Nelson Marlborough District Health Board

NELSON ARTERIAL TRAFFIC STUDY

HEALTH IMPACT ASSESSMENT ON FOUR OPTIONS IDENTIFIED IN STAGE TWO

18 DECEMBER 2010

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PREFACE

This is the Health Impact Assessment (HIA) on the four options short listed in Stage 2 of the Nelson Arterial Traffic Study.

This HIA assesses the health impacts of the four options short listed in Stage 2 of the Nelson Arterial Traffic Study. A further HIA will be undertaken assessing the health impacts of the preferred option/s selected in Stage 3 of the Nelson Arterial Traffic Study and the "do nothing" option.

It has been prepared by a working group of NMDHB staff and is primarily based on reports, documents and meetings prepared and arranged by the Nelson Arterial Traffic Study consultants. As part of this HIA process, the working group has raised a range of issues and points of clarification with the consultants. While some issues have been resolved, at this point in time not all of these have been addressed or answered.

1. INTRODUCTION

Nelson Marlborough District Health Board (NMDHB) is undertaking an independent Health Impact Assessment (HIA) of the Nelson Arterial Traffic Study (ATS).

An HIA is a formal process that aims to predict the potential effects of policies and projects on health and wellbeing, and on health inequalities. It can be applied to policy making at central and local government level, and is most effective when used early in the process. HIA is defined as a combination of procedures, methods and tools by which a policy or project may be assessed and judged for its potential effects on the health of the population, and the distribution of those effects within the population. It can help to identify ways in which:

- Positive health effects can be enhanced
- Negative health effects can be diminished or removed
- Health inequalities can be reduced

This document is the Health Impact Assessment of the four options shortlisted in Stage 2. A further HIA will be undertaken assessing the health impacts of the preferred option/s selected in Stage 3 of the Nelson Arterial Traffic Study and the "do nothing" option.

1.1 NELSON ARTERIAL TRAFFIC STUDY

In 2010, Nelson City Council (NCC) commissioned a study with the objective of determining the best transport configuration between Annesbrook and the QEII / Haven Rd roundabouts that would improve the city as a whole in the long term.

NCC has engaged a team of consultants to undertake the ATS. The consultancy team, along with Council staff and a New Zealand Transport Agency (NZTA) representative, form the Decision Making Team for the study. NMDHB is involved in the decision making team meetings, but has no vote thereby maintaining the independence of the HIA.

The ATS is being undertaken in four stages:

1 Evaluation of existing arterial traffic routes
2 Selection of best arterial route options
3 Evaluation of best arterial route options
4 Determination of preferred arterial transport configuration and comparison with existing arterial traffic routes

As part of the ATS, a Social Impact Assessment (SIA) was commissioned that parallels the HIA. As required by the project brief, the SIA pays particular attention to assessing the impacts on social wellbeing, physical and psychological severance, safety and recreation and health of the options. The SIA and other reports produced for the study have been a major source of information for this HIA.

1.2 NELSON ARTERIAL TRAFFIC STUDY - STAGE 1

The Stage 1 report analysed the existing transport system in Nelson to determine what it would look like in 2036. 30 years is the maximum industry accepted timeframe for this type of transport modelling. Although the model was updated in 2009 with the latest population and land use data, data is from the 2006 NZ Census. It shows what would happen if Council continued on with a 'business as usual' approach. The Stage 1 data will serve as the baseline for later comparison with the preferred option that will be chosen in Stage 4. The Stage 1 "business as usual" baseline does include the option of some improvements to the passenger transport services between Richmond and Nelson.

The travel modelling study was very different from earlier studies. The travel modelling data was affected by four key changes in assumptions: population estimates, demographic changes, land use projections and employment patterns. The 2006 Corridor Study (based on the 2001 transport model) made total population projections that were higher than those available from Statistics NZ. The consultants have used updated growth projections from Statistics NZ in the current study which show lower expectations of population growth.

The region's aging population, household sizes and a future "gap" in those aged between 18 to 35 years are likely to contribute to more off-peak rather than peak journeys. These trends are reflected in the current model.

Recent predictions in land use planning for both Nelson and Richmond meant adjusting the locations of the population growth. The majority of growth is expected to occur south of Annesbrook – outside the study area. The residential growth in the Nelson CBD is expected to be matched by CBD employment opportunities and contribute to reduced journey lengths and less use of vehicles.

In line with reduced population growth, the modelling factored in substantially fewer new jobs, and the jobs that are forecast favour Richmond. This has a particular effect on the study area, because a greater spread of employment opportunities are expected to match up to the population distribution forecast. Therefore, work trip lengths will be reduced and may even involve more walking or cycling.

The modelling was undertaken both with and without Public Transport. The general results of the modelling comparing the present situation with the situation in 2036 indicate:

- an increase of 26-28% in trips over the entire network by 2036;
- a significant increase in total vehicle kilometres, but a reduction in trip length;
- a significant increase in inter-peak traffic;
- a significant increase in traffic moving in the off-peak direction during AM and PM peak periods; and
- Little or no increase in trips for peak direction travel along the current arterial routes in Nelson.

1.3 NELSON ARTERIAL STUDY - STAGE 2

The Decision Making Team identified 18 options in Stage 1. To shorten the list, they eliminated options using two key criteria. The first criterion removed options that did not significantly improve the capacity of Nelson's main corridors. In other words, if the option would not allow a significant increase in the number of people and goods to travel over the route, the option was eliminated.

As a result of this first level review, all rail options were removed from the list. The team determined that installation of freight rail would not attract enough interest for commercial freight companies to make the jump to using rail over freight trucking on the main roads.

The second criterion was cost. The team noted that some of the options would never be constructed because of constraints on funding availability through Council and NZTA. Therefore, the team decided to cap project costs at $100 million, as anything above that figure would be too expensive for Council and NZTA to even consider funding within at least the next 20 years, and possibly further. Therefore, options were eliminated that would require the building of tunnels and installation of light rail.

Common to all options being considered is the severance effect of the construction process. During the construction phase the residents and people wishing to access services will experience significant adverse effects including: noise, dust, vibration from heavy machinery, restricted access to residential properties, services and facilities located on the affected roads.

The four options short listed (MWH September 2010) are:

Option A: Part time clearways

This option seeks to provide additional road capacity using the road along the current arterial routes. This would be in the form of a clearway lane northbound on SH6 from the Annesbrook Roundabout to the Haven Road roundabout and another clearway lane southbound on the Waimea Road / Rutherford Street route from the top of Rutherford Street to the Annesbrook Roundabout. These clearway lanes would be available to traffic during weekday peak periods but would revert to on-street parking outside of these peak times. A feature of this option is the construction of a shared path along the seaward side of Rocks Road.

Option B: Southern Arterial

This option aims to create a third arterial corridor along the route previously used by the railway and now called the railway reserve. This option would create a single carriageway road, i.e. one lane in each direction from a new roundabout intersection near the Beatson Road roundabout in the south, through the railway reserve and tying into St Vincent Street which would be upgraded to appropriately cater for the additional traffic. All intersections would be at-grade.

Option H: SH6 Four Laning

This option creates four lanes along the existing state highway following the existing alignment. Widening has been completed typically on only one side of the road as follows:

- Between Russell Street and Bisley Ave – on the western (sea) side.
- Between Bisley Ave and Rawhiti Street – on the eastern (inland) side.
- Between Rawhiti Street and Whakatu Drive – on the western (sea) side.

The exception to the above is throughout the Haven Road section, where widening typically occurs within the road boundaries by narrowing the median. Widening around the waterfront will require a new seawall to be constructed along the entire length of the coastal section, approximately 10-15m out from the existing seawall.

Option I: Waimea / Rutherford Four Laning

This option creates four lanes along the existing Waimea Road and Rutherford Street arterial route following the existing alignment. Widening has been considered as follows:

- Between Halifax Street and Bronte Street – on the eastern side.
- Between Bronte Street and Hampden Street – on the western side.
- Between Hampden Street and Motueka Street – on the eastern side.
- Between Motueka Street and Annesbrook Drive – on the western side.

Public Transport / Travel Demand Management

As Travel Demand Management and Public Transport are the same for each of the four options, for the purposes of the HIA these have been assessed separately. While the modelling of the impact of public transport on traffic volumes will be minimal, the impact of Travel Demand Management will be significant. In the study, it has assumed that Travel Demand Management would reduce vehicle ownership by 10% and that long term parking prices in the Nelson CBD would be doubled (MWH September 2010). The impact of Travel Demand Management has been estimated to result in a 7.5% reduction in trips across the network.

Some substantial public transport improvements have been included in the package of works for all options. The improvements adopted correspond to Phase A from the Nelson Regional Land Transport Strategy (RLTS). This provides a significant increase in the level of service provided at the moment, and if proved successful, could be expanded upon to Phase B, C or D in the future. Phase A includes the provision of one express bus service and two secondary bus services between Nelson and Richmond operating at least every 30 minutes in the peak, with a lesser frequency outside these times, Monday to Saturday 6.30am to 6.30pm. One secondary service will operate to the west and one will operate to the east of the corridor. The existing local access service (branded “The Bus”) is to retain its existing level of service, subject to regular review of routes and timing. The RLTS outlines infrastructure improvements including bus stop upgrades, on-street bus interchanges at Nelson, Stoke and Richmond and bus priority measures within Richmond, Nelson CBD and

on Waimea Road. Park and Ride facilities will also be considered to improve the bus service, and although unlikely to be viable in the short-medium term may be viable in the longer term.

A number of travel demand management initiatives that are identified in the RLTS have also been included in the package of works for each option. These are:

School travel plans: Ensuring all secondary, intermediate and primary schools have travel plans that encourage alternative modes of transport for all pupils travelling to and from school. These plans include training for safe walking, cycling and using school buses and also infrastructure improvements for key routes to and from the school.

