MINISTERIAL BRIEFING NOTE

Subject	Northwest Rapid Transit and Crown Infrastructure Partners involvement
Date	15 September 2023
Briefing number	BRI-2856

Contact(s) for telephone discussion (if required)				
Name	**Position**	**Direct line**	**Cell phone**	**1st contact**
Brett Gliddon	Group General Manager Transport Services		s 9(2)(a)	✓
Robyn Elston	National Manager System Design		s 9(2)(a)	

Action taken by Office of the Minister

- ☐ **Noted**
- ☐ **Seen by Minister**
- ☐ **Agreed**
- ☐ **Feedback provided**
- ☐ **Forwarded to**
- ☐ **Needs change [please specify]**
- ☐ **Withdrawn**
- ☐ **Overtaken by events**

15 September 2023

Hon David Parker – Minister of Transport

NORTHWEST RAPID TRANSIT AND CROWN INFRASTRUCTURE PARTNERS INVOLVEMENT

Purpose

1. This briefing provides with you with the requested information on Northwest Rapid Transit (NWRT) and Crown Infrastructure Partners (CIP) involvement, including as a funding partner.

2. The information is provided to support your meeting with Nicole Rosie, Brett Gliddon and Graham Mitchell, CEO of CIP, which is a funding partner of the Interim Northwestern Bus Improvements.

Background and context section

3. There are two projects along the Northwestern motorway, State Highway 16:

    a. Northwest Bus Improvements – a short term project focussed on urgently improvements to interim Public Transport facilities.

    b. NWRT - longer term approach to rapid transit.

4. The projects originated in the 2018 Northwest Rapid Transit Indicative Business Case (IBC).

5. Together they aim to improve public transport access to Northwest Auckland, considering the limited existing public transport options in the Northwest and the predicted population growth.

6. More people in the Northwest travel to work by car than any other region in Tāmaki Makaurau, and more than 60 percent of people living in this area commute to suburban/city centres areas for work.

7. It is anticipated that by 2051 the Northwest will have 100,000 more people living there and 40,000 new households, leading to increased congestion and pressure on the existing public transport network.

Interim Northwestern Bus Improvements

8. The Northwestern Bus Improvements is a joint Auckland Transport (AT) and Waka Kotahi project to deliver a range of short-term bus improvements over the next five years to support growth in the region.

9. The project aims to:

    a. Improve bus connections locally and into the city centre by building new bus stops at Te Atatū and Lincoln Road Interchanges.

b. Provide a more reliable and quicker bus journey into the city centre by extending the bus shoulders on the Northwestern Motorway between Westgate and Newton Road. This will increase bus priority from 13 kilometres to almost 20 kilometres.

c. Provide a new frequent express bus service using the motorway between Westgate, Lincoln Road, Te Atatū, and the city centre.

Please refer to attachment A for a map of these improvements.

10. The project is being delivered collaboratively under a joint delivery and governance approach adopted between AT and Waka Kotahi. Under this approach:

a. AT is responsible for the Te Atatū and Lincoln Road bus stations design, and for the design and delivery of interim Westgate and Brigham Creek stations.

b. Waka Kotahi is responsible for delivering the Te Atatū and Lincoln Road bus stops, and the corridor bus shoulder lane components along State Highway 16.

11. Construction of the interim works will enable AT to change to a 'hub and spoke' bus service model, similar to that used with the Northern Busway. This operating model would increase frequency and reliability of services in the Northwest. When complete, there will be a bus every seven to eight minutes from Westgate to the city centre during peak hours.

12. The project includes interim stations at Brigham Creek, Westgate, Lincoln Road, Te Atatū Road, and changes/additions to existing bus shoulder lanes along State Highway 16 between Westgate and Newton Road. The facilities will be in place until a longer-term corridor is constructed and would then likely be removed.

13. Below is a picture of a bus shelter on Te Atatū Road. Flyovers of the stations are available on the project website - https://at.govt.nz/projects-roadworks/northwestern-bus-improvements/

14. Infrastructure works (except Westgate station) are expected to be completed in September 2023 and new bus services will start to run in November 2023.

15. Total project funding is $100 million, of which:

    a. $50 million is provided by CIP. AT secured this funding in May 2022 as a shovel-ready project through the government stimulus package. AT and CIP signed the funding agreement in August 2020. The agreement stipulated a $100 million programme funding cap, timelines and budget splits.

    b. $50 million is funded by the National Land Transport Fund (NLTF) and was confirmed in December 2022. Waka Kotahi has no agreement with CIP for the works.

16. Consistent with the distribution agreed between AT and CIP, and reflecting the timing of funding availability, construction funding varies across the four projects in the programme. The table below shows the funding split at August 2023.

s 9(2)(b)(ii)

[redacted]

s 9(2)(g)(i)

[redacted]

s 9(2)(g)(i)

[redacted]

Northwest Rapid Transit

23. The Northwest Rapid Transit (NWRT) work is being led by Waka Kotahi in collaboration with Iwi, AT and Auckland Council and is at the Detailed Business Case (DBC) phase.

24. The project area is from Brigham Creek Road to the Auckland city centre. At the city centre end, integration with existing bus operations, passenger rail and/or future light rail is a critical part of the project. At the western end, the NWRT would tie into a designation recently lodged by Waka Kotahi that proposes a rapid transit link from Brigham Creek to Huapai, including an alternative State Highway 16 alignment from Brigham Creek to Waimauku. This link would be fully integrated with the NWRT project.

25. Waka Kotahi is leading the NLTF-funded DBC and is working closely with iwi partners and key stakeholders, including AT and Auckland Council. The work with AT includes identifying changes to local bus systems that would increase access to the NWRT spine, as well around the North West area and providing an integrated network approach to address the key issues.

26. Current thinking is that the project would be delivered and opened in stages, similar to delivery of the Northern busway.

27. The DBC is underway and due to be complete by June 2024.

28. Please refer to attachment B for a map of the proposed NWRT programme.

It is recommended that you:

1. **Note** the contents of this briefing.

....

Brett Gliddon

Group General Manager Transport Services

....

Hon David Parker, Minister of Transport

Date: 2023

Key
New express bus stop
Connecting bus shoulder
Existing bus shoulder
Hobsonville Rd
Fred Taylor Drive
Westgate
Triangle Rd
Central Park Dr
Lincoln Rd
Lincoln Rd
Lincoln Rd
16
Te Atatū
Te Atatū
Te Atatū Rd
Te Atatū Rd
Auckland
Newton Rd
Waterview
20

Kumeū
Te Tupu Ngātahi Supporting Growth
Future Rapid Transit Corridor
Whenuapai
BRIGHAM CREEK ROAD
Hobsonville
Te Tupu Ngātahi Supporting Growth
Westgate
West Harbour
Taupaki
Te Tupu Ngātahi Supporting Growth
Massey East
Te Atatū Peninsula
Massey
Waitematā Harbour Connections
Ponsonby
Westmere
Parnell
Point Chevalier
Grey Lynn
Grafton
Ranui
Lincoln
Te Atatū South
Kingsland
Eden Terrace
HIKURANGI (WAITĀKERE)
Henderson
Rosebank
Waterview
Auckland Light Rail City centre to Māngere
Epsom
Avondale
Sandringham
Kelston
Brigham Creek to the centre centre, alongside SH16
Existing Ferry Terminal
Existing Rail Station
Rail Line
Waitematā Harbour Connections
Auckland Light Rail City centre to Māngere
Te Tupu Ngātahi Supporting Growth
Future Rapid Transit Corridor

Waka Kotahi Speed Review 2023

Economic impact analysis

June 2023

Building a better working world

Contents

Transmittal Letter

Waka Kotahi Speed Review 2023 – Economic impact analysis

20 June 2023

Luke Wilson
Waka Kotahi, New Zealand Transport Agency
Private Bag 106602, Auckland 1143

Dear Luke,

Thank you again for the opportunity to assist Waka Kotahi in performing the 2023 Speed Review. In accordance with the Consultancy Services Order (CSO) Contract (the 'Contract'), dated 23 March 2023, EY was engaged to independently evaluate the economic impact associated with the speed limit reduction for the State Highway 5 Rangitaiki and Esk Valley segment. The priorities were to provide evidence regarding the effects of the speed limit reduction, both in terms of size and direction (i.e. costs and benefits). Our findings are outlined in this report (the "Report"), setting out our methodology, findings, and qualitative impacts.

In summary, our analysis concludes that the speed limit reduction is likely to have directly led to a decrease in both the number of crashes, and the severity of the crashes that occurred. This greatly offsets costs associated with travel time increases, and when combined with the economic benefits associated with vehicle maintenance and emissions, leads to a large net benefit. While not all economic impacts can be monetised through best practice appraisal tools, it is clear that the speed limit reduction has achieved its goal of reducing the number of fatalities and serious injuries that occur on the segment.

Purpose of the Report and restrictions on its use

The Report may only be relied upon by the Waka Kotahi pursuant to the terms referred to in the Contract. Any commercial decisions taken by Waka Kotahi are not within the scope of our duty of care, and in making such decisions, you should take into account the limitations of the scope of EY's work and other factors, commercial and otherwise, which you should be aware of from sources other than EY's work.

EY disclaims all liability to any party other than Waka Kotahi for all costs, loss, damage and liability that the third party may suffer, or incur, arising from, or relating to, or in any way connected with the provision of the deliverables to the third party without our prior written consent. If others choose to rely in any way on the Report, they do so entirely at their own risk. If Waka Kotahi wishes to provide a third party with copies of the Report, then EY's prior written consent must be obtained.

If you would like to clarify any aspect of the report or discuss other related matters then please do not hesitate to contact me.

Yours faithfully

Chris Money
Partner, Strategy and Transactions

Executive Summary

EY has completed an independent review of the costs and benefits attributable to the 18 February 2022 speed limit change on the Rangitaiki to Esk Valley section of State Highway 5 (SH5). Although Waka Kotahi databases and technical manuals represented key inputs to the analysis, EY developed and applied its methodology autonomously. Feedback from Agency officials was limited to terminology and drafting suggestions, for reasons of clarity and accessibility.

Economic impact analysis, in this context, involves estimating relevant outcomes and measuring results in monetary terms (wherever possible). This primarily takes the form of cost-benefit analysis, consistent with Waka Kotahi business case guidance, and makes use of best-practice appraisal tools. Although longer-term and more in-depth research is always possible, we are confident that the most pertinent and significant impacts of the speed limit change have been captured through this assessment.

