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Travel Behaviour Impacts of Covid-19 & Road Safety Outcomes in New Zealand

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Abstract

With nearly every country in the world battling to cope with outbreaks of the Covid-19 virus, the way of living and travel has changed dramatically in the last six months. The health pandemic has created significant implications on every aspect of our economy and lives. The impact on travel behaviour and mobility is no exception where various levels of lockdowns have forced change that has never been experienced in recent history. Most of the effects have been negative, but some have been positive, not the least being the opportunity to consider the effects on travel behaviour & road safety due to various levels of restrictions.

The research presented in this paper aims to investigate the impact on travel behaviours and road safety during the Covid-19 pandemic in New Zealand (NZ). It explores whether these changes were short-term effects returning to pre-pandemic levels or whether fundamental behaviour change will be more permanent.

1. Introduction

During the year of 2020, the transport industry in New Zealand (NZ) hoped for a positive outcome with the belief the number of crashes, serious injuries, and fatalities would reduce as a result of the reductions in vehicular traffic across the road network. The thinking behind this was that travel restrictions meant reduced exposure leading to fewer opportunities for the occurrence of crashes. Following these early speculations, it was necessary to investigate the actual impacts of Covid-19 on travel behaviours and subsequent road safety outcomes in NZ which formed the basis of this research.

Most of the data analysis that was undertaken as part of this research compared the changes observed in travel behaviour, traffic, speeds, and number and severity of crashes before, during, and after lockdown restrictions. Over the course of a normal year, fluctuations are observed in travel behaviours purely due to seasonal factors; hence in some instances, the data for 2020 was compared to that of the previous year to make sure that seasonal factors were not incorrectly identified as being a change due to Covid-19. Both qualitative and quantitative data were acquired to analyse the impacts of Covid-19; however, there were challenges in obtaining some data such as actual traffic volumes, particularly during the second lockdown period which extended from August to September. As a result, certain inferences were made using non-standard data such as Apple Mobility maps to come to conclusions.

2. Timeline of Events

It is worth noting that NZ as opposed to other nations acted uniquely in response to the threat of Covid-19 during the early stages of identifying Covid-19 cases in the country. Some of these bold and strict measures implemented led to NZ stamping out the pandemic successfully at different stages. As part of this strategy, an alert level system was developed to inform the public of the level of risk and the legal restrictions to be followed under each level (New Zealand Government, 2020b). The different alert levels and their legal restrictions that must befollowed and the key dates each alert level came into effect are shown in Figure 1. Some of these restrictive measures had a significant effect on the travel behaviours of people and the wider transportation network.

ALERT LEVEL 4

- Entire nation goes into self-isolation. Close physical interactions only allowed among people living in the same residential address. Travel is severely limited. Recreational activity is allowed within the area. All gatherings are cancelled. All businesses and education facilities closed except for essential services (e.g., supermarkets, pharmacies,petrol stations etc.)

ALERT LEVEL 3

- Travel within local area is allowed for example going to work or school, shopping or getting exercise. Travel between regions is heavily restricted

ALERT LEVEL 2

- People allowed to travel locally and in between regions but were advised to maintain a 2m distance when outside ofhome in public places

ALERT LEVEL 1

- No travel restrictions within the country. Business as usual

Year 2020

Alert Level 4	25th March- 27th April
Alert Level 3	27th April- 13th May
Alert Level 2	13th May- 8th June

Alert Level 1	8th June- 12th August
Alert Level 3/2	12th August- 23rd September_ Auckland at Level 3, rest of the country at Level 2
Alert Level 2/1	23rd September- 7th October_ Auckland at Level 2, rest of the country at Level 1
Alert Level 1	7th October- 31st December_ All of New Zealand at Level 1

Figure 1: Covid-19 restriction levels and timeline in NZ

3. Assessment Methodology

A methodological framework was developed to investigate the impacts of Covid-19 on travel behaviour and road safety outcomes in NZ as shown in Figure 2. This involved collection of quantitative data (e.g. traffic counts & speeds, road toll data, crash data, Qualtrics survey & Waka Kotahi-New Zealand Transport Agency survey, 2020). Most questions included the surveys were quantitative while a few were qualitative where the respondents were asked to provide their feedback and/or comments

The Qualtrics survey was an own online survey conducted in conjunction with New Zealand Automobile Association (AA). A total of 1376 responses were collected within a period of one month. The survey investigated the travel behaviour changes before, during and after the first lockdown period (Level 4) in NZ i.e., from January to July, 2020.