TravelSmart targeted travel choices programme: Implementing a TravelSmart programme within NCC which contacts around 5% of households annually. This programme helps individuals make informed travel choices about how to get to places by using their cars less and walking, cycling and using public transport more.

Workplace travel plans: Ensuring all workplaces with more than 50 staff have travel plans.

Car-pooling: Improvements to the current car-pooling programme to attract more registered users.

Promotion of alternative forms of travel: Promotion of alternative forms of travel through various mediums being undertaken regularly. Specific forms of promotion could include publicity campaigns, promotional events and information packs.

Increase parking pricing/public parking restrictions and controls: Regulating the cost and availability of public spaces. This would give lesser priority to all-day parking and higher priority to short stay parking in the CBD to support the local economy.

Review resource management plan rules with regard to:

- the location requirements for new developments and activities;
- promoting the co-location of urban developments which reduce the overall demand for travel and which are conveniently located to bus, walking and cycling networks
- through intensification and mixed use developments and control of developments which adversely impact on the efficiency of transport routes

1.4 IWI CONSULTATION

(MWH September 2010)

The following iwi were consulted by Montgomery Watson Harza as part of Stage 3 of the study:

- Ngāti Kuia
- Ngāti Toa Rangatira
- Ngāti Koata
- Ngāti Rārua
- Ngāti Tama
- Te Ātiawa

Ngati Koata, Ngati Rarua, Ngati Tama and Te Atiawa are represented by Tiakina te Taiao.

Tiakina believe it is important that they prepare a Cultural Impact Assessment specifically assessing their concerns and preferences relating to the four options.

Both pre-European and European historical sites and structures are important to Ngati Kuia. They would prefer to see minimal impact on these sites and structures. Their preference is for Option A: Peak Hour Clearways, with a second preference of Option B: Southern Arterial.

Option H: SH6 Four Laning is considered to have significant impact on historical sites and structures while this could be minimised with Option A. Ngati Kuia see benefit in having a third route out of the city but are aware of the perceived impact to the Victory community.

Ngati Toa Rangatira opposes Option H: SH6 Four Laning but would be comfortable with Option A or B. Ngati Toa is concerned about the impact of any option on cultural and archaeological sites and the effects on the coast and sea wall. Option I may be acceptable if the road is retained within the existing road formation but would probably not be acceptable if more land was required.

1.5 HEALTH

What keeps us well often lies outside the direct influence of the health and disability sector and is determined by a range of influences. Some of the most obvious are age, sex and hereditary factors, but there is a growing body of evidence for less direct determinants of health. These determinants are varied and include factors such as income and employment, housing conditions, urban design, water quality and education.

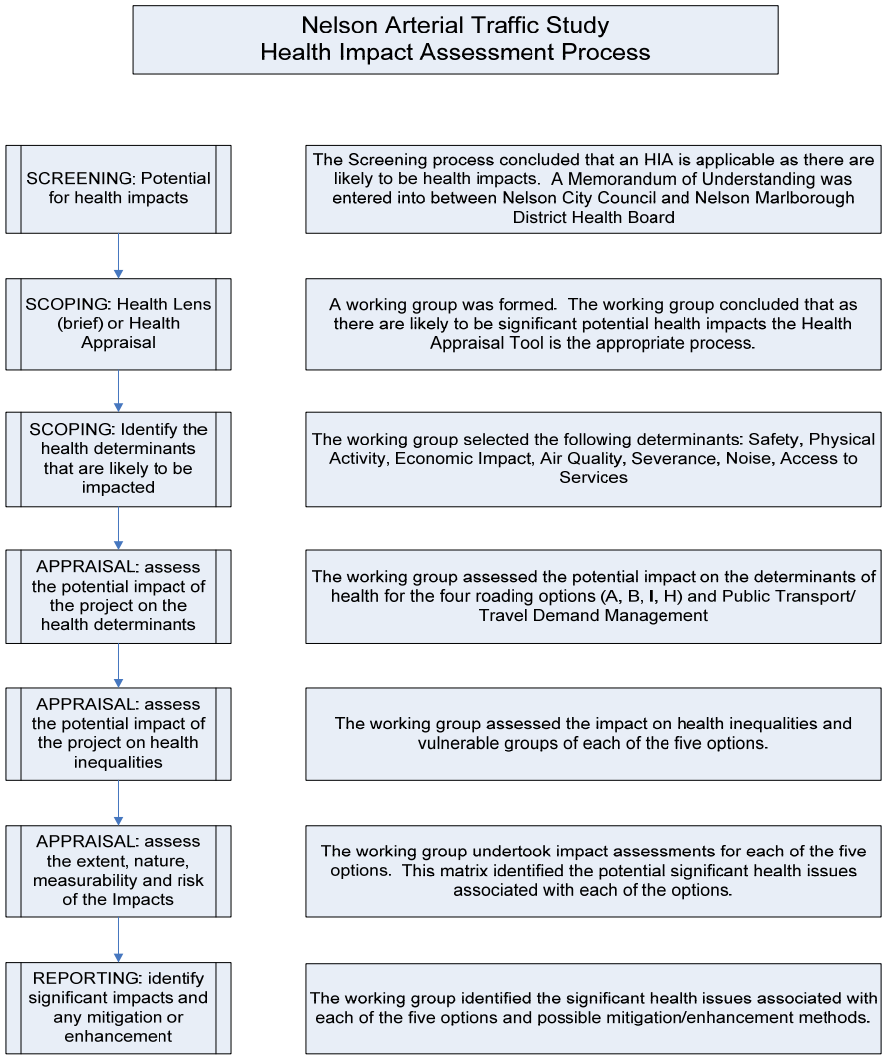
NMDHB acknowledges and supports the views submitted by Iwi of the Nelson/Tasman region in regards to potential contaminants from the Nelson Arterial Transport Scheme impacting on the environment and significant cultural / archaeological sites. Maori affinity with the environment encompasses mauri ora; inner strength, vitality and a secure identity, and waiora is linked more specifically to the external world and to a spiritual element that connects human wellness with cosmic, terrestrial and water environments (Durie, 1999).

Good health and wellbeing is difficult to achieve when there is environmental pollution. Health Protection/Promotion includes the nature and quality of the interaction between people and the surrounding environment so that:

- water is free from pollutants
- air can be breathed without fear of inhaling irritants or toxins
- earth is abundant in vegetation
- noise levels are compatible with human frequencies and harmonies
- opportunities are created for people to experience the natural environment

1.6 PROCESS FOR UNDERTAKING THE HEALTH IMPACT ASSESSMENT

The process used to develop this Health Impact Assessment is described in the following table:



1.7 HEALTH DETERMINANTS

During the scoping stage of the HIA the following seven health determinants were selected as most relevant for use in this assessment.

Determinant	Description
Community Severance	Studies have demonstrated the links between strong social networks and health. Busy roads may disrupt these networks and sever communities. Widespread car use also results in fewer people interacting on the streets in the ways that pedestrians and cyclists are able to.
Safety	In 2006 23% of the deaths by injury in New Zealand were the result of road crashes. An analysis of the total cost of road injuries for 2008, which included treatment and rehabilitation, time off work and the human cost, totalled $2.195 billion or 22.7% of the total cost of injuries. Perceptions of safety also have a significant bearing on people's behaviour.
Economic Impact	Where improved infrastructure such as roading supports local economic development, this may positively influence the health of the population through increased employment opportunity and income levels. However, should the cost of construction lead to significant increases in rates and rentals, then health may be adversely affected through reduced income available for health care as well as good diet, recreational physical activity, housing and other factors which determine health.
Noise	There are a number of effects on health and wellbeing resulting from noise including interference with speech communication (masking), sleep disturbance, physiological effects (heart rate, blood pressure, cardiovascular disease), mental health effects, the effects of noise on performance and annoyance
Physical Activity	The current advice is to achieve a minimum of 30 minutes moderate activity on at least five days of the week. Adults who are physically active have reduced risk of premature death and reduced risk of developing major chronic diseases such as coronary heart disease, stroke, diabetes and cancers. Transport infrastructure can either inhibit or promote physical activity.
Access to Health Services	Local road configuration may affect ease of physical access to health service facilities by cars, public transport, walking or emergency vehicles.
Air Quality	Vehicle engines produce a number of air pollutants that may pose risks to health either as acute effects or through chronic exposure. These include Nitrogen oxides, Carbon monoxide, Volatile organic compounds (VOCs), Particulates (PM_{10} and $PM_{2.5}$) and Ground-level ozone.

The health impact of the five options was assessed using each of these health determinants.

1.8 Health Inequalities

Incorporated in these assessments is the potential for the options to impact health inequalities. Inequalities in health occur across a range of areas including socioeconomic status, age, gender, ethnicity, disability and geographic location.

Although the entire Nelson community will be affected by the option selected, several specific population groups are likely to be especially affected. The following groups were selected as the focus of the HIA:

- Children and Youth
- Transport Disadvantaged (particularly older people and people with disabilities)
- People living in High Deprivation Neighbourhoods.

The possible impact on health inequalities of the different options is stated in the summary table located at the end of the document.

2. ASSESSMENTS

2.1 METHODOLOGY

The health impact of the five options was assessed using each of the health determinants described in Section 1.7. The format for each assessment follows the same format:

- General evidence for health impacts associated with the health determinant
- Local evidence for health impacts associated with the health determinant
- Appraisal of health impacts and possible mitigation for each of the five options

The impacts, both positive and negative, are assessed as being minor, moderate or major. For the purposes of this assessment, minor is defined as an insignificant health impact; moderate is defined as a quantifiable health impact while major is defined as a significant health impact that affects the quality of life and life expectancy of several people.