Analysis found that the speed limit change on SH5 both reduced the frequency of crashes and decreased the severity of injuries that would result from a crash. Approximately **34 crashes were avoided in the year following introduction of the speed limit change**, based on statistical analysis against a comparable prior year. We estimate the monetised value of each avoided crash to be $0.9m based on Waka Kotahi appraisal tools, which when applying the number of average avoided crashes will be equivalent to $31m for a full year. In addition, the reduction in the severity of a crash is equivalent to $3.2m (equivalent to approximately one quarter of a fatality). For the observed year, we see a benefit of $62m from reduced crash severity. This results in total safety benefits of **$93 million** for the year.

The speed limit change on SH5 increased travel time costs for road users. Although some sections of the highway saw a decrease in speed of over 10km/h, the weighted average was 2.3km/h. This implies a travel time increase of **0.5 to 2.8 seconds per km travelled**, and in total, **36 seconds to 3.6 minutes for a single journey.** This translates to a **cost of 23,476 hours for the year across all drivers** relative to an equivalent prior period. This differential in observed speed may be driven by the characteristics of SH5; many sections are classified as curved, winding, narrow, or containing significant roadside hazards. This translates to a total **travel time cost increase of $1.3 million** for the year.

Other costs and benefits were modest, but include a reduction in vehicle operating costs of $156 thousand and reduced emission impacts of $19 thousand for the year. Qualitative impacts related to perceptions of safety, noise, freight were investigated, however we were unable to identify any evidence that would alter the conclusions of our monetised economic analysis. Sensitivity analysis of each cost and benefit similarly indicates that conclusions are robust to alternative assumptions.

We estimate the economic impact of the speed limit change on SH5 to be **$92.6 million** in net benefits for the period March 2022 – February 2023. Sensitivity analysis, using alternative modelling assumptions, leads to a range in net benefits of $65m to $120m. Waka Kotahi can be confident that the speed limit change on SH5 has led to improved economic outcomes for New Zealanders.

1 Introduction

1.1 Background context

Waka Kotahi's Road to Zero initiative was published in 2019, striving for a world in which no fatalities or serious injuries occur on New Zealand's roads. As part of this initiative, the Agency regularly performs speed review processes, examining whether speed limits for specific corridors should be changed.

While technical analysis is a critical part of these speed reviews, Waka Kotahi also recognises the importance of local knowledge and experience. The Agency regularly seeks input from the public, alongside engaging in formal consultation regarding proposed speed limit changes. These consultations play a critical role in revealing any additional information to consider alongside the technical information that may play impact NZTA's final decision.

Waka Kotahi's SH5 speed review evaluates the speed limits the segment of State Highway 5 (SH5) that lies between Rangitaiki and Esk Valley. For the purposes of this report, we refer to the specific segment that was affected by the 2022 speed limit reduction as SH5.

Figure 1. State Highway 5 Speed Limits

This a particularly high-risk passage, with there being 16 fatalities and 75 serious injuries between 2010 and 2019, with the total number of crashes during this timeframe having led to 250 injuries. In addition to performing the speed review, the Agency has provided further investment, which was used to install side barriers, road markings, and maintain the overall roading quality to improve safety outcomes.

Waka Kotahi's technical assessment for this segment suggested that lowering the speed limit would reduce the number of crashes and injuries associated with this corridor. However, formal consultation and public feedback showed that many New Zealanders would prefer the local speed limit remaining at 100km/h. It should be noted that consultation also revealed an underlying theme of unease regarding driver behaviour, as well as concerns about road surface quality.

After evaluating the technical analysis and public feedback, the Agency decided to reduce speed limits on SH5 from 100km/h to 80km/h, implemented on the 18th of February 2022. In this announcement, Waka Kotahi also committed to commissioning an evaluation regarding the impact of the speed limit reduction, considering the safety, social, and economic impact, as key partners and community leaders desired further analysis and evidence demonstrating the appropriateness of the reduced speed limit.

This report details our (EY) independent analysis of the economic impact associated with the change in speed limit for SH5 (henceforth referred to as the Economic Impact Analysis). Our methodology applies an assessment approach that is consistent with Waka Kotahi economic appraisal guidance, and considers both quantitative and qualitative impacts rising from this change. Note that the evaluation is not a full business case nor an economic forecast of future outcomes.

1.2 Driver behaviour

Statistical analysis of safety and other transport-related outcomes essentially involves a 'before and after' comparison, making use of the best available evidence. Although monetised assessment focusses on specific measures such as deaths, injuries and travel time, factors such as driver behaviour represent important context for the analysis.

Measuring speed limit compliance is difficult due to the limited amount of data available and the potential privacy considerations surrounding such data. However, police reporting indicated a decrease in both the median and average speed, amongst those experiencing a crash, for the 2022 calendar year:

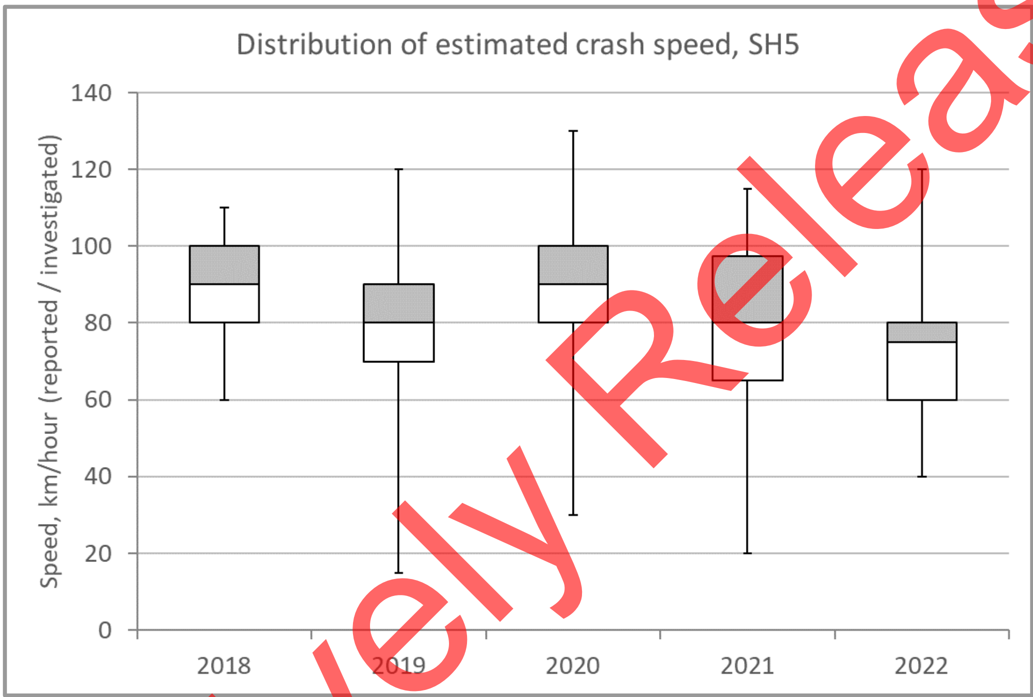


Figure 2. Reported speed data, SH5, by calendar year (Crash Analysis System)

This box and whisker plot provides a visual summary of the dataset, representing the minimum, maximum, median, and quartile crash speeds for each year. The box represents the central quartiles (the blank box representing quartile two, the grey representing quartile three, and the line between representing the median value), with the whiskers showing the full range.

This data suggests that the speed limit change did not significantly affect compliance, within the group of drivers involved in a crash on SH5. 25% of reported crashes, for example, were reported as exceeding the relevant speed limit in both 2020 and 2022 (100km/h and 80km/h limits respectively). The median speed, in particular, was lower in 2022 than in any previous year. It should be noted that the SH5 speed review began in February, rather than at the start of calendar year 2022, so this conclusion should be treated as indicative only.

Observed travel speed data, obtained from MegaMaps, also points to a decrease in average travel speed before and after the speed limit was changed:

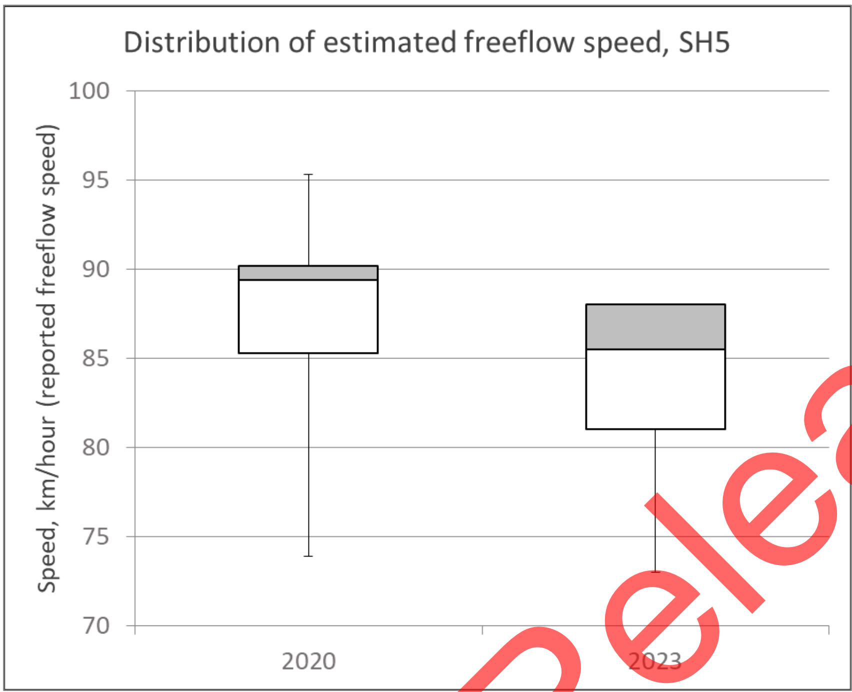


Figure 3. Distribution of observed speeds across SH5, by corridor section and calendar year

While average speeds have decreased by approximately 2km/h, this data indicates a number of drivers still choose to travel over the speed limit, making it difficult to reach a clear conclusion regarding the compliance behaviours of all drivers.

1.3 MBCM updates

Waka Kotahi's Monetised Benefits and Costs Manual (MBCM) is the standard reference for evaluating the economic impact associated with transport activities and investments in New Zealand. On April 14th 2023, Waka Kotahi released a newer version of the MBCM (version 1.6), significantly changing several parameter values and providing revised update factors.