The highest number of respondents (34%) were from Auckland, the most populated region in NZ. This closely compares with the latest available NZ census carried out in 2018. It indicates Auckland accounted for 1.6 million of the total population of 4.7 million in 2018 (New Zealand Government, 2020a). Of the Auckland respondents, 60% indicated that they lived within suburban areas and 45% of respondents were over 65 years of age. Most participants (71%) had access to public transport within a short distance of 800m from their place of residence and 39% indicated that their household owned and had access to two vehicles. In terms of employment status, the largest percentage of respondents were unemployed during the Alert Level 4 lockdown (40%) while 36% were employed and 'Working From Home' (WFH). Of all respondents, 19% identified themselves as essential workers.

Waka Kotahi also launched their own weekly quantitative surveys starting from 3rd April 2020 to collect data on the impacts of Covid-19 on the transport network. The surveys included a national representative sample of New Zealanders 18+ years old with a weekly sample of n=1259 per week (Waka Kotahi, 2020). The limitations associated with these surveys are the different sample sets used for each wave, hence the responses are not from the same group of participants. On the plus side, more timely and regular responses across NZ may have been recorded as the surveys were sent out on a weekly basis.

The crash data was sourced from the Waka Kotahi administered Crash Analysis System (CAS) database. The CAS system is NZ's primary tool for capturing information on road crashes (Waka Kotahi, 2020a)

The various data were then analysed using both descriptive and statistical data analysis methods.

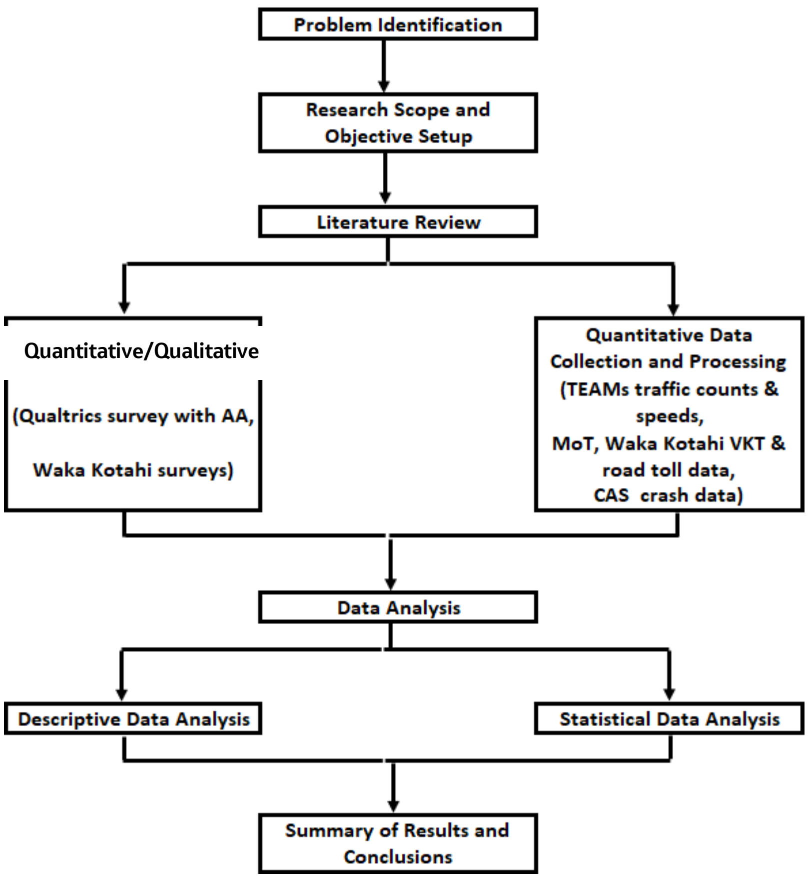


Figure 2: Research Methodological Framework

The statistical data analysis methods included the following:

- Correlation test- Assessing the correlation between two continuous or discrete variables to identify if the relationship between the variables is statistically significant. The most common type of correlation test is the Pearson correlation coefficient, also known as Pearson's r. The correlation tests for most of the survey results were run using the Stats IQ capability embedded in the Qualtrics software (Qualtrics, 2021b)

- Simple linear regression- A regression model which estimates the relationship between a single independent variable and a single dependant variable. The relationship is linear hence represented by a straight line and the data needs to be quantitative (Qualtrics, 2021a)

- Negative binomial regression- An enhanced version of a Poisson distribution which allows for overdispersion within the dataset (Ford, 2016)

- Time series analysis-

  It is a widely used approach when there is a requirement to forecast values based on historical data and the data is recorded in metric format over regular time intervals. Auto-Regressive Integrate Moving Average (ARIMA) is one such method that can be used to perform a time series analysis based on historical data and forecast into the future

  The model built in this research is a Seasonal ARIMA (SARIMA) model and it can be represented as follows

$$(p,d,q)x(P,D,Q):$$

Equation 1

Where, p = order of the AutoRegressive (AR) term;

d = the number of differencing required to make the time series stationary;

q = order of Moving Average (MA) term;

P = order of seasonal AR;

D = order of seasonal differencing; and

Q = order of seasonal MA.

In this research, the SARIMA model is fitted to the data using the Box-Jenkins method which involves three steps (Holmes et al, 2021) as shown in Figure 3

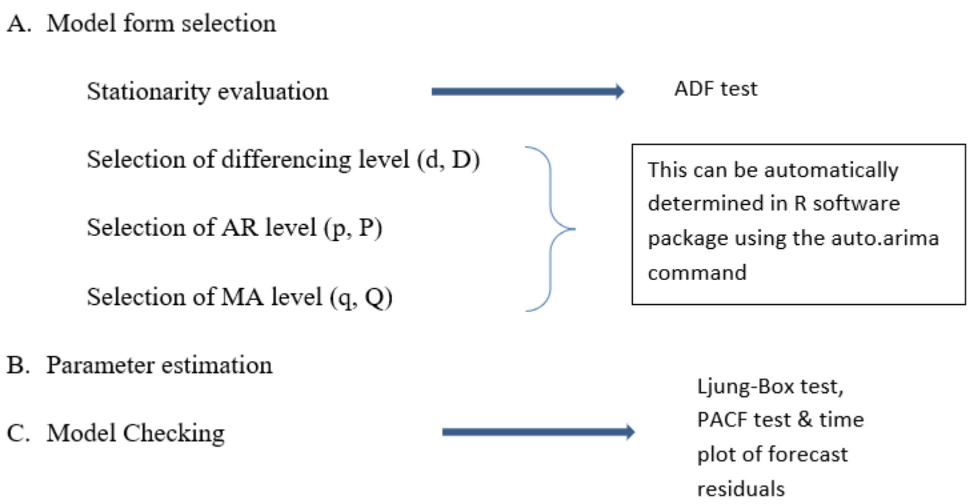


Figure 3 Box Jenkins Method (Homes et al, 2021)