2.2 COMMUNITY SEVERANCE

General Evidence for Health Impacts

Community severance arises when roads carrying high levels of traffic cut through residential neighbourhoods. It creates indirect health effects, for example disruption of social networks and reduced social support, thereby affecting health (National Health Committee 2003).

There are two aspects of social severance: physical severance and psychological severance.

- Physical severance results from the direct effect on trips that encounter a barrier.
- Psychological severance stems from feelings of being cut-off from services and facilities or neighbours, or from perceptions of danger associated with a road.

Busy roads may disrupt networks and sever communities. Widespread car use also results in fewer people interacting on the streets in the ways pedestrians and cyclists are able to as they commute. A study of three San Francisco streets found that the busier the traffic on a street, the more fragmented the social networks and the lower the satisfaction of residents (Leyden, 2007).

Social capital has been claimed to be important for the enhancement of the maintenance of population health (Ichero Kawachi, 1999) Studies going back to 1897 show that social integration can enhance population well-being and health (Simpson, 1951) (Ichero Kawachi, 1999) (Berkman, 1991) (Guo, 2001) (Bradbury, 2007).

A growing number of researchers agree that social networks and community involvement have positive health consequences. Persons who are socially engaged with others and actively involved in their communities tend to live longer and be physically and mentally healthier (Leyden, 2007).

Neighbourhood social capital may influence health by increasing access to local services and amenities. The same may be said for accessing services such as community health clinics or recreational facilities which are relevant to health.

Community severance produces a range of direct negative impacts on health, including reduced social support, reduced access to facilities and restricted access which increase the level of stress for some groups of the community.

The stress associated with community severance can exacerbate depression and anxiety (National Health Committee 2003). A report in 1995 also stated that interaction among people of a community must continue to be encouraged. A community's physical structure has both direct influences on health through exposure to risks, and indirect effects through the creation of neglect of health-inducing environments (McKinlay, 1995).

Studies undertaken in Britain, the United States and New Zealand have found that the severance effects of major roads on neighbourhoods are felt most severely by those dependent on walking for getting around. These were found to be children, women and non-car owners. New Zealand studies have also found that pedestrians, the elderly, women and "those that are home all day" are more likely to be adversely affected by traffic generally. As well as having particular difficulty crossing streets, pedestrians and cyclists are likely to feel more vulnerable to the danger, pollution and noise created by motor vehicles than someone travelling in a car.

There are also empirical linkages between walking, social engagement, and depression. The elderly are particularly susceptible to the corrosive effects of social isolation (Leyden, 2007).

In urban traffic the competing needs of motorists and pedestrians require careful evaluation in road planning and travel demand management schemes. Community severance has become one of the environmental concerns identified in road development and traffic operations (Guo, 2001). When road projects are assessed in terms of their economic, social and environmental impacts, one factor to consider is the severance caused by the infrastructure and the vehicles using the road (Guo, 2001). An assessment of the impact of the proposed route with regard to community severance, including impacts on the use of community facilities, particularly schools, recreational facilities or community services. Particular reference is made to use by children, older people and other vulnerable groups (Leyden, 2007).

Transport has positive impacts on health by facilitating social support, for instance enabling better access to friends or family. On the other hand, transport can damage health through community severance (National Health Committee 2003).

Severance whether physical or psychological, can result in a reduction in walking or cycling trips that involve crossing or walking along busy roads, a reduction (because of perceived risk) in freedom of movement (especially for children and other low mobility groups), a loss of social contact, and the use of less preferred community facilities.

Active health planning guidance can mitigate the symptoms of community severance and create a more inclusive and supportive society (National Health Committee 1998).

Local Evidence for Health Impacts

Relevant Findings from the 2004 Southern Link Environment Court Decision (Decision Number C35/2004) are:

We conclude that the Southern Link will have a significant impact upon the amenity and social cohesion of the area (para. 93).
…there is nothing in the proposal which in our view adequately avoids remedies or mitigates that effect (para.150).

Appraisal of Health Impacts and Mitigation Factors

Overall there is some evidence that the introduction of any of the four road options will have varying impacts on the communities involved.

Option A: Part-Time Clearways

It is already recognized that parts of these routes can be dangerous for pedestrians and increased severance and reduction in pedestrian safety is likely to occur with this roading option.

Pedestrian traffic is particularly high between the schools, the hospital and private medical facilities. The extra traffic lane will increase psychological and physical severance, particularly for students, the young and the less mobile. This option is likely to lead to a continuation of dangerous cycling conditions

Some retail outlets along this proposed route will have limited roadside parking which the clearway will remove at least during the morning peak (Corydon Consultants September 2010). This will add to private property access difficulties and increased severance and safety issues.

Mitigation is likely to be achieved by restricting heavy traffic movement and restricting clearway operating times, by creating more frequent pedestrian crossings or underpasses, by creating safe cycle and walking lanes and by improving Travel Demand Management.

Option B: Southern Arterial

This option is likely to result in a moderate negative severance impact on the communities involved. A number of increased severance issues have been identified during the course of this study.

In an area with a high proportion of young children and busy community facilities, this roading option is likely to increase traffic flow in some areas around schools which will add to the “danger perception” and would introduce a sense of perceived danger, impediments to crossing the road, and difficulties in turning in or out of driveways and intersections. At present, these problems are not currently faced and these have the potential to inhibit people’s freedom of movement (Corydon Consultants September 2010). According to residents in this area, this option may reduce free movement and cause issues for students accessing Kindergarten, Primary and Intermediate Schools (Corydon Consultants September 2010).

Traffic diverting from the busy Waimea/Ridgeway intersection particularly during the morning peak period, also generates a significant increase in traffic through this area during a time when it has a high number of cyclists and pedestrians (Corydon Consultants September 2010). Loss of safety for cyclists and pedestrians on the Railway Reserve and an increase in traffic will add to the severance problem which already exists.

Reduced amenity for some houses at the southern end of route would become apparent as traffic would travel on both sides of properties would add to the stress of the occupants.

An increase in road capacity could result in less people switching to public transport due to relatively less time savings attributed to buses.

Mitigation of effects

With no improvement in cycle and pedestrian facilities, this option will lead to increased severance and reduction in pedestrian safety, therefore the following mitigation effects need to be addressed: create more frequent pedestrian crossings or underpasses, create safe cycle and walking lanes, improve Traffic Demand Management processes, restrict heavy traffic movement, construct appropriate and safe pedestrian and cycle crossings

Option H: SH6 Four Laning

This option is likely to have a major negative physical and psychological severance as well as community disruption. Increased proximity of traffic to some housing and to school premises, especially classrooms will add to the sense of perceived danger, creates added impediments to crossing the roads and may result in the loss of positive learning opportunities.

Private property owners and pedestrians would experience more difficulty in crossing to facilities and services and accessing homes as a result of the doubling of the current carriage width. Overall it is likely to reduce walking and cycling levels. Difficulties at some intersections, local driveway access and parking issues are likely to occur.

Four-laning Tahunanui Drive would cause significant disruption to the local community as buildings are removed or severely compromised to the extent that the services and facilities they contain would be forced to close or relocate. These may include the loss of community services such as the Nightingale Library and easy access to the Suburban Club.

Mitigation of effects

Mitigation of the effects created or increased by this option, are able to be addressed by creating more frequent pedestrian crossings or underpasses, creating safe cycle and walking lanes, improving Traffic Demand Management processes, restricting heavy traffic movement, constructing appropriate and safe pedestrian and cycle crossings, relocating some properties and their allied activities and ensure enough people safe separation barriers and areas.

Option I: Waimea / Rutherford Four Laning

This option is likely to have a major negative physical and psychological severance as well as community disruption.

As the road will be located closer to schools than at present, this is likely to result in the loss of landscaping which, in its present form, creates a buffering effect. This option would also negatively affect some school sporting and recreational areas.

As the road will be located closer to some smaller retail outlets, the concern is that access difficulties created by this option may result in loss of some business/es. For similar reasons, the additional laning would impact on access to some health providers and as the road would run near some private properties; the occupants would feel the negative effects of severance.

If there is no improvement in cycle and pedestrian facilities, this may lead to increased severance and reduction in pedestrian safety.

Mitigation of effects

The issues raised may be mitigated by the design and incorporation of more frequent and appropriate pedestrian crossings or underpasses, creating safe cycle (not part of roadway) and walking lanes and improving Travel Demand Management. The restriction of heavy traffic movement and the establishment of safe separation barriers and areas will add to the mitigation effect, however, it may also be necessary to relocate some properties and their associated activities.

Public Transport and Travel Demand Management

Some substantial improvements to public transport, walkways and cycle ways are included in the four roading options under consideration. These include a number of travel demand management initiatives as identified in the Regional Land Transport Strategy.

It is recognised that the increased use of Public Transport and the introduction of Travel Demand Management measures would provide significant social and environmental benefits if implemented in an integrated manner along with roading improvements (Corydon Consultants September 2010). Public Transport and Travel Demand Management strategies would need to include viable and attractive alternatives to private car use. These would need to include improved provision for safe walking and cycling and significant improvement to the Public Transport System. An increase in cycling and walking may result in a negative effect unless the location of the cycle ways and pedestrian areas are constructed so as to provide maximum safety gains. Public Transport and Travel Demand Management is likely to result in an improvement in safety for those who travel by bus instead of car.

The introduction of a user friendly bus service (especially for transport disadvantaged groups), safe pedestrian and cycle ways, the roading options are likely to have a minor positive impact on severance. Public Transport and Travel Demand Management strategies could be implemented in the short-term, independent of the four roading options (Corydon Consultants September 2010).