While EY analysis began prior to these new values being released, our outputs reflect these updates, recognising that version 1.6 now represents the latest and best available guidance. Changes are highlighted because the social cost of deaths and serious injuries are a significant driver of our results. Some of these values have increased dramatically, for example, the social cost of a fatality rising from $4.3 million to $12.5 million. The full list of relevant changes are:

- Social cost of deaths and serious injuries;
- Network productivity and utilisation (travel time values);
- Air emission health impacts;
- Greenhouse gas emission impacts;
- Walking and cycling benefits;
- Update factors (changes over time to reflect inflation); and
- Miscellaneous changes for simplified procedures and decision-making.

From a total monetised value perspective, the MBCM update increases the quantified benefits. For clarity and to demonstrate analytical robustness, our results are calculated using both prior (version 1.5) and current MBCM (version 1.6) values. This report presents the two impact sizes separately, but the results using prior MBCM values should be considered a sensitivity because they reflect outdated evidence and research.

2 Methodology

The following chapter presents our methodology and results for the Economic Impact Analysis.

Our estimation for the net economic impact of the speed limit reduction is given as a monetised figure. This is recommended as best practice for economic appraisals within New Zealand.

Note that unless specified otherwise, all references to annual results relate to the March 2022 – February 2023 period.

Where possible, sensitivities have been included to show the full range of effects. For instance, we present effect sizes associated with the low, mid, and high shadow price for carbon, and analyse the changes in vehicle operating cost for a range of speeds.

2.1 Overview

We undertook a three-step approach for our Economic Impact Analysis:

1. Collated key SH5 data over time. These parameters include vehicle-kilometres travelled (VKTs), average travel speed, total journey volumes, and other associated travel data
2. Estimated the change in costs and benefits that is attributable to the decrease in speed limit
3. Performed cost-benefit analysis to determine the total impact size that results from the change in speed limit, relying on monetised values from the MBCM.

Step 2 applied various forms of statistical analysis, including econometrics to appropriately attribute specific valuations to the speed limit decrease. Outputs from step 2 were used to build a cost-benefit analysis model for step 3.

We provide a detailed breakdown of each step below.

2.2 Step 1: Data collation

As our evaluation depended heavily on the quality and form of input data, collation and cleaning was a critical component of our methodology to ensure that our results are accurate and fit for purpose.

Crash and speed related input data was provided by Waka Kotahi. Primary sources were the Waka Kotahi Crash Analysis System (CAS) database and geospatial MegaMaps tool. While we consider this data to be largely robust and appropriate for use for the Economic Impact Analysis, we note some limitations regarding the inputs below:

- The CAS data may not fully capture all crashes, specifically those which do not result in a fatality or serious injury. This is unlikely to affect final valuations in a material fashion, as such crashes are assigned a low monetised value within the MBCM
- Certain CAS values like crash speed are self-reported from external sources such as the police, thus adds some degree of inconsistency. Where possible, we have avoided using potentially inaccurate values within our analysis
- Traffic volumes, free flow speeds, and road conditions obtained from MegaMaps is collated into two temporal periods, 2020 and 2023. These time periods still align with our analysis, as the 2020 observations lie prior to the speed limit reduction, and the 2023 comes after, thus the comparisons we draw capture the effect of the change.

2.3 Step 2: Statistical analysis

This is the most conceptually complex step within our methodology as road crashes have a number of causes and influences. We apply a statistical methodology in order to isolate the effect that is associated with the speed limit change, rather than conflating any potential impacts that may rise from a change in other variables.

2.3.1 Hypothesis testing

One critical exercise that was required prior to quantifying impacts was testing whether the speed limit change had a statistically significant impact on the number of crashes. While published research is clear in that lower speeds tend to result in fewer and less severe crashes, this still required testing to prove the relationship held for this specific time period and location. A hypothesis test provides initial evidence into whether the impacts of the speed limit change are truly material.

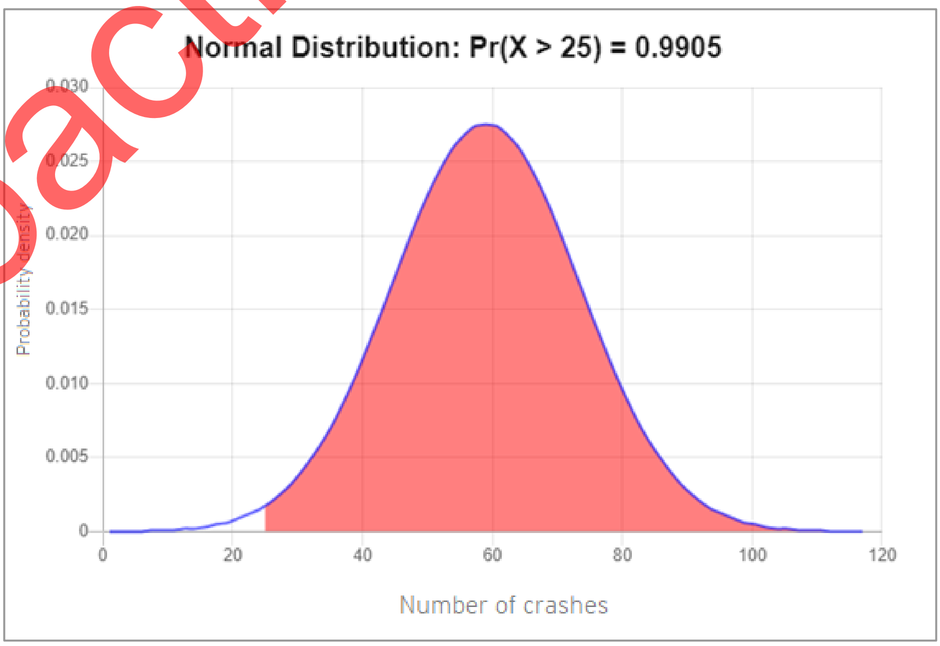
One challenge with this form of hypothesis testing is that the speed limit change was only in effect for one year at the time of analysis, which limits our ability to perform the t-test (and by extension, the z-test), both of which are a traditional methodology for hypothesis testing.

Instead, we constructed a distribution for the average number of crashes that would occur in a year for SH5 from crash data prior to the speed limit reduction. By doing so, we can see whether the observed number of crashes that occurred after the speed limit change stays statistically equivalent with a 100km/h limit, or whether it has changed by a sufficient amount such that it becomes statistically relevant. Note that this process assumes that crashes are distributed in a normal fashion, something that is well supported by historical research.

Due to the speed limit coming into effect in February 2022, we adjusted crash data to ensure consistent annual observations. Thus, we measure the number of crashes that occur from the beginning of March in a given year to the end of February for the next, e.g. March 2018 to February 2019 inclusive.

Furthermore, some observations during the 2022 period that occurred after the decrease still occurred at a posted speed limit of 100km/h. These observations have been cleaned, i.e., removed from the data, to maintain time consistency.

We present the normal distribution of crashes associated with the pre-speed limit change SH5 data, as well as summary statistics below:



Total years	4	Year range	2018-2021
Minimum	38	Maximum	71
Lower quartile	56	Upper quartile	66.5
Median	63.5	Mean	59

Figure 4. Statistical characteristics of crash data on SH5, prior to the speed limit change

The analysis suggests that, for a given year in which the speed limit was set at 100km/h for SH5, one would observe an annual crash count of 25 or lower roughly 1% of the time. It is, therefore, highly unlikely that such a crash count would be caused by random chance or variation. This implies that the speed limit reduction had a material impact on the number of crashes. Our crash count captures all crashes, including crashes that resulted in a fatality, serious injury, minor injury, or a non-injury.

We also perform robustness checks, expanding the dataset to include a selection of similar highways (i.e. routes connecting cities and those with similar geographies). These highways consisted of:

- SH39 Whatawhata – Otorohanga
- SH3 Piopio - Urenui
- SH1 Blenheim – Kekerengu.

With an expanded dataset, the conclusion of the speed limit change having a statistically significant impact (at the 5% level) on the number of crashes holds true.

2.3.2 Econometric analysis of crashes

Having confirmed that the speed limit change had a statistically significant impact on the number of crashes, we proceeded to estimate the attributable effect size. Observed changes are measured in monetised terms. Note that the use of recorded observations within a single year, as opposed to a sample of data or comparison between years, precludes sensitivity analysis being applied to the estimated change in crashes, injuries, and fatalities following the speed limit change.

EY analysis examined two effects that the reduced speed limit could have on crashes:

1. Reducing the total number of crashes
2. Reduce the severity of crashes, represented by a change in crash cost.

As an example, if a crash were to result in a death while travelling at 100km/h but only lead to a serious injury at 80km/h, we can state that there is an associated decrease in the cost associated with this crash that comes from the change in speed. By applying this approach to the change in speed limit and adjusting for other factors, we can quantify this particular effect and thus estimate the avoided cost.

First, we identify the reduction in total crashes. In defining the change between pre- and post-speed limit change, we account for several factors:

- The appropriate time period to consider
- Use of crash statistics from other similar corridors
- Potential travel implications rising from COVID.

For consistency in results and methodology, we apply the same observational sample used to identify whether the speed limit decrease had a statistical impact, and estimate the average, highest, and lowest change in crashes between years.

Table 1. Range of avoided crashes when comparing post speed limit reduction to pre

Sensitivity	Change in crashes
High	63
Average (mean)	34
Low	5

From here, we analysed what the value of one of these crashes would be. We calculate the value of crash from MBCM values, i.e., the total monetised impact of the fatalities, serious injuries, and minor injuries associated with a crash. We derived these monetary values from the current version of the MBCM, but for sensitivity analysis, we also present values calculated using old MBCM parameters. The difference between MBCM version 1.5 and 1.6 for 2023 are given below:

Table 2. Monetised safety impacts, Waka Kotahi Monetised Benefits and Costs Manual

Severity	MBCM 1.5 (2023 $ value)	MBCM 1.6 (2023 $ value)
Minor injury	$34,333	$92,983
Serious injury	$600,831	$910,370
Fatality	$5,550,534	$16,109,880

We use the average value of a crash for the 100k/h speed limit period to identify the avoided crash benefit:

Table 3. Monetised avoided crash benefits

Effect time period	Avoided crash benefit
MBCM 1.5 (2023 $ value)	$460,064
MBCM 1.6 (2023 $ value)	$936,319

We present the total benefits attributable to avoided crashes below:

Table 4. Decrease in annual crashes before and after speed limit change, and monetised value

Sensitivity	Change in crashes	MBCM 1.5 (2023 $ value)	MBCM 1.6 (2023 $ value)
High	63	$28,984,032	$58,988,097
Average (mean)	34	$15,642,176	$31,834,846
Low	5	$2,300,320	$4,681,595

Having considered all crashes, subsequent analysis focusses on the costs associated with crashes that resulted in at least a minor injury. We utilise standard econometric techniques to attribute the effect that the speed limit change has had on this particular cost, utilising an ordinary least squares specification.

