# Appendix L

## Economic Evaluation Approach and Assumptions

### General Assumptions

General assumptions for the economic evaluation of the scheme are as follows:

- 40-year evaluation period from the start of construction
- Base Date for the evaluation is 1 July 2021
- Time Zero is 1 July 2022
- Discount rate is 4%. Construction takes place over a 30-month period (all from Time Zero)
- No benefits are assumed to arise until after the completion of all works i.e. benefits have been assumed to commence in Year 3
- Traffic flows in 2036 are assumed to be as 2026 traffic flows, but with a 1% per annum daily traffic growth assumed between 2026 and 2036 based on current land use assumptions
- Peak spreading has been applied to distribute additional traffic growth outside the peak periods i.e. peak hour demand does not increase, but peak period demand does
- Travel time, congestion relief and VOC disbenefits for existing users of SH1 included. External delays for SH1 southbound traffic assessed based on a bottleneck analysis of apportioned trips rerouted onto SH1 based on SH1 and SH2 screen line traffic volumes
- Benefits are assumed to taper off linearly from 2036 to 2045, with no growth in benefits assumed after 2045, as the constrained nature of the Hutt Road/SH1 corridor will not allow for unlimited traffic growth in the future
- Taking into account planned investment in public transport, travel demand growth and the anticipated peak spreading of trips by all modes, bus patronage growth between 2026 and 2036 is assumed to be 3% with a 2% growth applied thereafter (with tapering to zero growth from 2045) - this assumption is based on the latest advice provided to the TQHR project team by the WAU in November 2021.
- Bus passenger travel time benefits have only been calculated for the morning and evening peak periods (i.e. 2 hours each)
- Approximately 450 new cyclist trips per day are assumed to be use the cycle facilities. This is due to the increased attractiveness of the route, increased use of e-mobility modes and the likely effect of the opening of the Te Ara Tupua shared path (which is forecast to attract around 620 extra trips per day by 2026). These will be users from Wellington's northern suburbs
- 50% of the cyclists accessing the corridor via the Te Ara Tupua shared path have been assumed to not cycle without an off-road cycle path being available all the way to the CBD. Hence, these cyclists are reliant on the Thorndon Quay section of this project being completed.
- Most of the new riders on Te Ara Tupua will be heading to the CBD, so will use the improved facilities on TQHR - the economic evaluation of Te Ara Tupua did not include these additional benefits for the TQHR section. The scheme consists of approximately half of the journey from Petone to the CBD, therefore, only 50% of the increase in cycle distance has been attributed to the scheme.
- Disbenefit to general traffic during construction have not been considered in economic analysis as they are not anticipated to be significant
- The reference case for the economic comparison includes the infrastructure upgrades along the corridor (excluding the bus lane/SVL) as these elements are primarily aimed at improving the safety of cyclists and pedestrians.

- No benefits have been assessed for the inter-peak and off-peak periods, as it is assumed that the bus lane/SVL will not be operating during these periods
- HCVs have not been assumed to use the proposed SPV lane on Hutt Road, and therefore the benefit of the SPV are likely to be under-estimated.

### Modelling Input

Details of the transport modelling undertaken to provide inputs to the economic evaluation are contained in the TQHR SSBC (Stage 2) Transport Modelling Report dated February 2022 (Appendix K). This report includes an explanation of the inputs obtained from the WAU Aimsun model and a corridor Sidra model developed for the project in Stage 1 of the SSBC process and refined in Stage 2.

In summary, the following inputs to the economic evaluation were derived from WAU's WTSM model:

- Public transport demand (bus and rail) provided by WAU in November 2021.
- Demand forecasts for the SH1 corridor, including screenline traffic volume data.

The following inputs were derived from the Sidra model.

- Vehicle travel times (separately for bus and general traffic (including trucks)) on Thorndon Quay and Hutt Road
- Vehicle operating cost skims.

### Capital Costs

Expected cost estimates (i.e. 50$^{th}$ percentile) have been used to assess the proposed scheme. The basis of these is explained in the financial case chapter of the SSBC.

Due to the high safety risk related to pedestrians along this corridor, the Do-Minimum (reference case) scenario includes costs related to the pedestrian safety improvements. This includes the raised pedestrian tables and pedestrian crossing signals from the scheme. The cost estimate of the Do-Minimum scenario is shown in Table 1. It is not possible to determine the cost of the other items required to provide the Raised Pedestrian Tables and Pedestrian Crossing as these items are not specified individually within the cost estimate relative to the Raised Pedestrian Tables and Pedestrian Crossing.



