staff – 2,800 staff and 2,100 inpatients, outpatients and visitors each day (4% of the city's population).

Secondly, many of these people are often termed as 'vulnerable', and for whom getting excellent outcomes is actually quite difficult. There are few opportunities to systematically address the social determinants of health at a city-wide scale and this is one of those opportunities. As a nation, we do not have many evidence-based ways to successfully address inequalities, except by addressing the social determinants. These determinants can affect health outcomes, employment outcomes, education outcomes or social outcomes. As such, any movement in the social determinants tend to have life-long and generational effects, creating very large financial benefits across multiple domains, if done well, or disbenefits if done poorly. For example, NZIER's calculation for the monetised liveability benefits generated by P1, but especially P2v3, are substantial per annum contributions.

Thirdly, the health outcomes arising from transport interventions have been rigorously studied and published in peer-reviewed scientific journals, reflecting the importance of transport to health and wellbeing. They are presented in the table below.

Determinant	Contribution to health and wellbeing outcomes
Access to health services	Contribution to direct health outcomes arising from diagnosis, treatment and management of acute and chronic health conditions. High quality of place (e.g. the environment within which the NDH sits) has strong positive associations with mental health and social connectedness for staff. The evidence about environment on patient treatment outcomes or recovery is inconclusive.
Safety	Stating the obvious, road traffic injuries and death are bad for people's health. Injuries and death happen across all transport modes to all age groups, though there are notable inequalities. Motor cyclists, pedestrians and cyclists are the three highest risk groups. Nationally, the number of traffic deaths has increased steadily from 2013 (253 deaths) to 2018 (377 deaths), with a more recent decrease to 320 deaths in 2020. A feeling of safety contributes to mental wellbeing.
Mode shift/ Connectivity	Active transport includes walking, cycling and public transport use. Public transport is typically regarded as active because of the walk/cycle required at the beginning and end of the bus/train ride. Benefits arising from active transport are varied, well described and widely accepted. They are summarised below (Community and Public Health, 2016): • Improves quality of life and life expectancy among adults (even if physical activity is adopted later in life) • Halves the risk of heart disease and stroke • Reduces the risk of some cancers (e.g. breast and colon cancer)

	• Reduces the risk and improves the management of type II diabetes (the most common form) • Assists with the prevention of falls in the elderly by maintaining bone mineral density • Reduces the symptoms of depression and anxiety, lowers levels of stress • Increases self-esteem • Helps maintain a healthy weight • Reduces air pollution and major respiratory illness. Improvement is independent of the type of active commuting, seen in both males and females, and for those previously untrained (Schaefer et al, 2020). Connectivity also contributes to social determinants such as social inclusion, access to education, access to employment, and access to housing to name a few.
Sense of Place	Contribution to mental health and social connectedness
Pollution	Pollutants from motor vehicles include $PM_{2.5}$, PM_{10}, black carbon, ultrafine particles, nitrogen dioxide (NO_2) and carbon monoxide (CO). These pollutants are released into the air via exhaust pipes, physical decomposition of the vehicle and road, and resuspension of particulate matter from the ground back into the air by motor vehicle traffic. Each pollutant is detrimental to human health and there is no safe level of intake. Light goods vehicles and buses contribute double the attributable deaths from PM_{10} and NO_2 per vehicle kilometre driven than cars, and heavy goods vehicles over four times. As such, moving one truck off a route is equivalent to potential improvements in air quality health outcomes of moving 4.5 cars. These pollutants lead to negative effects on all-cause mortality, cardiovascular disease, heart attack, some cancers, chronic and acute respiratory diseases, to name a few. There are 283 deaths per year attributed to New Zealand's road transport emissions of PM_{10} and NO_2. Reviews of air pollution exposure conclude that motorists are exposed to more particulate matter than both cyclists and pedestrians —who are the least exposed. This is because cars travel in the centre of roads where pollution levels are highest and pollutants become trapped in the vehicle cabin. To be clear, active transport modes such as walking and cycling provide health benefits which far outweigh the negative effects from any air pollution.