Prior to performing this statistical analysis, we first consider our dataset in the context of the Economic Impact Analysis. As noted above, this portion of the analysis examines the set of crashes that results in at least a minor injury. Crashes not resulting in any form of death or injury do not have an MBCM safety value attributed to them and, therefore, are excluded in this analysis.

The initial dataset used for this analysis comes from the Waka Kotahi CAS database, aggregating all crashes that occurred on SH5 from January 2018 to February 2023. We then assigned each crash a total value using MBCM values. Any crash that results in a value of 0 is then cleaned from the dataset. We also consider additional parameters such as season, time, and month, all of which can be derived from CAS information. These parameters reflect other potential causes for an individual to crash, beyond the speed they were travelling at.

One consideration we made for our estimation is the impact that COVID has had on driver behaviour. Therefore, we limited our dataset to the time period post 2020, such that we can reduce the potential variance that COVID has had.

Key features of these results are:

- The speed limit change is statistically significant at the 0.1 level, which means that through pure chance, it is only possible to observe an effect of this particular size less than 10% of the time. This supports the idea that the speed limit change truly had a material impact on the cost associated with a crash. Given that the coefficient is positive for both sets of results, we can state that the severity of a crash decreases as speed limits are lowered.
- The total number of vehicles is the single most important decider in determining the severity crash. This is an intuitive outcome, the greater number of people involved in a crash, the larger safety impacts.
- We observed that seasonal effects are not statistically significant, and thus have little impact on the cost associated with a crash. This could be due to a variety of reasons, but likely that this is resultant due to the fact that both the speed limit and the total number of vehicles have such strong effects that it virtually removes the impact that rises from differing seasons.

Using these values, we can now estimate the decrease in cost associated with a speed limit at 80km/h compared to 100km/h. Note that our econometric analysis estimates the marginal effect associated with a 1km/h change in the limit. Thus, we must multiply this effect by 20 in order to capture the total impact attributable to the speed limit decrease.

Table 5. Reduction in crash cost associated with speed limit change

	Marginal effect (1km/h change in speed limit)	Average cost per crash (100km/h to 80km/h change)
MBCM 1.5 (2023 $ value)	$79,028	$1,580,563
MBCM 1.6 (2023 $ value)	$162,807	$3,256,142

Both of our regressions have adjusted R-squared values which are around 0.18. An adjusted R-square value is a measurement of how well the model can describe variance in the data.

This would imply that our model accounts for at least 18% of the changes in crash cost. While 18% appears low, this is most likely due to the fact that crash costs are still greatly affected by factors that are external to the model (such as speed at impact, vehicle type, total number of passengers). Therefore, we consider our outputs relevant enough such that we can utilise them to calculate the total impact that the speed limit change has had.

We now consider the number of relevant crashes in the 1-year study period to identify the total impact. Of the 25 observed crashes post-speed limit change (March 2022 – February 2023), 19 of them resulted involved a fatality, major and / or minor injury. Thus, we can multiply the change in per crash to estimate the total reduced cost from these crashes over a full year:

Table 6. Total reduced crash costs associated with speed limit change

	Number of crashes	Year's cost savings
MBCM 1.5 (2023 $ value)	19	$30,030,700
MBCM 1.6 (2023 $ value)	19	$61,866,696

Note that performing sensitivity analysis for this effect is difficult. As we are analysing the impact for a full year utilising the true observed numbers, proposing a confidence interval or similar indicator of uncertainty would be disingenuous. Rather, we suggest that inclusion of these cost savings may be comparable to a form of sensitivity analysis, as one may disagree with established literature and suggest that other factors may lead to there being little difference in the cost associated with a crash under two differing speed limits for this particular corridor.

While these safety benefits are the biggest contributor to the benefit associated with the speed limit reduction, we must consider a combination of other effects in order to determine the net effect, and whether it results in a total benefit or cost.

2.4 Step 3: Cost Benefit Analysis

Beyond safety benefits, the speed limit change will affect both the travel time and the total vehicle kilometres travelled (VKTs) on the corridor. For transparency, we will assume that VKTs remain the same pre and post speed limit change. This is because we cannot calculate the effect that the speed limit decrease had on total trips travelled. Changes in travel time will still impact a variety of differing factors, such as:

- Vehicle operating costs;
- Greenhouse gas emissions; and
- Health impacts from pollutants.

We estimate the differences in impacts that result from the speed limit reduction through a cost-benefit analysis model, using the change in travel time to calculate the total impact. We rely on MegaMaps data, outputs from the Vehicle Emissions Prediction Model (VEPM), and MBCM values for this part of our analysis.

2.4.1 *Total trips / VKTs*

Drawing on MegaMaps data, we take an average of the daily trips in 2020 and 2023 with the length of the corridor (76km) to get total VKTs.

Table 7. Annual trips / VKTs used for analysis

Trip count / Total VKTs	Totals
Total daily trips	3,216 trips
Total yearly trips	1,173,840 trips
Total VKTs	89,199,861 VKTs

We now use these VKTs to calculate the effect changes associated with vehicle operating costs, greenhouse gas emissions and health impacts from other vehicle pollutants. We will monetise these impacts using MBCM values. Prior to calculating, we must first split VKTs by vehicle type. We assume that the New Zealand wide fleet profile for 2022 provided by the VEPM holds true for this corridor, and utilise those ratios for calculation.

2.4.2 *Vehicle operating costs*

When considering vehicle operating costs, we refer to the MBCM values. We consider three scenarios, with the first being what we observed to be the true change in travel speed, the second being a "low" scenario, where we assume that there is little change in travel speed, and finally a "high" scenario, in which we assume that there was a large change. The last two scenarios are sensitivities, and were obtained from the minimum and maximum freeflow speed changes seen in MegaMaps data.

Table 8. Vehicle speeds pre and post speed limit decrease

Vehicle type	Observed	Low (sensitivity)	High (sensitivity)
Pre-speed limit	86km/h	74km/h	95km/h
Post-speed limit	84km/h	73km/h	88km/h

Note that these values remain unchanged from the MBCM update. We present the present values for vehicle operating costs below:

Table 9. Vehicle operating costs per KM for given speeds

Vehicle operating cost	Observed $ value	Low $ value	High $ value
Pre-speed limit	32.76 cents/km	31.94 cents/km	33.55 cents/km
Post-speed limit	32.59 cents/km	31.87 cents/km	32.94 cents/km

Applying these values then estimates the total change in vehicle costs. We provide the observed effect alongside sensitivities:

Table 10. Total change in vehicle operating costs, per annum

Total impact (2023 $ value)	Observed	Low (sensitivity)	High (sensitivity)
Total change in vehicle operating cost, annual	-$156,128	-$65,053	-$546,449

As travel speeds reduce, the operating cost per kilometre is lowered. Therefore, we can state that the reduction of the speed limit brings an associated benefit with respect to the lowered vehicle operating cost for travellers.

2.4.3 Emission impacts

When considering the emissions impact associated with the speed limit reduction, we will be using VEPM outputs which have been monetised using MBCM values. As VEPM outputs are based on travel speed, we will use the same speeds that we used in vehicle operating cost, with one exception. Due to the fact that the VEPM does not allow speed inputs greater than 86km/h for Heavy Commercial Vehicles (HCVs) and Buses, we will assume that for the high sensitivity that pre-speed limit decrease, they were travelling at 86km/h, and post-speed limit they were travelling at 80km/h.

We present our speed inputs for the VEPM below:

Table 11. Vehicle speeds used to inform vehicle emissions calculations

Vehicle type	Observed	Low (sensitivity)	High (sensitivity)
Pre-speed limit	86km/h	74km/h	95km/h*
Post-speed limit	84km/h	73km/h	88km/h*

From here we use VEPM emission factors in conjunction MBCM effect sizes to calculate greenhouse gas (GHG) emissions effects and pollution health impacts.

Note that GHG emissions are valued using a shadow price, which is a government agreed monetised valuation based on international / national emission goals.

The value for both these impacts were changed with the new MBCM update. We present both prior and current values below:

Table 12. Shadow price of carbon

Shadow price of Carbon (CO2-e) ($/tonne)	MBCM 1.5 (2023 $ value)	MBCM 1.6 (2023 $ value)
Low	$64	$65
Middle	$96	$97
High	$128	$182

The previous version of the MBCM did not provide a middle value, thus deriving it as an average from the low and high gives $96.

Table 13. Associated health costs for emissions

Rural costs for emissions ($/tonne)	MBCM 1.5 (2023 $ value)	MBCM 1.6 (2023 $ value)
$PM_{2.5}$	-	$51,058
PM_{10}	$545,599.99	-
NO_x	$19,388.46	$25,011
CO	$4.90	$0.20
VOC/HC	$1,553.73	$63

Note that the old MBCM values are solely for national level impacts. Furthermore, while the current MBCM provides values for SO_2 impacts, VEPM does not provide specific outputs, thus we exclude it from our analysis. Another point of analytical difference is the addition and removal of $PM_{2.5}$ and PM_{10} effects respectively. While we will provide effect sizes for both categories, the MBCM no longer considers the impacts of PM_{10} and thus, we recommend non-consideration from an evaluation perspective.