Summary

All four roading options will have some negative impacts on the immediate and surrounding communities. It is recognized that the four-laning options will have a major negative impact on community severance.

Some of this negative impact could be mitigated by the provision of adequate and safe pedestrian and cycle road crossings and traffic calming within these areas.

It is noted that social isolation and community severance may be increased by lack of access, especially in areas with poor public transport. While there is considerable evidence showing the levels of social support related to health outcomes, it is difficult to isolate a link between transport and the degree of severance that may occur (National Health Committee 2003).

2.3 SAFETY

General Evidence for Health Impacts

Safety is an important issue in relation to transport and has significant effects on health and well-being. Throughout the 1960s and 1970s rates for morbidity and mortality from road traffic injuries were increasing in proportion to the population. Although there has been an increase in the number of motor vehicles in New Zealand, the rates have decreased as a result of various types of safety initiatives that have been implemented, including road safety programmes, infrastructural improvements and improved design of motor vehicles. However road traffic injuries remain a major contributor of death and disability in New Zealand (Kjellstrom & Hill, 2002). In New Zealand in 2006, 23% of the deaths by injury were the result of road crashes. An analysis of the total cost of road injuries in New Zealand in 2008, which included treatment and rehabilitation, time off work and the human cost, totalled $2.195 billion or 22.7% of the total cost of injuries (O'Dea 2010).

Different modes of transport have different rates of risk. While the table below is from the UK the relative rates of risk are similar here.

Fatalities per 100 million People in the UK *(from Victoria Transport Policy Institute 2010)*

	Per KM	**Per Trip**	**Per Hour**
Motorbike	9.7	100	300
Foot	5.3	5.1	20
Cycle	4.3	12	60
Car	0.4	4.5	15
Bus	0.04	0.3	0.1

Local Evidence for Health Impacts

In 2009 there were 419 crashes reported to Nelson Police. New Zealand Transport Agency (NZTA) identified loss of control, intersections, young drivers and vulnerable road users (pedestrians, cyclists and motorcyclists) as Nelson's major safety issues. Between 2005 and 2009 49% of all reported injury crashes involved a vulnerable road user (NZTA 2010). International research has revealed that as walking and cycling rates increase, the frequency of collisions between motorists and walkers or cyclists decreases (Jacobsen 2003). Despite Nelson's relatively high cycling rate, 25% of injury crashes in Nelson City between 2005 and 2009 involved a cyclist (NZTA 2010). This implies that the existing roading environment is unsafe for cyclists.

Road traffic is also known to cause effects on mental health and wellbeing. Studies show that about 1 in six (14 percent) motor accident survivors experience post traumatic stress

disorder, a quarter have psychological issues a year after the accident and one third experience clinical symptoms at follow-up 18 months afterwards (Goldberg & Gara, 1990).

The approach used to assess the impact of the proposed transport options on safety has focused on vulnerable road users.

Relevant Findings from the 2004 Southern Link Environment Court Decision (Decision Number C35/2004) are:

We are not able to conclude that the Southern Link will improve safety. (para. 143)

We are not satisfied that the Southern Link could be designed to prevent children crossing it inappropriately. (para. 147)

When we take into account the potential effects of the Southern Link on pedestrian safety, we are unable to see any basis on which this can be adequately avoided, remedied or mitigated. (para. 150)

Modelling undertaken as part of the arterial traffic study shows that while vehicle volumes across the different routes will vary considerably, average vehicle speeds are likely to vary little.

Option A: Part time Clearways

This option is likely to result in a minor negative impact on safety particularly for pedestrians with limited mobility and cyclists. Mitigation could be achieved by providing for continuous cycle routes along both clearways and the provision of frequent controlled crossing points.

Option B: Southern Arterial

This option is likely to result in a minor negative impact to safety in the Victory and Auckland Point School areas that is offset by a minor positive impact on Waimea Road / Rutherford Street and Tahunanui Drive / Rocks Road.

Option H: SH6 Four Laning

This option is likely to result in a minor negative impact for safety particularly for pedestrians**.** Mitigation could be achieved by providing frequent controlled or grade separated crossing points.

Option I: Waimea Road / Rutherford Street Four Laning

Approximately 2400 children attend schools that are bordered by this road. This option is likely to result in a moderate negative impact for safety particularly for pedestrians. Mitigation could be achieved by providing frequent controlled or grade separated crossing points.

Public Transport / Travel Demand Management

This option is likely to result in a minor positive impact as travel by bus is significantly safer than travel by private car. Increased cycling and walking may result in a minor negative impact for safety unless the "safety in numbers" effect occurs. If Travel Demand Management results in an overall reduction in trips there will be minor positive impact.

Conclusion

Options A, H and I will have a minor to moderate negative impact on the safety of vulnerable road users. This can be mitigated by the design of quality walking and cycling infrastructure. However, providing for continuous cycling infrastructure and regular controlled or grade separated pedestrian crossing points to the level needed to mitigate these impacts may impact other objectives such as minimising delays for vehicles.

Option B will have a neutral impact with reduction in safety along the new road offset by an increase in safety along the other arterial routes.

Public Transport/ Travel Demand Management is likely to result in a minor positive impact on road safety particularly if the "safety in numbers" effect occurs.

2.4 ECONOMIC IMPACT

General Evidence for Health Impacts

It is well established in New Zealand and internationally, that economic factors such as income (personal or household) and employment are closely associated with health status and inequity (Public Health Intelligence 2007).

In addition, a number of recent New Zealand studies have also reported strong and consistent negative associations between health outcomes and deprivation levels in local communities, using measures such as NZDep 2006 (Salmond & Crampton, 2000). This deprivation index is based upon variables from the 2006 Census which are used to assign a deprivation score to geographic areas (e.g. meshblocks). It can be used to consider the aggregated effects of a number of economic health determinants including;

- Unemployment
- Total personal income less than $10,000
- Receiving a means-tested benefit
- Living in a household without telephone access
- Living in a household without motor vehicle access
- Not living in own home
- Household crowding.

The approach used to assess the impact of roading infrastructure on economic factors and the health of the local population considers the following two mechanisms:

1. Changes in roading infrastructure may have either a positive or negative effect on local economic development, or the efficiency and competitiveness of existing businesses,

thereby increasing or reducing employment opportunities and/or income levels. This is important since both improved employment and income level are associated with better health status. The document "Economic Impacts of Nelson Arterial Road Improvement Alternatives" (Copeland September 2010) and modelling of vehicle trips and road user costs included in the Stage 3 Report of the ATS have been used to estimate the extent to which the various road options may result in local economic development (or suppression) and the creation of employment opportunities and higher income levels.

2. Since the cost of developing new road infrastructure will be born at least in part by local rate (and rental) payers (a $50M capital investment will result in an 8.3% rates increase), it is proposed that this may result in a reduction of disposable income available for health care costs or other factors that may affect health such as good nutrition, housing or access to recreational physical activity opportunities. The estimated costs of the road options included in the Stage 3 Report of the ATS have been used to assess the relative impact of increasing rates (and resulting rental increases) on health.

It should be noted that both of these economic mechanisms are expected to have a greater effect on the health of the more deprived sections of the community who are more vulnerable to the effects of employment and income.

Local Evidence for Health Impacts

The five key economic drivers of the Nelson/Tasman economy include horticulture ($351M), forestry ($339M), seafood ($235M), pastoral farming ($128M) and tourism ($128M). These five sectors account for 31% of the regions GDP, but are also importance since they drive other sectors in the local economy. Only tourism has shown significant growth in employment over the 2006-09 period. This situation is not predicted to change significantly over the next 10-20 years (Copeland September 2010). Export volumes from the primary production industries and volumes transported by road are predicted to remain largely unchanged in the future. Therefore the economic issues around improved freight transport systems may be largely about maintaining key production sector competitiveness rather than supporting significant sector expansion and resultant growth of employment and income levels (Copeland September 2010).

Option A: Part Time Clearways and H: SH6 Four Laning

This is likely to have a minor negative impact on economic development and health. There may be a neutral impact on the economic efficiency of the primary production industries. This is based on discussion at the Community Workshops which suggested that heavy traffic to the port would continue to use Rocks Road as at present, and on the modelled road user costs for these 2 options which differ the least (of all options) from the Base Network.

For tourism, these options are estimated to result in reduced opportunity for development, particularly due to reduced amenity value of the waterfront and reduced access to accommodation and restaurants sited on Rocks Road. However, seaward clip-ons developed along Rocks Road would part mitigate this negative effect through the creation of a better regional cycle link and strengthened regional tourism opportunities.

Option B: Southern Arterial

This is likely to result in some health gain from increased employment and income in the primary production and tourism sectors. It is difficult to estimate the extent of health gains from primary production employment and incomes since the economic impact assessment does not predict significant future expansion of local primary production industries overall. However, Option B may be expected to lead to improved industry efficiency and competitiveness resulting from faster port transport as non-port traffic is diverted from Rocks Road to the Southern Link road. This is also consistent with modelling which suggests that the greatest reduction in road user costs occurs for this option compared with the Base Network.

For tourism, Option B offers benefits from reduction of traffic flows along Rocks and Waimea Roads (Copeland September 2010).

Option I: Waimea Road / Rutherford Street Four Laning

This is likely to have a neutral impact on health via economic development mechanisms. The economic impact assessment suggests that Option I is likely to have a negative impact on primary production industries since this will increase travelling time and cost for port transport (Copeland September 2010). It should be noted that this assumes heavy traffic will not have the preferred choice of using Rocks Road. However this outcome is not supported by the modelling which suggests a decrease in road user costs for Option I (although this presumably refers to costs for all traffic types, not just heavy traffic).