Table 1: Do-Minimum (reference case) scenario capital cost estimate

| Item | Base Cost (extracted from Cost Estimate elements) |
|---|---|
| Raised Pedestrian Table | $85,000 |
| Pedestrian Crossing Traffic Signals | $485,000 |
| Uplift for Non-Specific Costs | $500,000 |
| **Physical Costs Estimate** | **$1,055,000** |
| Pre-implementation and Implementation Fees | $422,000 |
| **Project Base Estimate** | **$1,492,000** |
| Contingency (30%) | $448,000 |

| | |
|---|---|
| **Project Expected Estimate** | **$1,940,000** |
| Funding Risk Contingency (20%) | $388,000 |
| **95th Percentile Project Estimate** | **$2,328,000** |

This cost estimate for the Do-Minimum scenario (reference case) is based on an analysis of the scheme cost estimate items with the following assumptions:

- An uplift of 85% on the on the physical works estimate for the raised pedestrian table and pedestrian crossing signal has been included to account for non-specific costs within the scheme cost estimate (i.e. earthworks/demolition, drainage, line marking, temporary traffic management, preliminary and general costs)
- Pre-implementation fees and implementation fees are 40% over and above total physical cost estimate.

### Maintenance and Operational Costs

Implementation of the project will also result in existing and additional assets requiring ongoing maintenance and operational expenditure. This was assumed to be 1% of the capital cost. In addition, every 20 years over the evaluation period, a further 0.5% renewal cost was assumed.

### Benefits Calculated

The following benefit streams have been assessed for the recommended option:

- Cyclist crash cost savings
- Health benefits for cyclists
- Vehicle operating cost (VOC), travel time and bottleneck delay savings for all motorised vehicles on the corridor, as well as those diverting onto alternative routes
- External delays for southbound traffic in the AM peak associated with increased traffic on the re-routing onto SH1 which is currently at capacity
- Travel time savings for existing and additional bus users using bus lanes/ SVLs and from the improved bus stop designs and reduction in the number of bus stops
- Bus travel time benefits
- Bus service reliability benefits
- Pedestrian amenity benefits.

#### *External Delays for SH1 Traffic*

Screen line data was extracted from AIMSUN modelling for SH1 and SH2 for the Do-min+Peds scenario. This indicated that there are likely to be additional delays prior to vehicles entering to model area experienced by southbound traffic during the AM peak due with few viable alternatives available for diverted traffic.

Diverted trips were apportioned to SH1 and SH2 based on the relative traffic volume for each 15-minute time slice as part of the Do-min+Peds scenario. A bottleneck analysis was undertaken on these traffic volumes with the capacity of SH1 and SH2 based on the average traffic flows from the Do-min+Peds scenario within 90% of the peak traffic volume respectively. The resulting average vehicle delay was applied to the SH1 travel time. It is assumed that external delays associated with TQHR traffic is assessed as part of the SIDRA modelling of the corridor.

### *Cyclist Crash Cost Savings*

For the purposes of crash analysis, the crashes along the corridor have been grouped based on the current speed limit to match the resulting changes in crash costs. Crashes affected by proposed linear treatments (e.g. changing angled parking to parallel parking, raised median, etc.) have been grouped based on the affected crash type with the crash savings scaled based on the coverage of each segment.

Crashes affected by proposed point treatments (e.g. raised safety platforms) have been grouped based on the affected crashes that occur within a 50m radius from the proposed treatment.

The features proposed in each section that affect cycle crashes along this route are as follows:

- Mulgrave Street to Aotea Quay (50km/h area)
    - Separated cycleway – Crash reductions associated with this are limited to cycle crashes only. The net effect of the separated cycleway is the removal of conflict with parked vehicles with provision of an off-road cycleway. Currently cyclists only interact with parked vehicles on Thorndon Quay between Mulgrave Street and Tinakori Road.
- Aotea Quay to Onslow Street (60km/h area)
    - Raised Median – The effect of the raised median is to eliminate right turning movements in and out of accesses. This results in a reduction in higher risk movements crossing the cycleway.
- Onslow Street to Jarden Mile (80km/h area)
    - Raised Safety Platforms – Crash reductions associated with these are limited to crashes within the vicinity of the proposed treatment. This treatment results a reduction in traffic speed and increased awareness where the treatments are provided. This applies to the Jarden Mile intersection only.