The following table summarises the total effect sizes for emission impacts:

Table 14. Change in vehicle emissions costs, by effect, per annum

2023 $ values	MBCM 1.5 - Observed	MBCM 1.5 - Low	MBCM 1.5 - High	MBCM 1.6 - Observed	MBCM 1.6 - Low	MBCM 1.6 - High
CO2-e (low)	$5,241	-$586	$27,785	$5,323	-$595	$28,219
CO2-e (middle)	$7,862	-$879	$41,678	$7,944	-$888	$42,112
CO2-e (high)	$10,483	-$1,172	$55,571	$14,906	-$1,662	$79,015
$PM_{2.5}$	-	-	-	$2,107	$441	$9,204
PM_{10}	-$31,723	-$15,906	-$92,946	-	-	-
NO_x	$8,598	-$2,182	$45,890	$8,946	-$2,270	$47,743
CO	$0.65	$0.14	$3.22	$0.69	$0.15	$3.39
VOC/HC	-$0.53	-$2.01	$4.83	-$0.55	-$2.08	$4.99

Table 15. Total change in vehicle emissions costs, per annum

2023 $ values	MBCM 1.5			MBCM 1.6		
	Observed	Low	High	Observed	Low	High
Total (low)	-$17,884	-$18,676	-$19,263	$16,376	-$2,426	$85,174
Total (middle)	-$15,263	-$18,969	-$5,370	$18,997	-$2,719	$99,067
Total (high)	-$12,642	-$19,262	$8,523	$25,959	-$3,493	$135,970

As travel speeds reduce, we should also see a decrease in the total amount of emissions. For our observed speeds, we see a benefit from reduced emissions that is within the range of $16k to $26k. Analysis conducted using the MBCM version 1.5 shows negative impacts due to the increase in PM_{10}. This is not applicable to current guidance. The low sensitivity shows a cost associated with a travel speed decrease. We believe that this is a function of VEPM calculations regarding emissions at lower travel speeds.

2.4.4 *Travel time impacts*

Finally, we use the observed free-flow speed to calculate the travel time for before and after the speed limit change. We present these values below:

Table 16. Vehicle speeds and total travel time

	Observed	Low (sensitivity)	High (sensitivity)
Pre-speed limit	86	74	95
Post-speed limit	84	73	88
Time taken pre-change	0.88 hours	1.03 hours	0.80 hours
Time taken post-change	0.90 hours	1.04 hours	0.86 hours
Journey time increase	1.2 minutes	0.6 minutes	3.6 minutes
Total additional hours	23,476 hours	11,738 hours	70,430 hours

We use the composite value of travel time for rural strategic corridors to calculate the cost associated with the increase in journey length.

We provide the values we use below:

Table 17. Travel time values applied to cost-benefit analysis

Composite values of travel time ($/h/vehicle)	MBCM 1.5 (2023 $ value)	MBCM 1.6 (2023 $ value)
Rural strategic – All periods	$38.46	$51.93

Therefore, we calculate total annual travel time costs associated with the change in speed limit on SH5.

Table 18. Total change in travel time costs, per annum

Travel time impacts (2023 $ value)	MBCM 1.5			MBCM 1.6		
	Observed	Low	High	Observed	Low	High
Change in travelled hours	23,476 hours	11,738 hours	70,430 hours	23,476 hours	11,738 hours	70,430 hours
Hourly cost of time	$38.46	$38.46	$38.46	$51.93	$51.93	$51.93
Total cost	-$949,810	-$635,082	-$2,872,608	-$1,282,461	-$857,506	-$3,878,679

As travel speeds reduce, travel times will increase. As we have not attributed any changes in VKT to the speed limit reduction, the direction of the impact will always be negative. For our observed speeds, we see an estimated increase in journey times by 1.2 minutes, an increase of 23,476 hours spent travelling on SH5 over one year, and thus, an associated cost of $1.3m.

3 Qualitative impacts

While our quantitative analysis conclusively points towards there being a large economic benefit associated with the speed limit reduction, there are also several other impacts associated with a change in speed limit that are potentially relevant, but cannot be easily measured in dollar terms. This could be for a variety of reasons, such as:

- The impact being challenging to quantify, such that a single years of data for a specific highway is insufficient to produce a robust estimate of the effect that is attributable to a change in speed limit
- Data not being collected at a sufficiently granular level to permit monetised estimates (e.g., noise modelling)
- Economic appraisal tools in New Zealand not providing a method to measure such impacts in monetised terms (e.g., perceptions of safety).

While we cannot overcome these limitations and integrate all factors into our monetised analysis, we can consider key impacts from a qualitative perspective. This following section evaluates the potential ramification that the speed limit reduction could have on:

- Perceptions of safety;
- Noise; and
- Further impacts on freight.

3.1 Perceptions of safety

Waka Kotahi recognises safety under the Land Transport Benefits Framework, including the impact it can have on behaviour and wellbeing. Associated impacts are not monetised however, and quantified data is largely limited to survey responses.

Perceptions of road safety can represent a material impact to New Zealanders, over and above more traditional and tangible transport impacts. This is because individuals' opinions about safety are an important measure of liveability, with discomfort around the danger of roads acting as a potential barrier to access, social inclusion, and physical and mental health. Furthermore, given that crashes are the second largest cause of death and injury for visiting tourists and business travellers, the perception around New Zealand's road safety has the potential to affect the tourism industry.

Published research indicates that humans are not adept at judging risk, including the relationship between crash statistics and the likely outcomes of unsafe driving behaviours. This does not alter the underlying relationship between crashes and perception however, and international research identifies a direct relationship between travel behaviour and traffic incidents.[1] Improved perceptions of safety can, therefore, be viewed as an additional benefit of the speed limit change on SH5.

3.2 Noise

Waka Kotahi and international research identifies a positive relationship between motorway noise and vehicle speed. This research also points to the cost associated with changes in noise level, in several cases pointing to health implications in addition to a negative experience.

Available data is not sufficiently granular to quantify and monetise the noise impacts specific to a change in speed limit on SH5. Such analysis would need to consider the relatively low

[1] See, for example: https://trid.trb.org/view/1722929

housing density along the affected section, suggesting that the quantum of impacts would be small.

Nevertheless the directionality of this impact is clear. Published evidence points to increased vehicle speed contributing to noise. The decrease in speed created by the 80km/h speed limit can, therefore, be considered a benefit from the perspective of noise impacts.

3.3 Further impacts on freight

Recognising the relatively small, quantified impact associated with the change in travel time (i.e. a change in average speed of 2.3km/h), it is nevertheless important to consider the wider impacts that the speed limit reduction may have on freight, as they are a critical user of the roading network.

While the speed limit decreasing from 100km/h to 80km/h would appear to affect all users equally, HCVs have operated under a maximum speed of 90km/h across the country since 2004, and thus would only realise a partial reduction in speeds. All else being equal, the change in speed limit is likely to have had a lower impact on heavy vehicle travel speeds when compared to light vehicle. However, we note that specific characteristics of road freight travel, for example work-time rules, are not captured in this analysis

This does not preclude the existence of wider costs for the freight industry, given that travel time is only one of several factors affecting industry costs. A recent study by the Ministry of Transport identified that travel time represent about 44 per cent of road freight costs.[2] Other resource costs such as fuel and vehicle maintenance make up approximately 53% of freight travel costs. Duties and levies paid by goods vehicles make up the remaining 4 per cent of costs.

Analysis of vehicle operating costs indicate that an 80km/h travel speed generally reduces costs compared to a 100km/h travel speed. The same pattern applies to external costs such as vehicle emissions. Heavy vehicle duties such as Road User Charges are unlikely to change significantly in the absence of change to kilometres travelled.

Based on the key sources of freight cost identified by the Ministry of Transport, it is not clear that the speed limit change on SH5 has created material cost increases for freight, above and beyond the travel time implications included in the monetised analysis.

[2] https://www.transport.govt.nz/assets/Uploads/DTCC-Draft-Synthesis-Report-07-August-2022.pdf

4 Conclusion

Given our analysis, we conclude that:

- The speed limit reduction has made a material difference in reducing the number of crashes.
- This reduction offsets any negative economic impact generated by the increase in travel time.

Aggregating all results, we can estimate the total impact that the speed limit change has had. As we had value ranges for safety impacts (in terms of avoided crashes) and greenhouse gas emission effects (with respect to CO2-e), we will present our final results as a range.

Table 19. Summary table

	MBCM 1.5			MBCM 1.6		
	Observed	Low	High	Observed	Low	High
Avoided crash benefits	$2.3m to $29m	$2.3m to $29m	$2.3m to $29m	$4.6m to $59m	$4.6m to $59m	$4.6m to $59m
Reduced cost of a crash benefits	$30m	$30m	$30m	$62m	$62m	$62m
Vehicle operating cost impact	$156k	$65k	$546k	$156k	$65k	$546k
GHG emission impact	$5k to $10k	-$1k	$27k to $55k	$5k to $14k	-$2k to -$3.5k	$85k to $135k
Health impact of pollution	-$23k	-$18k	-$47k	$11k	-$1.8k	$57k
Travel time impacts	-$950k	-$635k	-$2.9m	-$1.3m	-$858k	-$3.9m
Midpoint totals	**$44.7m**	**$45.1m**	**$43.3m**	**$92.6m**	**$93.1m**	**$91m**
Total range	**$31m to $58m**	**$32m to $58m**	**$29m to $56m**	**$65m to $120m**	**$66m to $120m**	**$63m to $118m**

Our results conclude that the speed limit reduction results in crash benefits that have a range of $65m to $120m. Additional economic impacts are estimated to be in the region of -$1.1m. While we see small economic benefits associated with a reduction in vehicle operating costs and reduced emissions at lower speeds, the cost associated with an increase in travel time result in additional impacts being a negative.

This leads to a net economic benefit that ranges between $65m to $120m. This range essentially translates to an annual benefit that would be generated every year when comparing against a world in which the speed limit remained at 100km/h.

Approaching this from another perspective, the benefit that has been produced through the speed limit reduction is monetarily equal to 5 to 9.6 avoided fatalities. We believe this to be an apt comparison as a large proportion of our final results come from the avoided crash and reduced cost of a crash benefits.

Furthermore, lower speed limits have resulted in drivers travelling at lower speeds. Due to lack of data, we cannot probe deeper into the level of behavioural change associated with the speed limit reduction, the statistics suggest that the change has been adopted by drivers, therefore the speed limit reduction has led to lower travel speeds.

While we note that freight may be impacted by the speed limit reduction, we also emphasize the fact that the speed limit reduction makes roads safer, which in turn makes the journey for truck drivers safer, and reduces any potential accident or injury that they may experience. This is a critical point and when approaching from a resilience perspective, highlights the potential for there being a large amount of non-monetised benefits that rise from the speed limit reduction.

Peer Review:

State Highway 5 Rangitaiki to Esk Valley Speed Reduction Review undertaken by EY

DRAFT

John Williamson
August 2023

Smart. Thinking. People.

Table of Contents

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Date 20th August 2023
Version Version 2.0 Draft

1 Introduction and Background

The SH5 Rangitaiki to Esk Valley speed reduction was implemented by Waka Kotahi in February 2022. Partly in response to community views concerning speed limit reductions at that time, an independent review of the outcomes of the speed reduction was commissioned by Waka Kotahi and undertaken by EY.