4. Travel Behaviour Impacts of Covid-19

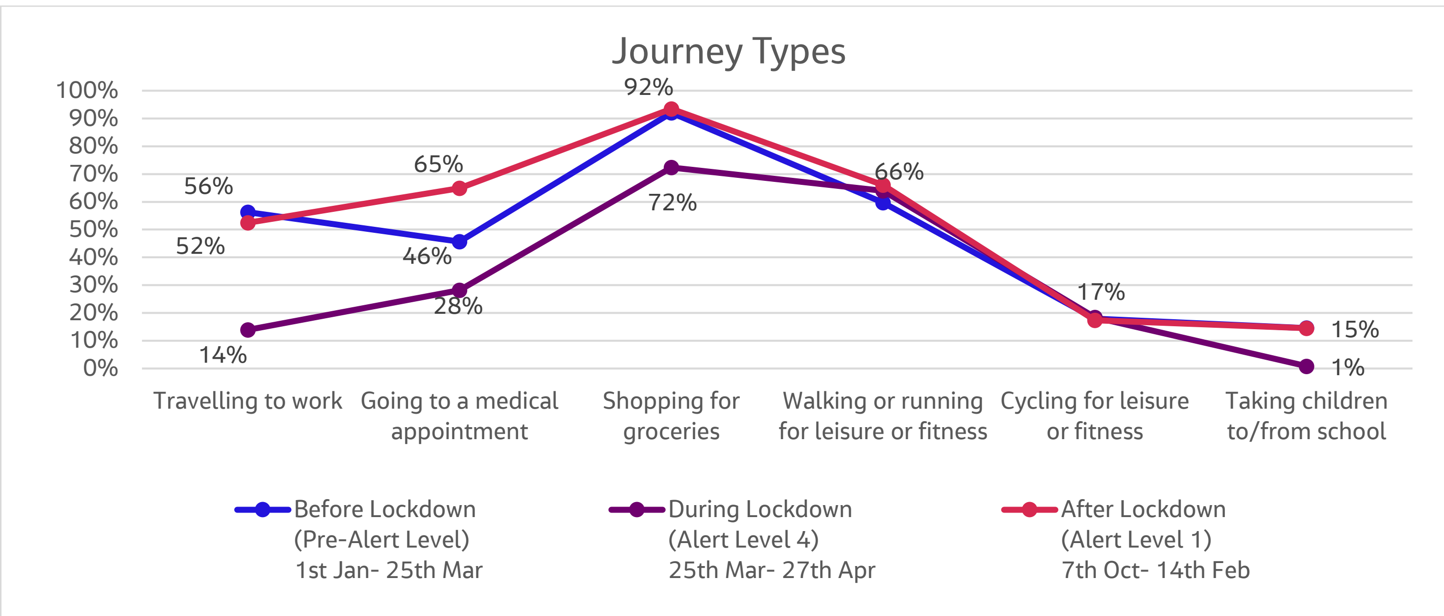


Figure 4 Qualtrics survey results for essential journey types taken during the first wave of the pandemic in NZ.

Note: Travelling to a place of education was included as a journey type in the survey but none of the respondents indicated taking this journey type before, during and after the first lockdown. This may be due to the demographic bias observed in Qualtrics survey. Hence this category is not shown in Figure 4