The impact on tourism is likely to be neutral since although there would be benefit from attracting traffic away from the waterfront, 4-laning Waimea Road will increase difficulty of access to tourist accommodation and other businesses already sited on that road (Copeland September 2010).

Public Transport / Travel Demand Management

This is likely to have a minor positive impact on economic development if heavy traffic travel times to the port are shortened due to reduced vehicle congestion on existing roads. However, the potential impact of public transport is likely to be small (Copeland, September 2010).

All Options

This is likely to have a minor to moderate negative impact on health if there are increased household costs flowing on from rates increases, in the following order of magnitude: Option H (greatest); Option I; Option B; Option A (least). The costs (in terms of increased property rates) of implementing Public Transport / TDM was not available at the time of writing this report, and would depend on the level of public transport improvements that were introduced.

Conclusion

Overall it is unlikely that any of the 4 road options will have a "high" impact on health via economic development mechanisms. Although this factor is a potentially important determinant of health, it is unclear from the economic impact assessment, the extent to which any of the road options will have a significant impact on future employment opportunities or income within the key primary production sectors that make major contributions to local GDP (this is partly due to the future uncertainties that surround other key variables such as international commodity prices in determining the performance of the primary production sectors (Copeland September 2010). Road options that reduce traffic flows on Waimea and Rocks Roads may result in some benefits to health in terms of enhanced performance of the tourism sector. It is expected that reduced financial resources available to households as a result of increased property rates and rentals, could have a minor to moderate negative impact on health, particularly on the most deprived communities, and thereby increase existing disparities in health status. The lowest cost option may therefore be the most desirable from this perspective.

2.5 NOISE

General Evidence for Health Impacts

There are a number of adverse effects on health and wellbeing resulting from noise (WHO 1999, HPA 2010), the most notable being:

- Interference with speech communication (masking) (WHO 1999, HPA 2010)
  - Commonly occurs with road traffic noise
  - Masking can interfere with understanding speech, listening to TV or radio and social engagement
- Sleep disturbance (HPA 2010, Hume 2008, WHO 1999, WHO 2009)
  - Causal relationship for night time noise exposure and sleep disturbance and insomnia has been reported
  - Good quality evidence is available to support a causal relationship between disturbed sleep and fatigue, accidents, and reduced performance
  - Behaviour, mood and well being have all been reported as being adversely affected by sleep disturbance
  - Certain groups (often referred to as “vulnerable groups”)are more sensitive to such effects including the elderly, pregnant women, and children; people with certain, physical and mental health problems; people with pre-existing sleep difficulties and shift workers
  - Thresholds for sleep disturbance are given in the WHO Night Noise Guidelines for Europe (WHO 2009) for levels recorded both inside bedrooms and outside - these thresholds and health effects are set out in Table 1 in Appendix C.
- Physiological effects such as effects on heart rate, blood pressure, hormone level changes (WHO, 2009)
- Increased risk of cardiovascular disease (Basner 2010, HPA 2010, Kjellstrom 2008, WHO 2009)
- Mental health effects
  - There is limited evidence to support a link between night time noise and depression and other mental illness (WHO 2009).

- Effects on performance
  - Clear evidence of noise being associated with impaired cognitive performance both in children and adults with studies showing impaired task performance at school and at work; increased errors, and decreased motivation (Goines 2007, Stansfeld, 2005)
- Annoyance
  - Is the most common adverse health effect of environmental noise
  - The degree of annoyance is affected by a range of factors with considerable differences in the response to noise by different people (Goines 2007)

These adverse effects are looked at in more detail in Appendix C. A glossary of terms is also in Appendix C.

Mitigation of Effects

Mitigation of health effects from traffic noise may include such measures as:

- use of low noise material on road surfaces
- increasing setback distance of "receiver locations" from road edge
- use of noise barriers and bunding (acoustical screening)
  - safety of road users (drivers and pedestrians) must be considered in design
  - increase of noise on the road may occur due to reflection from the barrier
- reduction of road traffic noise at source
  - reducing number of vehicles at peak times by travel demand management
  - speed limits or traffic calming measures to reduce vehicle speeds
  - maintenance of, and standards required for, vehicles so less noise produced
- use of acoustic insulation
  - by modification of building design e.g., double glazing of windows in premises
  - air conditioning of premises/schools etc so windows do not need to be opened for ventilation

Local Evidence for Health Impacts

The Noise Effects Study Malcolm Hunt Associates 2010 (Hunt 2010) looked at the noise effects of the roading options and contains noise contours for locations that are expected to be affected by traffic noise (in the year 2036) at levels greater than 65dBLA$_{eq(24hr)}$ and 55 – 65dBLA$_{eq(24hr).}$ The relevant findings of this study are summarised below.

"Do Minimum" (scenario if no change in roading from current situation)

The affected areas under the "do minimum" scenario at the year 2036 align closely with areas currently affected by traffic noise and noise levels are predicted to be within 1 dB of current levels due to predicted limited growth in the volume of traffic. This is presented graphically in Figure 2 in Appendix C.

Option A: Part Time Clearways

Noise levels in 2036 are predicted to be very similar to the "do minimum" scenario. There will be noise effects for some individual properties but the implementation of mitigation measures

as required under NZS 6806:2010 *Acoustics – Road traffic noise- New and altered roads,* would minimise the impact on those properties (Standards NZ 2010).

Option B: Southern Arterial

Predictions are for a small decrease in noise for the existing roading network (2-3 dB) with an increase in noise in some parts of the Victory area where traffic noise has not previously been an issue. Levels up to 15-20 dB above the "do minimum" levels are predicted. The report (Hunt 2010) states these "new" noise and vibration effects will be significant and mitigation will be needed according to NZS 6806:2010 (Standards NZ 2010). The report also notes that some of the closer existing dwellings may require acoustic insulation. The affected area is outlined in Figure 3 in Appendix C.

In addition to the Malcolm Hunt Associates study, information is available from the Environment Court decision (ELRNZ 2004) regarding the proposed Southern Link.

The Court concluded that:

- the proposed Southern Link motorway would have significant noise effects on both Victory and Nelson Intermediate schools in terms of the change in noise levels received in the playground
- the noise effects would be so significant at the Victory Kindergarten that the Kindergarten would need to be relocated
- the Court stated that mitigation could reduce classroom noise but there would still be an amenity effect to students and teachers both in the classroom and while in the playground and concluded that 40dB$AL_{eq(1hr)}$ for classrooms was an appropriate noise level.

Option H: Four Laning Rocks Road

Traffic volumes are similar to the "do minimum" scenario, with a slight increase in noise and vibration effects for some specific properties. Around 32 noise receiver sites and 14 commercial properties are likely to experience increases in traffic noise and will therefore require mitigation.

Option I: Four Laning Waimea Road & Rutherford Street

Traffic volumes are similar to the "do minimum" scenario, with increases in noise and vibration effects for some specific properties. Around 35 dwellings and a number of commercial properties are likely to experience increases in traffic noise. Site specific mitigation will be required in some circumstances. Further information is needed to determine if the Nelson Hospital site would experience increased noise from traffic under this option.

Appraisal of Health Impacts and Mitigation Factors

The issue of children's performance and noise is important particularly as in the ATS there are a number of schools close to roads in all the options under consideration. It is also noted that aircraft noise already impacts on parts of the Stoke Tahunanui community.

"Do Minimum" (scenario if no change in roading from current situation)

For people living in areas where traffic noise levels are greater than 55dbA (Figure 2 – Appendix C), there will be a significant number who will be affected by annoyance. Also there will be interference with voice communication in some situations.

Noise induced sleep disturbance will start occurring for people exposed to noise levels in the order of 32-42dB inside bedrooms. There will be some accommodation to sleep disturbance over time as people adjust. Day time effects from tiredness would be expected and some groups, such as the elderly, school children and shift workers, will be more vulnerable to sleep disturbance and its consequential effects.

There will possibly be an impact on the incidence of hypertension and ischaemic heart disease in people exposed to noise above 55dB$LA_{eq(24hr)}$ (19% and 4.5% respectively for each increase of 5dB above 55dB).

Given that the traffic noise level predicted for the year 2036 is similar to now it is likely that adverse health effects are already being experienced in some parts of the community.

Option A: Part Time Clearways

For this option similar adverse health effects to the "do minimum" scenario are likely given that the predicted noise levels are very much the same. Mitigation measures should lessen these effects.

Option B: Southern Arterial

For this option there will be additional adverse health effects on the population now exposed to new traffic noise (i.e. the Victory to Bishopdale area). The noise levels predicted in the Malcolm Hunt Associates Study (in the order of 15-20 dB above the "do minimum" scenario) are sufficient to give rise to annoyance, sleep disturbance, masking of communication, impacts on performance and possibility of hypertension and cardiovascular disease incidence for those living close to the new road.

Several schools will be exposed to new levels of noise from increased traffic and there will likely be adverse effects from this on children's learning.

The Environment Court concluded that the proposed Southern Link motorway would have significant noise effects on both Victory and Nelson Intermediate schools and that the noise effects would be so significant at the Victory Kindergarten that the Kindergarten would need to be relocated.

While the use of noise mitigation measures will lessen negative health effects, such measures, for example double glazing, will not remove them entirely as windows would need to be closed to be effective. In addition for classroom noise mitigation, windows would need to remain closed which will be an issue in Summer unless air conditioning is used.

For this option adverse health effects from noise are likely both on people living near the existing network and on the particular population now exposed to noise from the proposed new section of roading in this option.
If this option proceeds there will be a small decrease in noise for much of the existing network (2-3 dB less at 2036). This reduction will be just noticeable. It is likely to translate to a small reduction of health effects related to the existing network.