This report provides an independent peer review of the EY SH5 Rangitaiki to Esk Valley Speed Reduction Review.

2 Scope and Purpose of the Peer Review

Generally, the purpose of an independent peer review is to reduce the risks that projects either do not deliver on the outcomes forecast, or they fail to deliver the outcomes at the level of efficiency and effectiveness stated. In essence, the EY Review provides this level of assurance for the SH5 Rangitaiki to Esk Valley speed reduction. Therefore, this Peer Review provides a second level of assurance, for what is an important issue to the community and road users.

This Peer Review focuses on the conformity of the EY Review with best practice and relevant guidelines. To assist in this, the review is undertaken where possible with reference to the standard Waka Kotahi economic assessment framework as set out in the Monetised Costs and Benefits Manual (MBCM) and Waka Kotahi Knowledge Base. The tests to be included within an independent peer review which are relevant here include:

- Economic methodology – scope of benefits, assumptions and input parameters.
- Validity and reliability of input data.
- Consideration of alignment with the methodology applied in other similar reviews.
- Additionally, the review also considers:
  - Whether the evidence provided supports and aligns with the findings of the Review.
  - Whether there are any clarifications needed to ensure that readers are very clear about the approach, assumptions, methodology and results.

3 Introduction

3.1 Structure of this Peer Review

To ensure easy reconciliation with the EY Review this Peer Review follows the section by section structure of the EY report. The review then pulls together the main observations in the concluding section.

3.2 Background Context (Section 1.1)

Geographical scope of the EY Review. It is noted that the EY Review refers "to the specific segment that was affected by the 2022 speed limit reduction as SH5" (the segment of State Highway 5 (SH5) that lies between Rangitaiki and Esk Valley).

- **Comment:** Did EY also look at changes in speed and crashes on the remaining sections of SH5 between Taupo and Napier as part of their review? If so, it might be helpful to report the findings? I suspect this question may be raised by other readers of the Review.

Other Interventions: It is noted by EY that "[I]n addition to performing the speed review, the Agency has provided further investment, which was used to install side barriers, road markings, and maintain the overall roading quality to improve safety outcomes."

- **Comment** Has it been considered and is it possible that these interventions have made some contribution to the reduction in crashes on the section of SH5 where the speed reduction has been implemented? I wasn't able to definitively determine this from my reading of the Review and it would be helpful to clarify this point as again, I suspect it may be raised by other readers.

Scope of the economic assessment: It is noted that the EY report provides a clarification that it is not a full business case nor an economic forecast of future outcomes.

Comment: This is a helpful point to make. As the Review is not an economic forecast of future outcomes then the application of Waka Kotahi's economic assessment methodology can only be done within the context of the observed data/outcomes. So for example, there is no attempt by EY to project future costs and benefits, to discount these back to a present value or to produce a benefit cost ratio. I agree that the reliance solely on observed evidence is the correct approach for the Review to adopt.

3.2 Driver Behaviour (Section 1.2)

I concur with EY that this section provides a useful context and I note the difficulty of measuring compliance with speed limits. My main observations on this section are as follows:

- Firstly, the box and whisker plots indicate a degree of variability from year to year, particularly for the range of driver speeds.
  - **Comment**: Is this something that needs further explanation/elaboration in the report?
- Secondly, it is noted that the 'the speed limit change did not significantly affect compliance within the group of drivers involved in a crash on SH5'.
  - **Comment**: I would say it appears from the data to have had no effect at best, given that the upper quartile of drivers in 2022 were above the speed limit and this is the same as for 2018 and 2020 and worse than 2019 and 2021. Albeit in 2022, drivers were required to comply with a lower speed limit.

- Figure 3 reports the distribution of the estimated freeflow speed for SH5 for 2020 and 2023 (post the speed reduction):
  - **Comment**: It would help to clarify the precise geographical location that the MegaMaps data refers to. I am assuming this covers just the section of SH5 over which the speed restriction applies, but this is not clearly stated. I also not that in Figure 3 the max plot appears to be missing for 2023.
  - **Comment**: The data indicates that prior to the speed limit reduction, 75% of observed freeflow speeds were 90 km/h or less, well below the 100 km/h speed limit. Although freeflow speeds have fallen slightly post the speed limit reduction, there now appears to a significant level of disregard for the new, lower speed limit. This partly explains the small reduction in observed average speed. When linking this observation to the later analysis of transport dis-benefits associated with the speed limit reduction, it would pay to include a sensitivity test based on a lower freeflow speed, on the assumption that over time drivers may well become more compliant with the new speed limit (which would be expected to increase the dis-benefits).

3.3 MBCM Updates (Section 1.3)

The clarification of the reliance on the updated MBCM parameters and values is helpful. I concur with the use of the updated values for the assessment and also note that it is helpful that a sensitivity test using previous values is provided for comparison. This can be considered a ‘best practice’ approach.

4 Methodology (Section 2)

The EY review considers the costs and benefits of the safety and economic impacts of the speed reduction on the region. It does so by applying as much as possible a range of reliable data sources to related to crashes and speed and by using methodologies and values derived from accepted guidelines, primarily the Waka Kotahi Monetised Benefits and Costs Manual.

- **Comment**: On this basis, the EY Review can be considered an evidence based assessment, using industry accepted practices. This an important point to make clear to readers.

4.1 Data Collation (Section 2.2)

I concur with EY that the Waka Kotahi CAS and MegaMaps data is largely robust, noting the limitations identified and that overall, this is the most reliable data available the purpose of the EY Review.

4.2 Statistical Analysis (Section 2.3)

The EY Review applies “a statistical methodology in order to isolate the effect that is associated with the speed limit change, rather than conflating any potential impacts that may rise from a change in other variables.”(Review, p11.) I agree that this is a valid approach to use for this review.

- **Comment**: As I noted in my earlier comment, a number of other safety interventions have also been made to the section of SH5 where the speed reduction has been implemented. It might be helpful to clearly differentiate the effect of these interventions on the frequency and severity of crashes, separately from the speed reduction.

EY note that with the speed limit change only being in effect for one year at the time of analysis, this "limits their ability to perform the t-test (and by extension, the z-test), both of which are a traditional methodology for hypothesis testing."

- **Comment**: I note that these tests could potentially be applied at some point in the future. They may also be applied to other parts of the State Highway network where speed reductions have been in place for a sufficiently long time.

- **Comment**: I concur with the probability distribution approach adopted for the study.

Need for more explanation around the estimation of the reduction in crashes:

The data reported in Figure 4 and the following paragraph (para 1 on p12) combined with Table 1 form the core of the evidence around the reduction in crashes arising from the speed limit reduction. But this information requires quite detailed inspection in order to deduce the impact of the speed limit reduction on the number of crashes. For example, Figure 4 identifies the mean number of crashes between 2018 and 2021 as being 59. The next paragraph then states:

> "The analysis suggests that, for a given year in which the speed limit was set at 100km/h for SH5, one would observe an annual crash count of 25 or lower roughly 1% of the time. It is, therefore, highly unlikely that such a crash count would be caused by random chance or variation."

But this section doesn't explain why an annual crash count of 25 might be relevant. Only on reading Table 1 on the following page is this explained, via the mean reduction in crashes of 34 (59 - 34 = 25 crashes). On the other hand, I note that the Executive Summary very clearly states:

> "Analysis found that the speed limit change on SH5 both reduced the frequency of crashes and decreased the severity of injuries that would result from a crash. **Approximately 34 crashes were avoided in the year following introduction of the speed limit change,** based on statistical analysis against a comparable prior year."

In my view Sections 2.3.1 and 2.3.2 would benefit from some re-ordering, with Table 1 integrated into Figure 4, with a clear reference to the reduction in the number of crashes post the speed limit reduction (as per the Executive Summary). But, more importantly, as this finding is at the core of the safety benefits it would also be useful to provide a more detailed description of the data and analysis which leads to the finding that 34 crashes were avoided in the year following introduction of the speed limit change.

Comment: **This is probably the most important point made in my review.**

Comparison of the SH5 speed reduction to similar parts of the State highway network:

Figure 1 illustrates the geographical extent of the speed reduction on SH5 between Taupo and Napier and the extent to which the 100 km/h limit has been retained. This raises two points:

- It would be helpful if EY were to confirm in their Review whether the crash data referred to in Section 2.3 is related only to the section of SH5 over which the speed reduction has been imposed?
- If this is the case, then I note in Section 2.3.1 the references to undertaking robustness checks on other comparable parts of the State Highway network (e.g. sections of SH39, SH3, SH1). However, I cannot see any reference to crash data for 2022-2023 for the sections of SH5 where the speed limit has not been reduced. I would think that a comparison of the crash data between the different sections of SH5 (i.e. the section with reduced speed compared to the section without reduced speed) would be the most relevant test and that those interested in the outcomes of the speed reduction would be looking for this information. If this test has not been undertaken it would be worthwhile considering adding this to the review.
- **Comment: Inclusion of a clear an assessment of the number of crashes on the sections of SH5 between Taupo and Napier not covered by the speed reduction and comparison of the 2022/23 results with the section of SH5 where the speed reduction applies.**

4.3 Econometric Analysis (Section 2.3.2)

Value of Crashes:

- I have checked the values applied to different types of crash events the accompanying spread sheet with the most recent MBCM values as follows:

Table 4.1: Value of Crashes

Event	Value in Spreadsheet	Comment
Death	$12,500,000	As per MBCM Updated
Serious Injury	$660,100	As per MBCM Updated
Minor Injury	$68,000	As per MBCM Updated

- I concur with the methodology used in this Section, but what is missing in my view is a clear summary of the combined assessment of the value of avoided crashes ($31.8m) plus the value of the reduced severity of crashes ($61.9m) leading to the total benefit of $93.7m. The Executive Summary provides such a clear summary of these results, but this is not included in the actual detail of the review.

> "*Approximately 34 crashes were avoided in the year following introduction of the speed limit change, based on statistical analysis against a comparable prior year. We estimate the monetised value of each avoided crash to be $0.9m based on Waka Kotahi appraisal tools, which when applying the number of average avoided crashes will be equivalent to $31m for a full year. In addition, the reduction in the severity of a crash is equivalent to $3.2m (equivalent to approximately one quarter of a fatality). For the observed year, we see a benefit of $62m from reduced crash severity. This results in total safety benefits of $93 million for the year.*"

For readability it would be helpful to provide this (or a version of this) summary at the end of section 2.3.2.