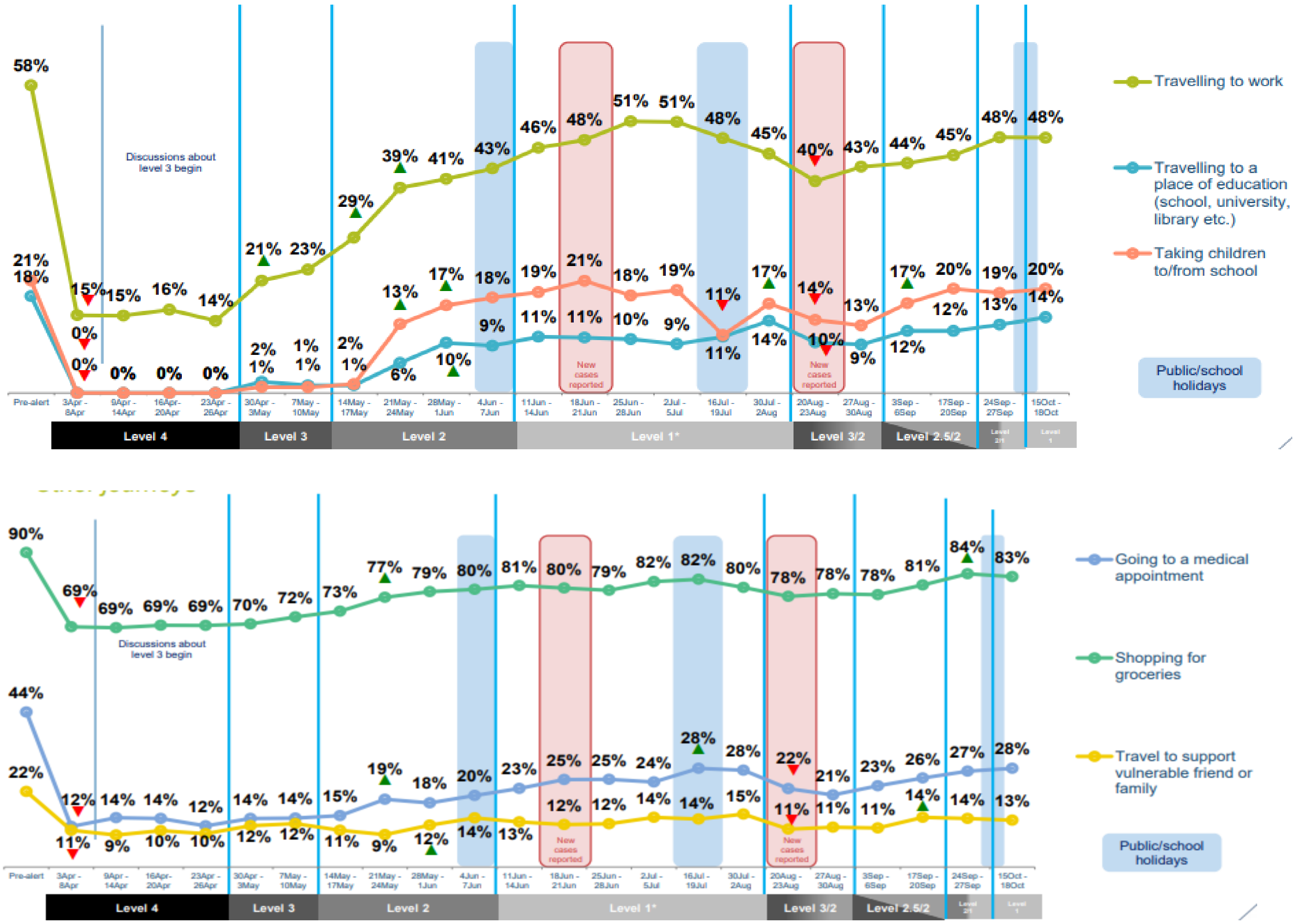


Figure 5 Survey results for essential journey types made during both waves in NZ (Waka Kotahi, 2020)

Based on the data analysis, it was observed that there were significant changes to travel behaviours as would be expected with the enforced restrictions. The changes were measured by analysing the trends in journey types, journey frequencies, and transport mode usage. When the survey results were analysed, it was evident that there were major reductions in the number of essential journeys that were most frequently over the normal course of a week during lockdown periods. Of the essential journeys, ‘travelling to work’ type trips showed the highest levels of reduction of approximately 40% during the first lockdown (level 4) based on the Qualtrics survey (Figure 4). An 18% reduction was seen during the second lockdown (level 3 in Auckland and level 2 in the rest of NZ) based on Waka Kotahi survey (Figure 5). The government’s restrictions were the main drivers of this change in travel behaviour especially during the first lockdown where people were to stay and work from home rather than commuting to work. Apart from the changes in travelling to work, shopping for groceries also dropped by approximately 20% during the first lockdown and 12% during the second lockdown compared to pre-Covid levels. This explains the significant reductions in traffic volumes of over 90% observed during the first lockdown in comparison to the levels observed for the same period in 2019. During the second lockdown, Auckland in particular showed reductions in traffic volumes again due to the Level 3 restrictions (Figure 6).