### *Health Benefits for Cyclists*

Based on the existing cycle counts along the TQHR section, the new cyclists on this section were estimated based on the proportion of new cyclists estimated using the population catchment method in the MBCM. It assumed that there are approximately 450 new cycle trips generated within the catchment.

As this project also has the potential to further encourage cyclists to/from Petone and further north, it has been assumed that this project will result in a further 50% increase of new cyclists estimated from the Ngā Ūranga ki Pito-One Shared Path Project. The scheme consists of approximately half of the journey from Petone to the CBD, therefore, only 50% of the increase in cycle distance has been attributed to the project, which is a conservative assumption.

The total new cyclists travelled distance was then applied to the unit rate of new cyclist health benefit of $2.20/km.

It is noted that that a significant portion of the benefits can be attributed to cyclist benefits, in particular cyclist health benefits.

It also acknowledged that there are interdependencies in relation to cycle benefits, in particular with Te Ara Tupua, to realise the full benefits calculated. That said, the benefits calculated were not included in the benefits for this project. Whilst the BCR may be at the higher end of what some would predict could be expected, the approach has been agreed with Waka Kotahi.

It is also acknowledged that the connection to Te Ara Tupia is currently unfunded and is not provided for within the funded Ngā Ūranga to Pito-one project. This lack of connection could therefore potentially reduce the growth in the number of cyclists which have been assumed to use the TQHR project.

### *Bus Stop Time Savings*

The project will remove two bus stops in each direction on the TQHR corridor.

A 30 second time saving per stop has been assumed at peak times/in the peak direction, and no saving has been assumed in the off-peak/counter peak direction.

This means a saving of one minute inbound in the morning peak period and one minute outbound in the evening peak period.

The fact that most of the retained or relocated bus stops will be easier for buses to access and/or egress (largely because buses will be exiting stops into a bus lane rather than a general traffic lane), has been assumed to result in a further 20 seconds saving per stop at half of the stops in the peak period/direction.

On the basis that there are approximately nine stops where this saving will materialise, a further saving of one and a half minutes is estimated.

The total time saving in the morning peak inbound/evening peak outbound is therefore estimated to be around about two and a half minutes.

By way of comparison, Figure 5 in the Strategic Case report indicated that the total dwell time in the southbound direction, in the morning peak, is around 80 seconds, with an 85th percentile dwell times of around 180 seconds. This period/direction has the longest dwell times for the corridor.

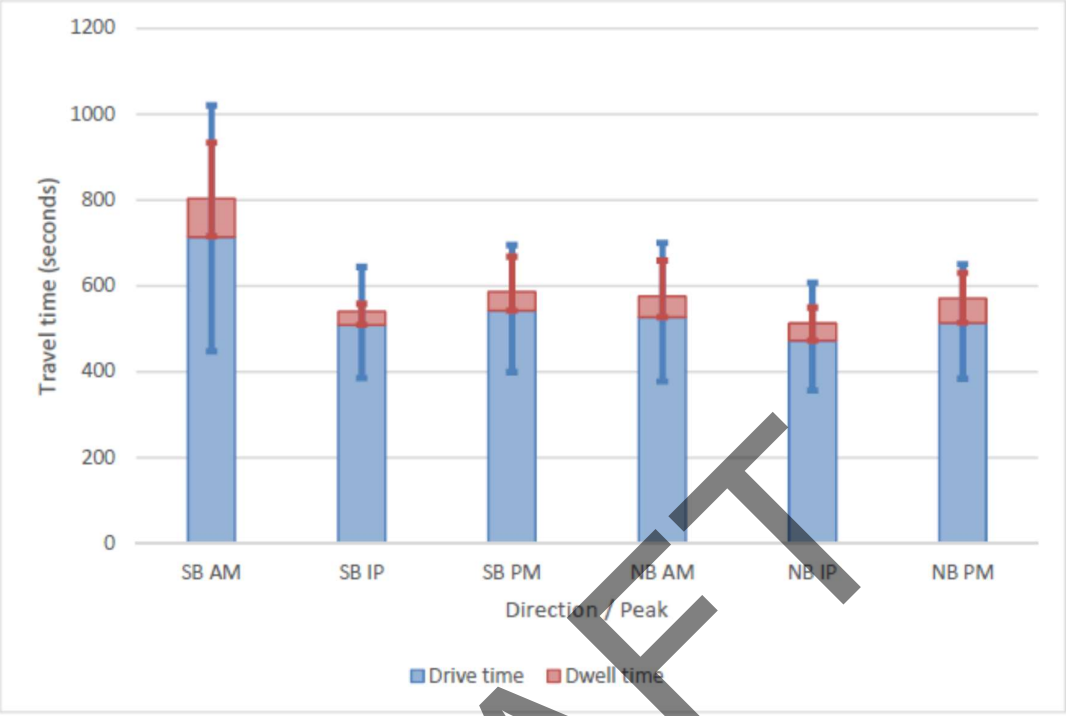
A notional one-minute saving in the off peak and counter peak time periods has been assumed.