4.4 Cost Benefit Analysis (Section 2.4)

The approach used to estimate the transport related costs and benefits of the speed reduction considers

- Vehicle operating costs (VOC)
- Emissions
- Travel time

The approach is described as being consistent with the methodologies set out in the MBCM and is therefore in line with standard industry practice.

Specific Checks:

- Section 2.4 Corridor length of 76 km. **Confirm whether this is the length of the section covered by the speed reduction**.
- Section 2.4.1: Splitting VKT by vehicle type using the fleet profile in the VEPM. This is an acceptable way of disaggregating overall VKT into vehicle type. I have checked this approach against the Waka Kotahi State Highway Traffic Volume, for the proportion of heavy vehicles. The EY Review assumes that 6.1% of all traffic are heavy commercial vehicles. I note that in 2020 The Te Pohue telemetry site (roughly at the mid-point between Taupo and Napier) observed a heavy vehicle split of 16.5% between 2016 and 2020. The average proportion of heavy vehicles across all telemetry State Highway sites over this period was 9.1% in 2020. So it might be the case that the VEPM data reflects a lower proportion of heavy vehicles. However, I do not believe the effect on the results of the assessment would be very significant if this was the case and an adjustment was made to reflect the telemetry site data.

Table 4.2: Proportion of Vehicle Types

Vehicle Type	EY Assumption	SH Telemetry
Private Car	69.1%	
Light Commercial	24.1%	
Medium Commercial	0.0%	
Heavy Commercial (1)	3.7%	16.5%
Heavy Commercial (2)	2.4%	
Bus	0.7%	

- I note that the growth factor for VKT is assumed to be zero from 2020/21. This is an appropriate assumption and as this is a point in time assessment, rather than a future projection changing this assumption will have little impact on the result.
- Section 2.4.1: From my observation of the accompanying excel spreadsheet, the appropriate VEPM data for emissions (2022 Fleet average emission factors) are applied.

- Section 2.4.2: From my observation of the accompanying excel spreadsheet, the appropriate MBCM values have been applied to monetise the value of the impact on emissions (emissions cost)

- Section 2.4.2: I note the three scenarios tested. **It might be helpful to test a fourth 'worst case' scenario comprising the pre reduced speed limit high freeflow speed (95km/h) and post speed limit low freeflow speed (73 km/h). just to show what effect this would have. I presume it would only be small.**

- Section 2.4.3: The use of the MBCM and VEPM values/inputs/effect sizes is appropriate and done correctly. I note the speed adjustment for HCVs for the pre speed reduction, again this is appropriate. Overall, the effect on the monetised value of emissions, even under the updated MBCM values is marginal. This is as expected.

- Section 2.4.4: As per Section 2.4.2, I would suggest undertaking a **fourth, 'worst case' scenario.** It might be worth noting too that if enforcement is effective at bring freeflow speed down to at or below the new limit, then it would be expected that travel time disbenefits will increase, but then so too would the safety benefits.

4.5 Qualitative Impacts

I have not examined these in detail, as they do not contribute to the monetised results, but this is useful for completeness and I support the logic of including these points.

5 Summary

This Peer Review has considered the conformity of the EY Review with best practice and relevant guidelines. The Peer Review finds that in general the EY Review is consistent with relevant guidelines and methodologies, such as Waka Kotahi's Monetised Benefits and Costs Manual and can therefore be considered to be best practice.

The EY Review would benefit from a number of relatively small changes, including:

- A more detailed explanation around the estimation of the reduction in crashes due to the speed reduction

- The inclusion of a more comprehensive explanation around the estimation of the reduction in crashes due to the speed reduction.

Overall the EY SH5 Rangitaiki to Esk Valley Speed Reduction Review can be considered to be a reliable, evidence based assessment of the effects of the SH5 speed reduction on the number and severity of crashes and on travel time, vehicle operating costs and vehicle emissions.

The main finding of the EY Review, that the benefits of a reduced number and severity of crashes outweighs the economic costs arising from increased travel time can be considered to be correct.

Table 5.1: Summary of Peer Review Comments

	Summary of Comments	Importance
1	**Geographical scope of the EY Review.** EY Review refers "to the specific segment that was affected by the 2022 speed limit reduction as SH5" (the segment of State Highway 5 (SH5) that lies between Rangitaiki and Esk Valley). • Did EY also look at changes in speed and crashes on the remaining sections of SH5 between Taupo and Napier as part of their review? If so, it might be helpful to report the findings? I suspect this question may be raised by other readers of the Review.	**M**
2	**Other Interventions:** EY note that "[I]n addition to performing the speed review, the Agency has provided further investment, which was used to install side barriers, road markings, and maintain the overall roading quality to improve safety outcomes." • Has it been considered and is it possible that these interventions have made some contribution to the reduction in crashes on the section of SH5 where the speed reduction has been implemented? It would be helpful to clarify this point as again, I suspect it may be raised by other readers.	**M**

3	**Driver Behaviour:**
	• Firstly, the box and whisker plots indicate a degree of variability from year to year, particularly for the range of driver speeds. Is this something that needs further explanation/elaboration in the report?
	
	• Secondly, it is noted that the 'the speed limit change did not significantly affect compliance within the group of drivers involved in a crash on SH5'. I would say it appears from the data to have had no effect at best, given that the upper quartile of drivers in 2022 were above the speed limit and this is the same as for 2018 and 2020 and worse than 2019 and 2021. Albeit in 2022, drivers were required to comply with a lower speed limit.
	
	• Figure 3 reports the distribution of the estimated freeflow speed for SH5 for 2020 and 2023 (post the speed reduction):
	  ○ It would help to clarify the precise geographical location that the MegaMaps data refers to. I am assuming this covers just the section of SH5 over which the speed restriction applies, but this is not clearly stated.
	  ○ I also not that in Figure 3 the max plot appears to be missing for 2023.
	
	The data indicates that prior to the speed limit reduction, 75% of observed freeflow speeds were 90 km/h or less, well below the 100 km/h speed limit. Although freeflow speeds have fallen slightly post the speed limit reduction, there now appears to a significant level of disregard for the new, lower speed limit. This partly explains the small reduction in observed average speed. When linking this observation to the later analysis of transport dis-benefits associated with the speed limit reduction, it would pay to include a sensitivity test based on a lower freeflow speed, on the assumption that over time drivers may well become more compliant with the new speed limit (which would be expected to increase the dis-benefits).
		L
		
		M
		
		M
		
		L
		
		M

4	**Methodology:** The EY Review can be considered an evidence based assessment, using industry accepted practices. This an important point to make clear to readers.	
5	**Statistical Analysis**	

	The EY Review applies "a statistical methodology in order to isolate the effect that is associated with the speed limit change, rather than conflating any potential impacts that may rise from a change in other variables."(Review, p11.) I agree that this is a valid approach to use for this review. • As I noted above, a number of other safety interventions have also been made to the section of SH5 where the speed reduction has been implemented. It might be helpful to clearly differentiate the effect of these interventions on the frequency and severity of crashes, separately from the speed reduction. EY note that with the speed limit change only being in effect for one year at the time of analysis, this "limits their ability to perform the t-test (and by extension, the z-test), both of which are a traditional methodology for hypothesis testing." • **Comment**: I note that these tests could potentially be applied at some point in the future. They may also be applied to other parts of the State Highway network where speed reductions have been in place for a sufficiently long time. • **Comment**: I concur with the probability distribution approach adopted for the study.	H M
6	**Need for more explanation around the estimation of the reduction in crashes:** The data reported in Figure 4 and the following paragraph (para 1 on p12) combined with Table 1 form the core of the evidence around the reduction in crashes arising from the speed limit reduction. But this information requires quite detailed inspection in order to deduce the impact of the speed limit reduction on the number of crashes. For example, Figure 4 identifies the mean number of crashes between 2018 and • In my view Sections 2.3.1 and 2.3.2 would benefit from some re-ordering, with Table 1 integrated into Figure 4, with a clear reference to the reduction in the number of crashes post the speed limit reduction (as per the Executive Summary). • But, more importantly, as this finding is at the core of the safety benefits it would also be useful to provide a more detailed description of the data and analysis which leads to the finding that 34 crashes were avoided in the year following introduction of the speed limit change. **This is probably the most important point made in my review.**	H H
7	**Comparison of the SH5 speed reduction to similar parts of the State highway network:** Figure 1 illustrates the geographical extent of the speed reduction on SH5 between Taupo and Napier and the extent to which the 100 km/h limit has been retained. This raises two points: • It would be helpful if EY were to confirm in their Review whether the crash data referred to in Section 2.3 is related only to the section of SH5 over which the speed reduction has been imposed? • If this is the case, then I note in Section 2.3.1 the references to undertaking robustness checks on other comparable parts of the State Highway network (e.g. sections of SH39, SH3, SH1). I would think that a comparison of the crash data between the different sections of SH5 (i.e. the section with reduced speed compared	

	to the section without reduced speed) would be the most relevant test and that those interested in the outcomes of the speed reduction would be looking for this information. • **Inclusion of a clear an assessment of the number of crashes on the sections of SH5 between Taupo and Napier not covered by the speed reduction and comparison of the 2022/23 results with the section of SH5 where the speed reduction applies.**	**H**
8	**Value of Crashes:** I concur with the methodology used in this Section, but what is missing in my view is a clear summary of the combined assessment of the value of avoided crashes ($31.8m) plus the value of the reduced severity of crashes ($61.9m) leading to the total benefit of $93.7m. The Executive Summary provides such a clear summary of these results, but this is not included in the actual detail of the review. "*Approximately 34 crashes were avoided in the year following introduction of the speed limit change, based on statistical analysis against a comparable prior year. We estimate the monetised value of each avoided crash to be $0.9m based on Waka Kotahi appraisal tools, which when applying the number of average avoided crashes will be equivalent to $31m for a full year. In addition, the reduction in the severity of a crash is equivalent to $3.2m (equivalent to approximately one quarter of a fatality). For the observed year, we see a benefit of $62m from reduced crash severity. This results in total safety benefits of $93 million for the year.*" For readability it would be helpful to provide this (or a version of this) summary at the end of section 2.3.2.	**H**
9	**Section 2.4** Corridor length of 76 km. Confirm in the report whether this this the length of the section covered by the speed reduction	**M**
10	**Section 2.4.2:** It might be helpful to test a fourth 'worst case' scenario comprising the pre reduced speed limit high freeflow speed (95km/h) and post speed limit low freeflow speed (73 km/h). just to show what effect this would have. I presume it would only be small.	**M**
11	**Section 2.4.4:** As per Section 2.4.2, I would suggest testing a fourth, 'worst case' scenario.	**M**

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25 August 2023

Kirstan O'Donoghue
Principal Safety Engineer
Waka Kotahi NZ Transport Agency

Dear Kirstan,

Re: Review of Economic Impact Analysis for SH5: Rangitaiki to Esk Valley

AECOM was engaged to review and provide commentary on the technical approach of the Economic Impact Analysis Report and supporting Peer Review for the speed limit reduction from 100 km/h to 80 km/h on State Highway 5 from Rangitaiki to Esk Valley. The report, completed by Ernst & Young (EY), provides an independent evaluation of the economic impact associated with the speed reduction, focusing on safety benefits, travel time costs and vehicle emissions benefits. Table 1 lists several key metrics that were determined from the analysis.