6. Suggestions to increase potential positive effects and avoid potential negative effects

Throughout the course of this work, several suggestions have been put forward by interviewee's and focus group participants regarding possible improvements to the programmes. Along with the assessor's own suggestions, those which are supported by findings and evidence are presented below.

Determinant of health supported	Suggestion to increase potential positive effects and/or avoid potential negative effects
- Access to health services - Safety - Mode shift / Connectivity - Sense of place	Choose P2v3 for moderate improvements in health and wellbeing. Choose P1 for slight improvements in health and wellbeing. Choose Do Minimum for a slight reduction in health and wellbeing.
- Access to health services	Regardless of programme chosen: Council and Southern DHB could work together to review mobility parking around the NDH. With explicit consideration of (1) the number of parks needed and (2) the quality of mobility carparks (carpark dimensions, safe access to the kerb, distance/route from hospital). This is further supported by the Public Engagement, where all-day parking locations were strongly desired on the edge of the central city, alongside acknowledgement that inner city parking should be prioritised for people with mobility issues and short-stay retail.
	Regardless of programme chosen: When contracting for NDH and any urban development work associated with a programme, have a specific clause in the bid document requiring specialist skills associated with designing/engaging for people with disabilities. These skills should include engagement with the disability community and specialist expertise in universal design as it relates to their field of expertise e.g. transport engineering. This expertise must incorporate the lived experiences of disabled people in Dunedin. And/or assign a Principal Advisor – Disability with the NDH/DCC teams. Ensure there is a list of physical features (for example, features important to people with disabilities) that cannot be traded-off as part of the tender evaluation process. Continue the principal advisory role into final sign-off for the 'practical completion certificate' to ensure what is said will be done is implemented appropriately.
	The Wakari shuttle service is used and supported. Consider other starting destinations for access to inpatient and outpatient services.
- Safety	Consider reducing the speed limit on the State Highway in P2v3
	The slow zone appears to stop short of the tertiary precinct and 50km/h speeds remain on the State Highway. Together with risks from mid-block crossing and heavy vehicles on Frederick St, consideration of an extension to the slow zone is warranted.
- Mode shift/Connectivity	Include consideration of small-powered vehicles (e.g. e-scooters and e-skateboards) into the design and construction of cycle lanes.
	Consider whether a park and ride is feasible for northern residents, or for NDH patients arriving from Central Otago/North Otago e.g. at Pinehill or elsewhere.
	The use of universal design is not standard within Dunedin City Council contracts and could be considered.
	Park and ride services (which are already proposed in P1 and P2v3) to be strongly promoted to hospital staff, especially if there is the opportunity to drop in front of the hospital and/or bus hub.
	Ensure the P2v3 cycle spine connects safely to the balance of the cycle network, particularly the Harbour route.

7. Conclusion

This assessment considers the potential impacts of the Shaping Future Dunedin Transport programmes on health and wellbeing.

The assessment collected data via multiple methods, including literature reviews, existing work such as the multi criteria analyses, and interviews/focus groups with stakeholders and community.

Overall, the Do Minimum option has the potential to negatively affect health and wellbeing outcomes. Whereas both P1 and P2v3 have the potential to improve health and wellbeing outcomes, with P2v3 substantially more so than P1.

A modest number of suggestions are made within the assessment to further embed potential positive outcomes and avoid/mitigate potential negative outcomes.

8. References

Community and Public Health (2016). Active and public transport infrastructure: a public health perspective. Christchurch: Canterbury DHB.

Elvik R, Sørensen M, and Nævestad T-O (2013). Factors influencing safety in a sample of marked pedestrian crossings selected for safety inspections in the city of Oslo. *Accident Analysis & Prevention*, 59: 64-70.

Frith B (2012). Economic evaluation of the impact of safe speeds: literature review. NZTA Research Report 2012. Wellington: NZTA.

IAIA (2006). *Best Practice Guidelines for health impact assessment.* Fargo: International Association for Impact Assessment.