### *Bus Reliability Benefits*

The scheme is expected to improve bus reliability when the bus lanes/SVLs are operational (i.e. southbound during the morning peak period and Northbound the during the evening peak period). The existing bus travel times and travel time variability is shown in Figure 1.

This information was extracted from the Strategic Case Report (Figure 5) and shows that the variability in bus travel time during morning peak period is approximately twice as much as the those experienced during the evening peak period. The scheme is not expected to significantly the variability of the dwell times at the bus stops, outside of what has been considered as part of bus stop removal analysis.

Figure 1 - Bus Travel Times by Time of Day (average with 15th/85th percentile error bars)






For the purposes of the economic analysis, the following assumptions have been made:

- There will be a 30 second reduction in average late time for southbound buses in the morning peak period
- There will be a 15 second reduction in average late time for northbound buses during the evening peak period
- No improvement to bus reliability will arise whilst the bus lanes are not operational
- The improvements to bus reliability will affect 50% of bus passengers in 2026, increasing to 60% in 2036 due to peak spreading.

### *Pedestrian Amenity Benefits*

The daily pedestrian volumes along the scheme are based on the those identified in Table 4 of the Strategic Case, as shown in Table 2. These pedestrian volumes are related to 2019 strategic case identified that over the past 20 years there has been a 3% per annum growth in pedestrian volumes. This growth rate has been applied between 2019 and 2036 with growth rates tapering off linearly to 2046.

Table 2: 2019 Assumed Current Pedestrian Data (values over 50 rounded to nearest 10)

| Location | Peak Hour Flow | Daily Flow |
|---|---|---|
| Thorndon Quay | 200-300 | 2,000-3,000 |
| Hutt Road (Thorndon Quay to Kaiwharawhara Road) | 50-100 | 500-1,000 |
| Hutt Road (Kaiwharawhara Road to Onslow Road) | 20-40 | 200-400 |
| Hutt Road (north of Onslow Road) | 5-15 | 50-150 |

For the purposes of the economic evaluation, it is assumed that the pedestrian volumes are consistent along the length of the sections identified. It has been assumed that the average pedestrian trip length on the facility will be 1km and pedestrians have a walking speed of 1.2m/s. The pedestrian amenity benefits are based on the methodology and values stated in '*Impact on Urban Amenity in Pedestrian Environments, Waka Kotahi, 2020*'.

A 3km/h reduction in average speed along the corridor has been assumed in the calculation of pedestrian amenity benefits.

Whilst the applicability of other pedestrian amenity benefits has been considered, there is not expected to be significant improvement in pedestrian amenity relating to the features considered in '*Impact on Urban Amenity in Pedestrian Environments, Waka Kotahi, 2020*'.

### Sensitivity Testing

Sensitivity testing has been undertaken on the following scenarios:

- High-cost scenario based on the 95$^{th}$ percentile capital costs
- High cycle growth scenario where the number of new cyclists generated by the scheme is doubled to approximately 900 new cycle trip from within the direct catchment and a 100% increase in new cyclists generated from Ngā Ūranga ki Pito-One Shared Path Project
- Low cycle growth scenario where the number of new cyclists generated by the scheme is halved to approximately 260 new cycle trip from within the direct catchment and a 10% increase in new cyclists generated from Ngā Ūranga ki Pito-One Shared Path Project
- High and low bus patronage as a result of the scheme with a +/-20% bus patronage numbers
- 25% reduction in through traffic on Thordon Quay Hutt Road being diverted to the SH1 corridor. This sensitivity test was based on a separate modelling results undertaken on the Thorndon Quay Hutt Road corridor
- Increasing the evaluation period to a 60-year evaluation period
- Changes in discount rate to 6% and 3%
- Removal of external delays associated with southbound traffic in the AM peak re-routing onto SH1. This sensitivity test represents where these trips are delayed later in the peak such that there is no additional cost associate with peak spreading.
- Change in SH1 travel time during the AM peak period to achieve a BCR of 1.0 assuming a net change in vehicle operating costs of zero to partially account for changes in travel time.