Table 1: Key Findings Reported in EY Economic Impact Report

	Metric	EY Values in Report
1	Avoided Crashes	34 average (high estimate 63, low estimate 5)
2	Average Value of Avoided Crash	$936,319
3	Reduction in Cost due to Reduced Severity	$3.26 million / per crash
4	Combined safety benefit per year	$93 million
5	Weighted average of speed decreases	2.3 km/h

The peer review, completed by Ascari, provided several valuable comments about the analysis, but stated that overall, the report was a reliable, evidence-based assessment of the effects. Following our review by Section 9(2)(a) [redacted] and Section 9(2)(a) [redacted], AECOM has several comments on the validity of the presented approach, which may have significant impacts on the reported findings, summarised as follows.

1. **Lack of consideration of the impact of safety improvements on collision reductions:** The report noted that safety investments were completed on SH5, including side barriers and road marking improvements; however, no consideration was made in the analysis to isolate the effect that this would have on safety benefits, regardless of speed limit changes. The High-Risk Rural Road Guide states that side barriers have a 45% reduction in run-off-road injury crashes and a 40% reduction in total crashes.

   The news website Stuff[1] indicates that $2.5M of safety improvements were to be constructed on the corridor covering the interventions above as well as the installation of Audio Tactile Profiled markings.

   Reference to the improvements was raised in the peer review, and we agree that this is a critical consideration impacting the analysis, possibly resulting in overly inflated safety benefit numbers from the speed limit reduction.

[1] https://www.stuff.co.nz/national/125579424/planning-for-100m-safety-upgrade-on-notorious-napiertaup-road-being-brought-forward

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2. **Oversight of the significant impact that regression-to-the-mean has on pre/post crash data analysis**: Regression-to-the-mean effect is a statistical phenomenon important in crash data analysis. Due to this effect, roads with a high number of crashes in a particular period are likely to have fewer during the following period, even if no measures are taken. In simpler terms, it explains a natural fluctuation in crash data year over year and its impact has been found to distort comparisons between before-after crash data to a significant extent.

   To put this in context for the corridor of study, one crash on SH5 in 2020 resulted in 12 DSIs, making up for nearly 45% of the DSIs that year. The next year, there were only 2 DSIs on the same section of SH5, which is a significant reduction despite no changes being made. It appears that the analysts attempted to account for regression-to-the-mean by looking at the decrease in crashes before/after the speed limit year over year (see Metric 1 in Table 1). It perhaps would have been more suitable to report the lowest change and use that for subsequent analysis to avoid an artificial inflation of benefits.

   In general, the MBCM states that "for the purpose of crash analysis, generally a minimum of the past five years of reported crash history is used. This reduces the error caused by regression to the mean." Given the relatively short period of time since the changes, it is suggested that a minimum of 3 years of crash data is needed to avoid regression to the mean and provide a robust and statistically valid comparison. However, observations of the performance of the safety measures immediately after implementation is still useful and should continue to be monitored.

   Additionally, based on a quick review of CAS data along the corridor, it is not clear how the change of crashes data listed in Metric 1, Table 1 were obtained. A maximum change of 63 crashes appears high. More data supporting the expected reduction in crashes and explanation of why an average of 34 is an appropriate estimate would increase the validity of the approach, as this number is foundational for subsequent analysis.

   As suggested in the Peer Review, AECOM agrees that a comparison of the crash data for the same time periods should have been reported for the section of roadway on SH5 that did not have a speed limit reduction. This would have provided some indication of the natural annual variation in crash data along the same corridor.

3. **Concern with the average value of crash calculation**: It is not clear how the analysts determined the average value of a crash of $936,319. More detail about this calculation and supporting data would be valuable because this value is foundational for subsequent analysis.

4. **Model assumptions for the reduction in severity of crashes due to speed limit changes**: The validity of the econometric model to determine the Marginal Effect of a 1 km/h change in speed limit on injury severity is difficult to assess without more information. Details of the model should be provided. In general, a model Adjusted $r^2 = 0.18$ is very poor and is perhaps not reliable enough to base definitive economic conclusions on.

   In addition, it does not seem appropriate that the 1 km/h benefit forms a linear relationship (i.e., can be multiplied by 20 for comparison of 80 km/h to 100 km/h posted speeds), especially given what research has shown on the exponential nature of injury-severity curves. This model and linear relationship assumption is used to determine the average reduction in cost due to reduced speeds- the $3.26 million metric provided in Table 1. It is recommended that the model assumptions are reviewed as it is used to estimate $62.9 million in annual savings, which may not be an accurate representation.

   The report also states on Page 14 that the "total number of vehicles is the single most important decider in determining the severity crash." This statement should be re-phrased, as AADT is not tied to severity outcomes, whereas speed is tied to severity outcomes.

5. **Concern with the Reliability of Speed Data**: The speed data was used to provide estimates on the change in operating speeds and impact on journey times before and after the posted speed limit change. Figure 2 in the EY report displays the estimated crash speeds from CAS, which is not an accurate representation of speeds and differs from the distributions in Figure 3. Using the presented MegaMaps data, the average speeds were found to decrease by approximately 2km/h, although only 2023 data was available, which has a shorter reporting period (Metric 5 in Table 1).

   Further commentary should be provided on natural fluctuations in the speeds with time. Analysis completed by Waka Kotahi with Tomtom data from 2019 and 2020 showed fluctuations in mean speed prior to the speed limit (~0.5-2 km/h depending on the segment). In general, the speed changes presented in the report could be within the margin of error/natural fluctuations on the road. However, AECOM notes that there are limitations in the available speed data and recognises EY's efforts in presenting ranges in the subsequent economic assessments.

   It would have provided some interesting insight to look at the available data on the section of SH5 that did not have a speed limit reduction to compare to the reduced speed section over the same time periods.

6. **Lack of commentary on or quantification of the influence of confounding variables**: The analysis relied on the available crash and speed data collected over a multi-year period but did not provide commentary or potential quantification of how other confounding variables may have influenced the input data. It was stated that COVID data was removed from the reduction in severity portion of the analysis but was included in the probability distribution for crashes. Other effects that may have influenced the data was construction work to install barriers and complete other safety improvements, possible temporary speed limits, level of enforcement and education efforts.

   Enforcement and education efforts were completed along SH5 in 2022 to provide a more holistic approach to improving safety, this included an increase in police interactions by 417% compared to the previous year, multiple safety billboards and electronic signs[2]. The impact of these confounding factors was not commented on in the analysis.

7. **Underestimation of the % of Heavy Vehicles in the Vehicle Operating Costs and Emissions Section**: The underestimation of the % of heavy commercial vehicles (EY used 6.1% instead of 17.3% from Traffic Monitoring Site Data in the area) was listed in the Peer Review but it also stated that this was unlikely to influence the results of the assessment. AECOM agrees that the HCV% does not influence the travel time impact according to MBCM 1.6. The Composite Values of Travel Time for all periods on rural strategic roads should be confirmed (Table 17 of the EY Report) and assumptions referenced if a 2023 update factor was applied.

   For the emissions calculations, Heavy vehicles produce ~3x more CO_2-e compared to light vehicles, therefore the underrepresentation of heavy vehicles does impact this estimate. This should be reviewed, as it may have a more significant effect on the analysis after the safety benefits are reviewed following the commentary above.

8. **Alignment of the findings with international research**: Research undertaken internationally to review the impacts of speed limit changes on safety have found that broadly a 1% reduction in mean speed typically leads to a 4% reduction in fatal crashes, a 3% reduction in serious injury crashes and a 2% reduction in minor injury crashes. Research undertaken for Waka Kotahi by WSP[3] on speed limit changes at three locations in New Zealand, found the

[2] https://www.stuff.co.nz/national/125592557/no-fatal-accidents-since-launch-of--stay-alive-on-5-campaign-on-napiertaup-road
[3] https://www.nzta.govt.nz/assets/resources/speed-management-guide-road-to-zero-edition/wsp-the-impact-of-change-in-speed-limit-of-three-sites-report.pdf

reductions at these sites aligned with what would have been predicted from international literature.

Noting the discussion above on the accuracy of the reduction in mean speed, a reduction in mean speed from 88km/h to 86km/h would equate to a 2.3% reduction in mean speed. Research suggests this would result in approximately a 9% reduction in fatal crashes, a 7% reduction in serious injury crashes and a 5% reduction in minor injury crashes. The EY report has a mean number of total crashes before the change of 59 crashes per year and 25 after. This provides a 58% reduction in total crashes. Although this includes all crashes and not just injury and fatality crashes, this reduction is well outside what would be expected from a mean speed change of 2km/h, reinforcing the likelihood that the regression to mean effect and other factors outside of the speed change may be impacting crash numbers.

9. **Missing references**: Several sections in the report cite literature or present statistics; however, no references are provided. The report would be strengthened with the inclusion of a reference section.

10. **Response to Peer Review Comments**: AECOM agrees with several of the comments and questions raised in the peer review; however, it does not seem that these were addressed in the final version of the EY report. Several clarifications were requested, reformatting of the data to improve reader comprehension, additional analysis on the SH5 section of road that had no speed limit reduction, and quantification of the impact due to safety interventions are a few of the comments that should have been addressed.

There are several concerns with the Economic Analysis that could have significant impacts on the reported benefits related to the speed limit reduction on SH5 from Rangitaiki to Esk Valley and AECOM recommends a subsequent review of the findings to confirm the validity of the results.

Please feel free to contact us if any further explanation is needed.

Yours Sincerely,
Section 9(2)(a)
[redacted]
AECOM New Zealand