Option H: Four-Laning Rocks Rd

Under this option, noise levels are predicted to be similar to the "do minimum" scenario. However in addition there will be a small number of people living or working at a number of specific sites that are exposed to increased noise and consequent added risk of adverse health effects. Specific site mitigation will lessen this risk.

For this option, similar adverse health effects to the "do minimum" scenario are likely given that the predicted noise levels are very much the same.

Option I: Four-Laning Waimea Road and Rutherford Street

Under this option, noise levels are predicted to be similar to the "do minimum" scenario. However, in addition a small number of people living or working at a number of specific sites are exposed to increased noise and consequent added risk of adverse health effects. Specific site mitigation will lessen this risk. eg particular attention would need to be given to the Nelson Hospital site.

For this option similar adverse health effects to the "do minimum" scenario are likely given that the predicted noise levels are very much the same.

Public Transport/Travel Demand Management

Modelling information prepared for Stage 3 (MWH July 2010) suggests there may be a 7.5% reduction in vehicle numbers if public transport and travel demand management is implemented. This scenario was not assessed in the Noise Effects study undertaken for the Stage 3 Report (Hunt 2010).

It is possible that such reduction in vehicle numbers may reduce adverse health effects in the "do minimum" scenario and may mitigate any increase in adverse health effects arising from implementation of any of the other options.

Summary

It is likely that current noise levels from the existing roading network will be giving rise to adverse health effects in some parts of the community, and that these low level health impacts will persist in 2036 if there is no change to current roading. Similar noise levels (and consequent health effects) are predicted for three of the options studied. The fourth option (Southern Arterial) will introduce "new" traffic noise to a particular area of the Victory-Bishopdale community that has not been previously exposed and includes schools and a Kindergarten. This noise is sufficient to give rise to an increase in low level adverse health effects experienced in the "Victory Valley" area.

2.6 PHYSICAL ACTIVITY

General Evidence for Health Impacts

There is a significant amount of evidence showing that physical activity enhances health. Spending a total of 30 minutes of fast walking or cycling each day, even if it is broken up into 10 to 15 minute segments can reduce the risk of several different health risks such as cardiovascular disease, obesity and type 2 diabetes (Davis et al., 2005).

The most beneficial health impact of transport is its potential to increase physical activity levels through walking and cycling (British Medical Association, 1995). However, transport infrastructure can either inhibit or promote forms of active transport (Public Health Advisory Committee, 2003).

Travel related physical activity is increasingly being replaced by motorised transport in many industrialised countries. Rates of walking and cycling to work and school have plummeted throughout New Zealand over the last twenty years. In the 1986 Census 14.7% of commuters either walked or cycled to work. By 2006 the percentage had dropped to 7.2% (Statistics New Zealand website).

Cyclists are not a homogenous group. While an experienced cyclist may not need any special provision, high vehicle speeds and volumes will deter less confident cyclists (Wilke, 2008). Similarly, pedestrians needs vary. NZTA puts pedestrians into three categories- on foot (including joggers and people with sensory impairments), on small wheels (e.g. Skateboards, prams) and Mobility impaired (e.g. People using wheel chairs and mobility scooters). Barriers to people walking include lack of continuous pedestrian routes, traffic fumes and noise, unsuitable crossing treatments and the speed of traffic (NZTA, 2007).

Local Evidence for Health Impacts

Only 57.3% of Nelsonians achieve the recommended levels of physical activity (McNeill et al 2008). One reason may be perceptions of safety. 29.7% of Nelson respondents to 2008's NMDHB Baseline Survey gave road safety concerns as a barrier to being more physically active (McNeill et al 2008).

The approach used to assess the impact of the proposed transport options on physical activity has been to consider the impact of the option on both active transport (walking and cycling for transport) and recreational walking and cycling.

Option A: Part Time Clearways

This is likely to have a minor negative impact on active transport and a neutral impact on recreational walking and cycling. While the proposed shared path along Rocks Road is likely to generate more walking and cycling this is likely to be offset by the suppression of recreational walking and cycling along other parts of the roading network. Mitigation measures could include ensuring that there is adequate provision for cycling on the clearway

vehicle lanes on Tahunanui Drive, Rutherford Street and Waimea Road. Consideration also needs to be given to how walkers and cyclists get on and off the Rocks Road shared path and screening between Rocks Road and the path to make this an attractive facility to use.

Option B: Southern Arterial

This is likely to have a neutral impact on Active Transport as provision is being made for a walking and cycling path adjacent to the proposed road. The option will have a minor negative impact on recreational walking and cycling. While the current shared path in the Railway Reserve is a well used recreational resource the replacement facility is likely to be unattractive for recreational use being beside and below the new road. This may in part be offset by an increase in recreational physical activity along the other arterial routes as traffic volumes drop. The negative impacts of this option could be mitigated if the proposed shared path was redesigned and its placement in relation to the proposed road reconsidered. Thought also needs to be given as to how walking and cycling links from the shared path to Jenner Road are maintained.

Option H: SH6 Four Laning

This is likely to have a neutral impact on both active transport and discretionary recreation. While good standard cycle lanes and footpaths will be provided replacing the current poor quality footpath and cycle lanes, the size of the proposed road may make the road difficult to cross and unappealing to walk or cycle along. This could be mitigated if consideration is given to screening between Rocks Road and the shared path, and good provision is made to enable walkers and cyclists to cross onto the shared facility.

Option I: Waimea Road / Rutherford Street Four Laning

This is likely to have a neutral impact on active transport as the impact of any increase in traffic volumes is likely to be offset by the provision of cycle lanes along the route. It is likely to have a neutral impact on recreational walking and cycling with any decrease in recreational walking along Waimea Road / Rutherford Street offset by an increase along Rocks Road. This option could be enhanced through controlled or grade separated crossing facilities at regular intervals.

Public Transport/ Travel Demand Management

This is likely to result in a moderate positive impact on both active transport and recreational physical activity, with people walking to get to and from bus routes. Travel Demand Management will have a significant impact on reducing vehicle trips and encouraging more people to walk and cycle as a means of transport.

Conclusion

Options A and B will have a minor negative impact on physical activity levels. Option H and I will have a neutral impact. While mitigation and enhancement strategies exist for all four options, these may add significantly to the overall cost of the options or compromise other transport objectives. Public Transport / Travel Demand Management has an overall positive impact on physical activity levels.

2.7 ACCESS TO HEALTH SERVICES

General Evidence for Health Impacts

Local road configuration may affect ease of physical access to health service facilities by personal vehicles, public transport, walking or emergency vehicles. This may occur as a result of difficulty crossing multiple lanes of traffic to gain access or egress from businesses, loss of road-side parking, or other results of changed traffic flows and speeds (Corydon Consultants September 2010, Copeland September 2010). Proposed four-laning road options are expected to be more disruptive than 3-laning or other options.

The impact of the proposed road options on access to health services will also depend on the number of services sited on the route and the populations of people potentially affected (Corydon Consultants, September 2010). This analysis is limited to services providing health services specifically, whilst acknowledging that other community-based services also contribute to health of the population (for example emergency accommodation or other support services, those providing recreational physical activity opportunity, and those offering affordable healthy food choices). Access to a broader range of services has been considered in the Social Impact Assessment. Access to services is a particularly important issue that could affect the health of transport-disadvantaged groups, such as the young, elderly and disabled (Corydon Consultants, September 2010).

Local Evidence for Health Impacts

Option A: Part Time Clearways

This option is likely to have a minor to moderate negative impact, involving the addition of a third lane of traffic.

Option B: Southern Arterial

This option is likely to have a neutral effect on access to health services for the population overall, since although access to health services may be improved on Waimea Road and Tahunanui Drive, this option may disrupt access to a smaller number of services in the Victory Community.

Options H: SH6 Four-Laning and I: Waimea Road / Rutherford Street Four-Laning

This option is likely to have a moderate negative effect. The Tahuna Medical Centre already has access issues under the existing roading arrangements (Corydon Consultants September, 2010).

Health service access difficulties may be mitigated by road design considerations such as the inclusion of traffic light controlled crossings.

Public Transport / Travel Demand Management

Public Transport / Travel Demand Management could also mitigate these negative effects (particularly relevant for transport-disadvantaged groups) by leading to improved access to services if careful consideration is given to the best routes and timetabling. Whilst improvement in access due to public transport and Travel Demand Management is likely to be minor for the overall population (due to reduced road congestion overall), a stronger benefit is expected for the elderly, young, disabled or other transport-disadvantaged groups.

Conclusion

The four road options are all likely to have minor to moderate negative impacts on access to health services with 4-laning options expected to be the most disruptive. However, improved public transport /travel demand management, if successfully implemented, could be expected to have a weak mitigating effect for the general population, and lead to significantly improved access for transport-disadvantaged groups.

2.8 AIR QUALITY

General Evidence for Health Impacts

Vehicle engines produce a number of air pollutants that may pose risks to health either as acute effects or through chronic exposure. These pollutants include Particulate Matter (PM_{10} and $PM_{2.5}$), nitrogen oxides (NOs) which include nitrogen dioxide (NO_2), carbon monoxide (CO) sulphur dioxide (SO_2) and ozone (O_3). Specific health effects attributed to these pollutants are discussed below and in more detail in Appendix D.

In recognition of the adverse effects on health caused by these pollutants, the Ministry for the Environment (MfE) produced National Guidelines (MfE, 2002) and National Environmental Standards (NES, 2004) for Ambient Air Quality. The Guidelines set values for a key number of air pollutants that are a minimum requirement for ambient air quality to protect both human health and the environment. Some of these Guideline Values have been adopted as mandatory Standards under Resource Management Act regulations (NES, 2004). These mandatory Standards are set out in Table 1.