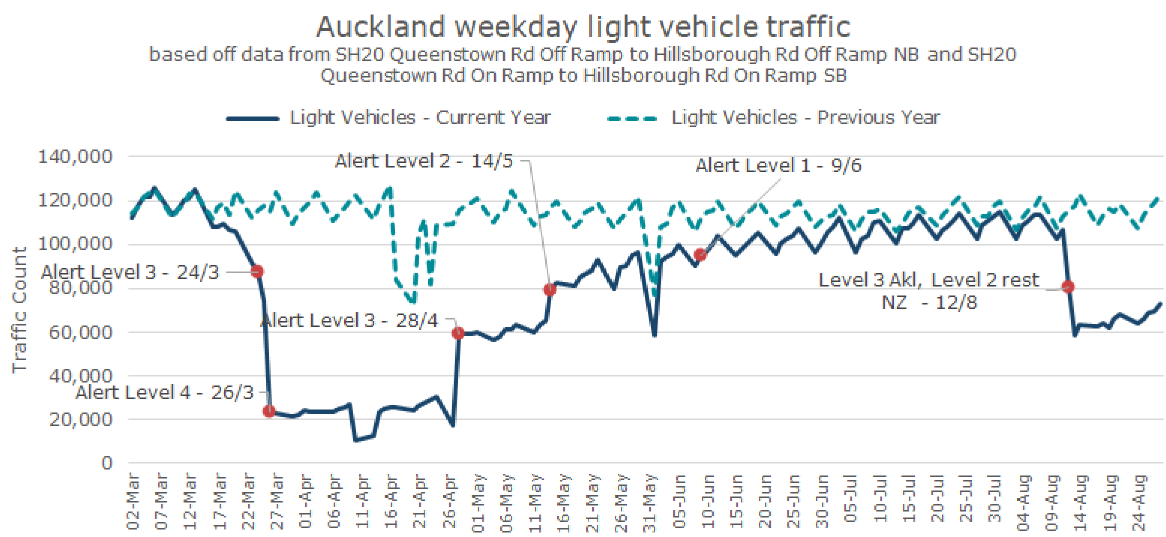


Figure 6 Comparison of Auckland weekday light vehicle traffic counts during both waves in 2020 to that of the previous year (Waka Kotahi, 2020)

Although record low traffic volume reductions were observed during the lockdowns, it seemed as though people returned to their normal lives as soon as the lockdown ended with observed traffic levels building up to match the same levels as in 2019. The traffic volumes in Auckland returned to normal levels as soon as the lockdowns ended which mostly constitutes the percentage of people travelling to work (Figure 6). The cause of this can be explained with regard to the two following elements:

1. People who used to travel to work continued to travel to work after the restrictions were lifted; and
2. Although the number of people travelling to work reduced after the lockdown, it was compensated for by the people who switched from public transport to private motor vehicles for travelling to work causing no change in peak hour traffic volumes.

To investigate the first point, a correlation test was run between the people who travelled to work before and after the first lockdown. This returned a Pearson's r value of 0.803 and a p-value of <0.00001 indicating there is a strong positive correlation between the two scenarios. This indicates that most people who used to travel to work before Covid-19 restrictions generally returned to traveling to work after the restrictions were lifted.

There were high expectations that the percentage travelling to work would decrease after the lockdown due to the prominence given to WFH, but evidence suggests otherwise. Travelling to work has in fact decreased by approximately 10% and WFH percentages have increased by the same amount towards the end of the year.

Regarding driver behavioural change, a 10% change is noteworthy and does have a major effect on infrastructure capacity and Level of Service (LOS). It was not possible to quantify how much of this 10% change in travelling to work was enforced by loss of employment (economic retraction). If the traffic volume decreased by the same amount as travelling to work, then it should be noted a 10% reduction in traffic growth can offset the needs for building new infrastructure for years. However, this change was not observed in the traffic volumes which raises the second point, indicating that modal substitution may have occurred following the lockdown from public transport to private motor vehicles.