MacMillan A, Connor J, Witten K, et al (2014). The societal costs and benefits of commuter bicycling: Simulating the effects of specific policies using system dynamics modelling. Environ Health Perspect, 122: 335–344.

Massey University (2021). NZ Index of Deprivation. Available at https://ehinz.ac.nz/indicators/population-vulnerability/socioeconomic-deprivation-profile/#nzdep-for-2018-nzdep2018

Ministry of Transport (2021). HD006 Mode share of travel time by age group (%). Available at https://www.transport.govt.nz/statistics-and-insights/household-travel/how/

Nilsson, G (2004) Traffic safety dimensions and the power model to describe the effect of speed on safety. Lund Bulletin 221. Lund: Lund Institute of Technology.

Schaefer C, Mayr B, Dolores Fernandez La Puente de Battre M, et al (2020). Health effects of active commuting to work: The available evidence before GISMO. Scand J Med Sci Sports, 30(Suppl1): 8–14.

Statistics NZ (2021). 2018 Census place summaries. Available for Dunedin City, Dunedin Central, Campus South, and Habourside. Available at https://www.stats.govt.nz/tools/2018-census-place-summaries/

Appendix 1: Statistical areas with study area

Figure 4. Campus South Statistical Area 2

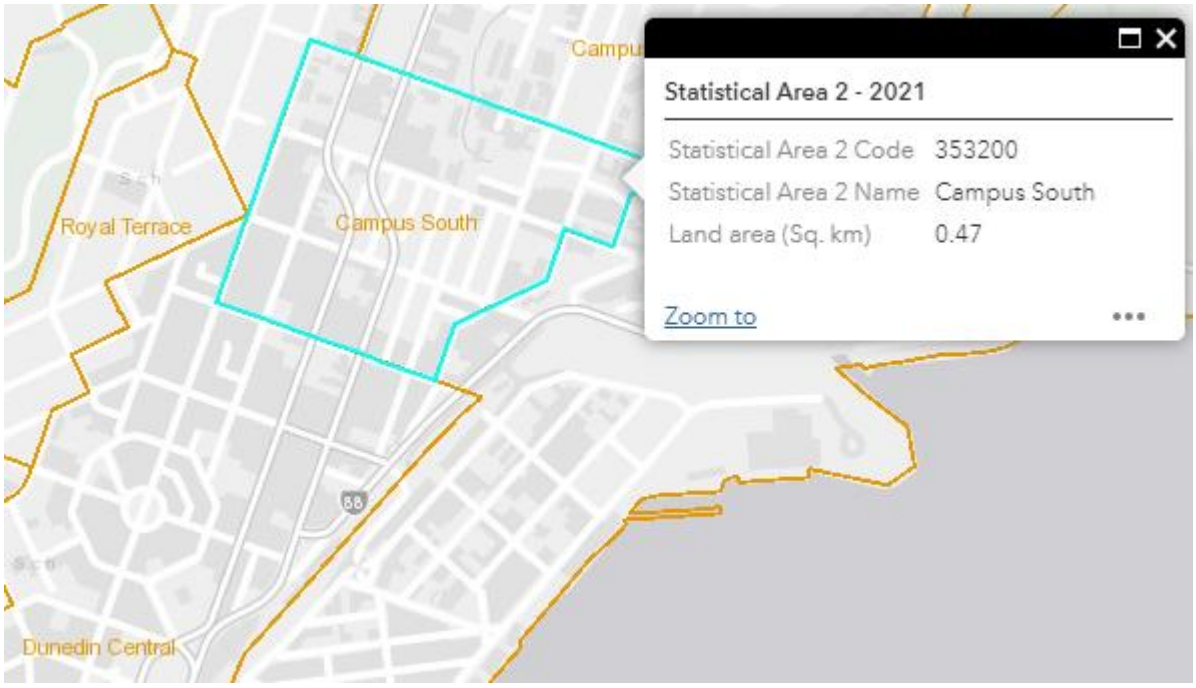

Figure 5. Dunedin Central Statistical Area 2

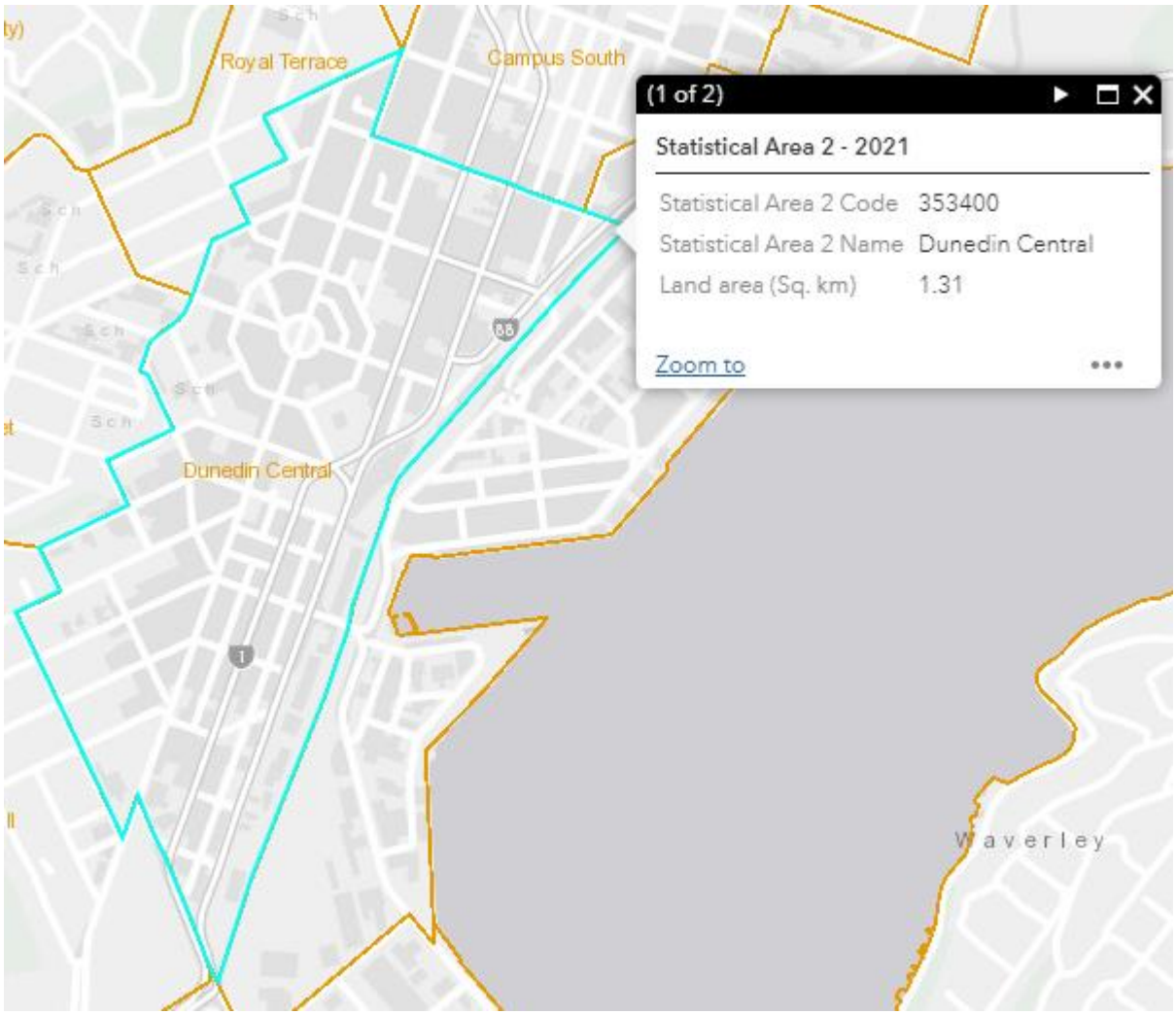

Figure 6. Harbourside Statistical Area 2