Table 1: NZ Ambient Air Quality Standards *(NES, 2004)*

Pollutant	Standard	Time average	Allowable exceedances per year
Carbon monoxide (CO)	10 mg/m^3	8-hour (running mean)	1
Nitrogen dioxide (NO_2)	200 µg/m^3	1-hour	9
Ozone (O_3)	150 µg/m^3	1-hour	0*
Particulate matter (PM_{10})	50 µg/m^3	24-hour	1
Sulphur dioxide (SO_2)	350 µg/m^3 570 µg/m^3	1-hour 1-hour	9 0*

* These levels are not to be exceeded at any time.

Particulate Matter (PM_{10} and $PM_{2.5}$)

Particulate Matter is emitted in vehicle exhausts and is also formed in the atmosphere through chemical reactions between the various pollutants found in exhaust fumes.

PM_{10} are 'thoracic' particles smaller than 10 microns in diameter which can penetrate into the lower respiratory system and $PM_{2.5}$ are 'respirable' or fine particles smaller than 2.5 microns that can penetrate into the gas-exchange region of the lung (Fisher, 2007).

- Both short and long term exposure to low dose concentrations of particulate matter has been shown to be an important risk factor in cardiopulmonary and lung cancer mortality (Fisher 2007, Hales 2000, HPA 2009).

Nitrogen Oxides (NO & NO_2)

- The major source of nitrogen oxides in urban areas in NZ is motor vehicles (Fisher 2007).
- Nitrogen oxides can irritate airways, with nitrogen dioxide having an inflammatory reaction with the lung contributing to increased morbidity and mortality particularly for susceptible groups such as asthmatics, people with chronic bronchitis and young children.

Carbon monoxide: (CO)

- Motor vehicles are the main source of CO in most urban areas, although domestic heating also contributes (Fisher 2007).
- CO is easily absorbed into the blood decreasing its ability to carry oxygen which can then have consequent effects on body organs.

Volatile Organic Compounds (VOCs)

- These are a large family of carbon-containing compounds. Engine exhausts contain a number of different VOCs.
- Some VOCs, such as benzene, can cause cancer although the risk is small.

Sulphur dioxide (SO_2)

- Motor vehicles are minor contributors to ambient SO_2 and the contribution has changed over the years with different concentrations of sulphur in fuel.

- Sulphur dioxide is a respiratory irritant with some people such as asthmatics being particularly susceptible to this pollutant. It has been associated with increase in mortality and in increased hospital admissions for respiratory and cardio-vascular disease (Fisher 2007).

Ground-level Ozone (O_3)

- Ground-level ozone irritates airways and may trigger reactions in people who have asthma; people with chronic lung and cardiovascular disease and in people taking active exercise outside over extended periods

Mitigation

These include a range of traffic management measures such as:

- reducing vehicle numbers by,
  - using incentives or penalties
  - enhancing public transport
  - travel demand management
- limiting speed,
- ensuring vehicle separation from pedestrians and cyclists,
- banning heavy goods vehicles in certain areas;

Technical measures include:

- improved vehicle emission control technology
- legislative measures for emission control,
- increased use of electric and hybrid vehicles, and
- urban planning improvements e.g. distance of houses from roads.

Local Evidence for Health Impacts

Particulate Matter

- In Nelson during the winter months the majority of PM_{10} arises from domestic wood burners and only a small proportion is due to vehicles. However in summer, without domestic wood burners, the vehicle proportion is greater, as is the proportion arising from natural sources e.g. at Tahunanui from the sea (Sheldon 2010).
- In 2002 work was undertaken on the likely impact on mortality from PM_{10} pollution in Nelson. This showed there were approximately eight premature deaths per year and 14 hospitalisations due to PM_{10} pollution at that time (NCC 2008).
- Other research was undertaken in New Zealand to identify the PM_{10} contribution from vehicles and its impact on health (Fisher 2002). No specific estimation for Nelson is available as Nelson was grouped into the rest of the South Island.
- In the NZ Environment Court hearing into the proposed Southern Link motorway in 2004 the Court concluded that:
  - there was clear evidence of serious health risk to people in the St Vincent St valley
  - there was an inability to mitigate the deleterious air quality in the Victory Square area

- there was evidence diesel emissions produced more $PM_{2.5}$ than wood fires and indicated that, while reducing emissions of PM_{10} by replacement of wood fires was a positive move, the Court could not justify an increased discharge of diesel particulates into the air of this area (ELRNZ 2004)
- Monitoring by the Nelson City Council over recent years has shown a significant downward trend in PM_{10} across the city.
- Monitoring data for $PM_{2.5}$ is available (St Vincent Street) for 2009 and 2010 but has not yet been fully analysed. It is estimated that $PM_{2.5}$ fraction makes up approximately 90% of the winter PM_{10} (Sheldon 2010).

An assessment of air quality for the four route options being considered at Stage 3 of the Nelson Arterial Study (MWH 2010) reported:

- PM_{10} data was used for the study model as this was most comprehensive data set available in the Nelson situation.
- Monitored levels of PM_{10} from 2006 were used in the model and predicted levels of PM_{10} and vehicle associated PM_{10} were calculated for 2016 and 2036 for the different roading options.
- It was concluded in terms of air quality that:
    - Option H (Four Laning Rocks Road) or Option I (Four Laning Waimea Road) would be preferred (based on spread sheet modelling).
    - Option A (Part Time Clearways) and Option B (Southern Arterial Route) are the least favoured on PM_{10} air quality.

The report noted that the model assessed PM_{10} by calculating vehicle emissions and adding this to a baseline PM_{10} which was derived from PM_{10} readings at city monitoring stations. Dispersion modelling was not undertaken therefore limiting the value of the assessment.

Nitrogen Oxides (NO & NO_2)

- In Nelson monitoring was undertaken for NO_2 in the Victory School Area (Air Shed A) during the winters of 2001, 2003 and 2010. The levels recorded were within the Guideline Value (1-hour) but in 2010 there had been a small increase compared to 2003. (Sheldon 2010)

Carbon monoxide: (CO)

- Monitoring of CO in the Victory area (Air Shed A) in the winters of 2002, 2003 and 2010 showed CO was well within Guideline Values (Sheldon 2010).

Volatile Organic Compounds (VOCs)

- Monitoring for benzene was undertaken in the Victory area (Air Shed A) over the period June 2003 to May 2004. Results showed an annual average benzene level of 4.16µg/ m^3), which was, while within the applicable Air Quality Guideline Value (10µg/m^3) for that time, it breaches the current guideline value of 3.6 µg/m^3.(reduced in 2010 from 10µg/$m^{3)}$
- No recent benzene monitoring has been done.

Sulphur dioxide (SO_2)

- No monitoring has been done for SO_2 in Nelson.

Ground-level Ozone (O_3)

- No monitoring has been done for ozone in Nelson.

Vulnerable groups

- The highest concentrations of preschool and school-aged children are living in census area units: Toi Toi, Grampians, Washington, and Broads (Corydon 2010).
- The highest concentrations of people past retirement age are living in census area units: Tahuna Hills, Trafalgar, Bronte and Britannia (Corydon 2010).
- Schools located on roads that are being considered under the options are:
    - Option A: Tahunanui School, Auckland Point School, Hampden Street School, Nelson College for Girls, Nelson College (classrooms for both Colleges are set back from road)
    - Option B: Nelson Intermediate, Victory School, Auckland Point School
    - Option H: Tahunanui School, Auckland Point School
    - Option I: Hampden Street School, Nelson College for Girls, Nelson College (classrooms for both Colleges are set back from road)
- There are also preschools and kindergartens on or close to the roads affected by the proposals.
- Nelson Hospital is on Waimea Road.

Appraisal of Health Impacts and Mitigation Factors

Air pollution can have a significant impact on people's health. Air pollution is an issue for Nelson particularly in parts of the city affected by topography (valleys) and climate (inversion layers).

The MWH study findings on their own are of limited use in providing evidence to predict the adverse health effects of vehicle related air pollution, particularly because of the limited pollutants considered and the lack of dispersion modelling.

On this basis we believe there is not enough information to make a quantitative assessment of the adverse effects arising from vehicle pollution from this study, and that a qualitative assessment only can be made.

The vehicle related PM_{10} component of this air pollution is a small percentage but it is important this does not increase and ideally improves. It is known that the areas with a higher average PM_{10} winter baseline levels are breaching the NES value on a number of days each year (NCC 2010). While exceedances have been decreasing in these areas there is a risk that even a small increase in the vehicle component of PM_{10} may lead to an increase in exceedances and thereby increased risk of adverse health effects.

The vehicle pollutants most relevant to Nelson are likely to be particulates, especially $PM_{2.5,}$ nitrogen oxides (NO & NO_2), carbon monoxide and benzene.

Local weather, geography and urban form will influence the dispersion of air pollutants. This pollution will have most impact on people immediately adjacent to the road or actually in vehicles on the road, but pollutants may also impact on dwellings and workplaces some distance from the road. Although the vehicle numbers and composition of traffic predicted for Nelson are considerably less than those used in a European study (which showed significant increases in pollutants up to 250 metres away from heavily used urban highways - WHO 2005), it is likely that the pollutants will spread beyond the nearest receptor distances used in the Air Quality Stage 3 study.

Within the roading options, in addition to variation in the background level of pollution, there is also variation in the way vehicle pollutants will disperse and therefore impact on the population in the surrounding area. It is well accepted this is of most concern in the Victory Valley area where there is a significant problem with winter inversions resulting in pollutants not dispersing rapidly. This impacts on Option B.

Further, some groups are more susceptible to pollution e.g. children, the elderly, people with pre-existing medical conditions and people who are actively exercising. Some of the roading options are adjacent to places (e.g. schools and hospital) with people from these groups. People who cycle or walk to work during peak traffic flow are also a vulnerable group.

Regarding the vulnerable group of children, Option B is predicted to have a moderate adverse health impact from traffic related air pollution, given that the Victory/St Vincent Street area has a high baseline of poor air quality, a high proportion of children living in the area and several schools and a kindergarten. These effects could be mitigated by banning heavy goods vehicles from the road, ensuring adequate separation of cycle and walkways from the road, and strategies to decrease vehicle numbers.

The remaining roading options, including the “do minimum”, are likely to have a low adverse health impact from traffic related air pollution. These effects could be mitigated by ensuring adequate separation of cycle and walkways from the road, and active approaches to decrease vehicle numbers.

Summary

The effects of vehicle related air pollution include an increased mortality risk, particularly due to cardiovascular mortality and an increased risk of respiratory morbidity (including allergic reactions in asthmatics).

Certain groups of people are more susceptible to these effects. These groups include children, the elderly, and people with pre-existing medical conditions and people who are actively exercising.

With the exception of Option B all the roading Options (including the “do minimum”) are likely to have a low adverse health impact from traffic related air pollution. The most useful mitigation options available would be active strategies to reduce vehicle numbers, particularly at peak times.

Option B is predicted to have a moderate negative health impact from traffic related air pollution. There are limited mitigation options available due to the high baseline particulate pollution related to the unique geographical configuration of the Victory valley area but active strategies to reduce vehicle numbers, particularly at peak times, would help to minimise the adverse health effects .

3. SUMMARY

Common to all options being considered is the severance effect of the construction process. During the construction phase the residents and people wishing to access services will experience significant adverse effects including noise, dust, vibration from heavy machinery, restricted access to residential properties, services and facilities located on the affected roads.

OPTION A: PART TIME CLEARWAYS

Parts of these routes can be dangerous for pedestrians and increased severance and reduction in pedestrian safety is likely to occur with this roading option.

It is likely to result in a minor negative impact to safety particularly for pedestrians with limited mobility and cyclists.

This option is likely to have an overall minor negative impact on economic development and health due to its impact on the tourism industry. This option is likely to have a minor negative impact on health if there are increased household costs flowing on from rates increases.

There will be a low level of adverse noise effects for some individual properties that can be mitigated.

It is likely to have a minor negative impact on active transport and a neutral impact on recreational walking and cycling.

It is likely to have a minor to moderate negative impact on access to health services.

It is likely to have a minor negative health impact from traffic related air pollution.

OPTION B: SOUTHERN ARTERIAL

This option is likely to result in a moderate negative severance impact on the communities involved and a number of increased severance issues have been identified during the course of this study.

It is likely to result in a minor negative impact in safety in the Victory and Auckland Point School areas that is offset by a weak positive impact on Waimea Road / Rutherford Street and Tahunanui Drive / Rocks Road

It is likely to result in some health gain from increased employment and income in the primary production and tourism sectors. This option is likely to have a minor negative impact on health if there are increased household costs flowing on from rates increases.

There is likely to be moderate adverse health effects from the increase in noise in Victory.

It is likely to have a neutral impact on active transport and recreational walking and cycling.

It is likely to have a neutral impact on health service access for the whole population, since the hospital and medical centres serving larger patient populations are mainly sited on Tahunanui Drive or Waimea Road.

Option B is predicted to have a moderate adverse health impact from traffic related air pollution. There are limited mitigation options available due to the high baseline particulate pollution related to the unique geographical configuration of the Victory valley area but active strategies to reduce vehicle numbers, particularly at peak times, would help to minimise the adverse health effects .

OPTION H: SH6 FOUR LANING

This option is likely to have a major negative physical and psychological severance as well as community disruption. Common to all these roading proposals is the severance effect of the construction process.

This option is likely to result in a minor negative impact for safety particularly for pedestrians**.**

This option is likely to have an overall minor negative impact on economic development and health. There may be a neutral impact on the economic efficiency of the primary production industries but a negative impact on tourism. This option is likely to have a moderate negative impact on health if there are increased household costs flowing on from rates increases

There will be a slight increase in noise and vibration effects for some specific properties. Around 32 noise receiver sites and 14 commercial properties are likely to experience increases in traffic noise. There will be some low level health impacts that can be mitigated.

It is likely to have a neutral impact on both active transport and discretionary recreation.

This option is likely to have a moderate negative effect on accessing health services.

It is likely to have a minor adverse health impact from traffic related air pollution.

OPTION I: WAIMEA ROAD / RUTHERFORD STREET FOUR LANING

This option is likely to have a major negative physical and psychological severance as well as community disruption. Common to all these roading proposals is the severance effect of the construction process.

It is likely to result in a moderate negative impact for safety particularly for pedestrians.

It is likely to have a negative impact on employment and income related to the primary production and tourism sectors. This option is likely to have a moderate negative impact on health if there are increased household costs flowing on from rates increases

A small number of people living or working at a number of specific sites are exposed to increased noise and consequent added risk of adverse health effects. Specific site mitigation will lessen this risk. Particular attention would need to be given to the Nelson Hospital site. There will be a minor level of negative health effects that can be mitigated.

It is likely to have a neutral impact on Active Transport as the impact of any increase in traffic volumes is likely to be offset by the provision of cycle lanes along the route. It is likely to have a neutral impact on recreational walking and cycling with any decrease in recreational walking along Waimea Road/ Rutherford Street offset by an increase along Rocks Road.

This option is likely to have a moderate negative effect on accessing health services.

It is likely to have a minor negative health impact from traffic related air pollution.

PUBLIC TRANSPORT / TRAVEL DEMAND MANAGEMENT

Increased use of Public Transport and the introduction of Traffic Demand Management measures would provide significant social and environmental benefits if implemented in an integrated manner.

It is likely to result in a minor positive impact on safety as travel by bus is significantly safer than travel by private car. Increased cycling and walking may result in a weak negative impact for safety unless the "safety in numbers" effect occurs. If Travel Demand Management results in an overall reduction in trips there will be a minor positive impact.

Public Transport / Travel Demand Management is likely to have a minor positive impact on economic development if heavy traffic travel times to the port are shortened due to reduced vehicle congestion on existing roads. The costs (in terms of increased property rates) of implementing Public Transport / TDM was not available at the time of writing this report, and would depend on the level of public transport improvements that were introduced.

Modelling information prepared for Stage 3 (MWH July 2010) suggests there may be a 7.5% reduction in vehicle numbers if public transport and travel demand management is implemented. This scenario was not assessed in the Noise Effects study undertaken for the Stage 3 Report (Hunt 2010). It is possible that such reduction in vehicle numbers may reduce adverse health effects in the "do minimum" scenario and may mitigate any increase in adverse health effects arising from implementation of any of the other options.

Public Transport / Travel Demand Management is likely to result in a moderate positive impact on both active transport and recreational physical activity.

Public Transport / Travel Demand Management is likely to have a minor positive effect by improving access to health services (particularly relevant for transport-disadvantaged groups) if careful consideration is given to the best routes and timetabling.

It is likely to have a minor positive effect on health through reducing air pollution through reducing vehicle numbers and therefore reducing vehicle air pollution.

3.1 SUMMARY OF IMPACTS

Where squares have been left blank there is a neutral or no impact.

- \- minor negative impact
- -- moderate negative impact
- --- major negative impact
- \+ minor positive impact
- ++ moderate positive impact
- +++ major positive impact

	Option A: Part time Clearways	Option B: Southern Arterial	Option H: SH6 Four Laning	Option I: Waimea/ Rutherford Four Laning	Public Transport/ Travel Demand Management
Community Severance	-	-- (Victory Area)	---	---	+
Safety	-	+ (Waimea/ Tahuna) - (Victory Area)	-	--	+
Economic Impact	- Rates	- Rates + Development	-- Rates - Development	-- Rates	? Rates + Development
Noise	-	--	-	-	+
Physical Activity	- Transport	- Recreation (Victory Area)			++ Transport ++ Recreation
Access to Health Services	-		--	--	+
Air Quality	-	--	-	-	+

Refer to the text above for further detail.

3.2 CONCLUSIONS

Option A

Option A will have an overall negative impact on health but the impacts will be low. There is scope for mitigating some of the negative impacts on health.

Option B

Option B will have an overall negative impact on health. Additional noise, social severance and air pollution will have a moderate negative health impact on the Victory Community. While some impacts can be reduced it will not be feasible to mitigate all of the health impacts.

Option H

This option will have an overall negative impact on health. Its impact on social severance will be major and the impact on rates and access to services will be moderate. It will not be feasible to mitigate all of the health impacts.

Option I

This option will have an overall negative impact on health. It will have a major impact on severance and a moderate impact on safety, rates and access to services. It will not be feasible to mitigate all of the health impacts.

Public Transport/ Travel Demand Management

This package will have an overall positive impact on health. It should be noted that this is not a stand alone option and will be included with whichever roading option is chosen. Public Transport/ Travel Demand Management will mitigate some of the negative impacts of the preferred roading option. The positive impacts of this option could be enhanced through further investment in active transport infrastructure.

Option	Health Impacts	Health Inequalities	Mitigation or Enhancement
A: Part time Clearways	Negative	Neutral impact	Most impacts can be mitigated
B: Southern Arterial	Negative	Increases inequalities	Not all impacts can be mitigated
H: Tahunanui Drive/ Rocks Road Four Lanes	Negative	Neutral impact	Not all impacts can be mitigated
I: Waimea Rd / Rutherford St Four Lanes	Negative	Neutral impact	Not all impacts can be mitigated
Public Transport/ Travel Demand Management	Positive	Reduces inequalities	Could be enhanced by further investment in active transport

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