Hence the mode usage was analysed, and the Qualtrics survey results (Figure 7) indicated the public transport usage after the first lockdown for travelling to work was 2% lower than the pre-lockdown levels. Private motor vehicle usage was up by 2% after the first lockdown. It is not possible to conclude modal substitution just by these results due to the demographic bias in the dataset obtained from a Qualtrics survey of AA members (car owners). Therefore, the Waka Kotahi survey results (Figure 8) based on a more unbiased travel behaviour dataset were analysed to identify any indications of modal substitution across all journeys. During the first lockdown, approximately a 30% reduction in public transport was seen but after the first lockdown, the level only rose by around 18%. Private motor vehicle usage was also 3% lower than pre-lockdown levels after the first lockdown. This is explained by the traffic volumes because it was still 20% lower after the first lockdown compared to the previous year. People may have continued to work from home or do shopping online even after the first lockdown. But what matters is the longer-term trend that was observed towards the end of the year. The traffic volumes were back up to previously observed congestion levels seen during 2019 towards the end of the year. The mode usage indicates that public transport levels were 3% lower than pre-Covid levels, but the private motor vehicle usage was back up to 94% which is the same as pre-Covid levels.

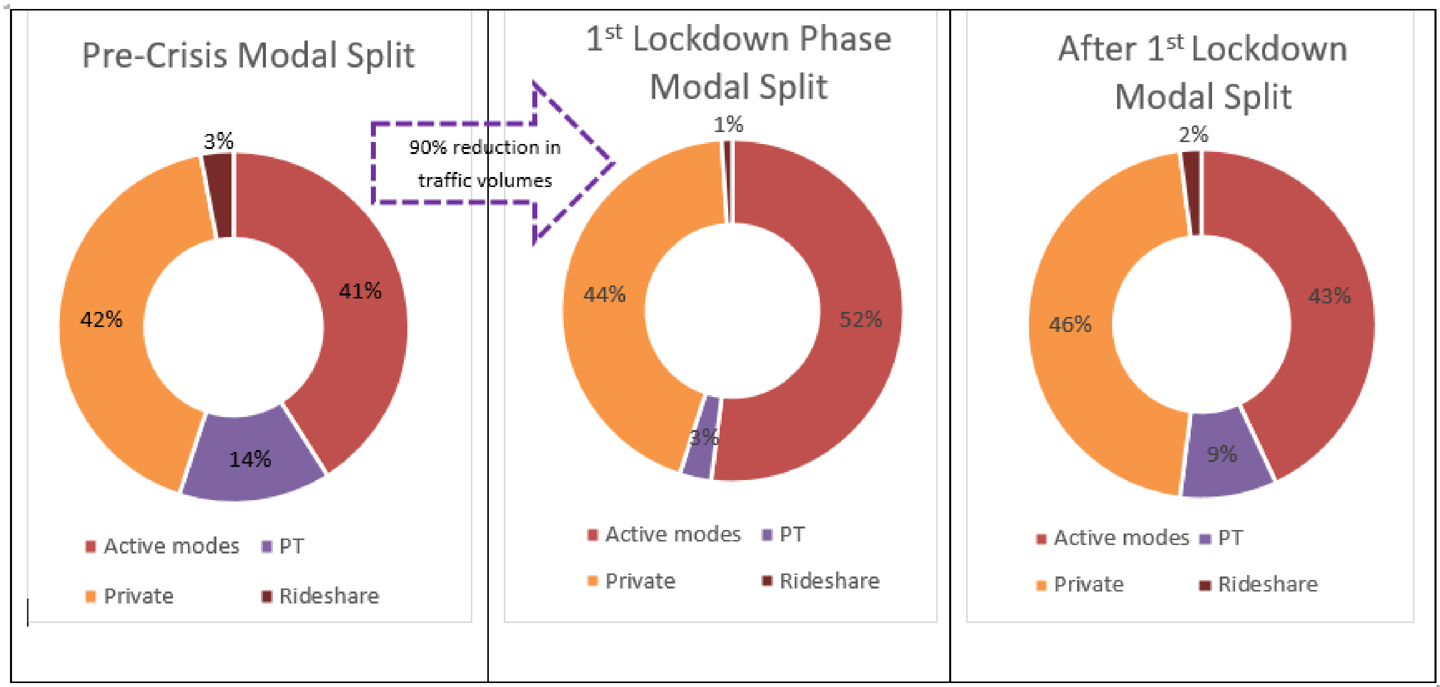


Figure 7 Qualtrics survey results for the respondents who indicated any days of travel in a week before, during and after the first level 4 lockdown

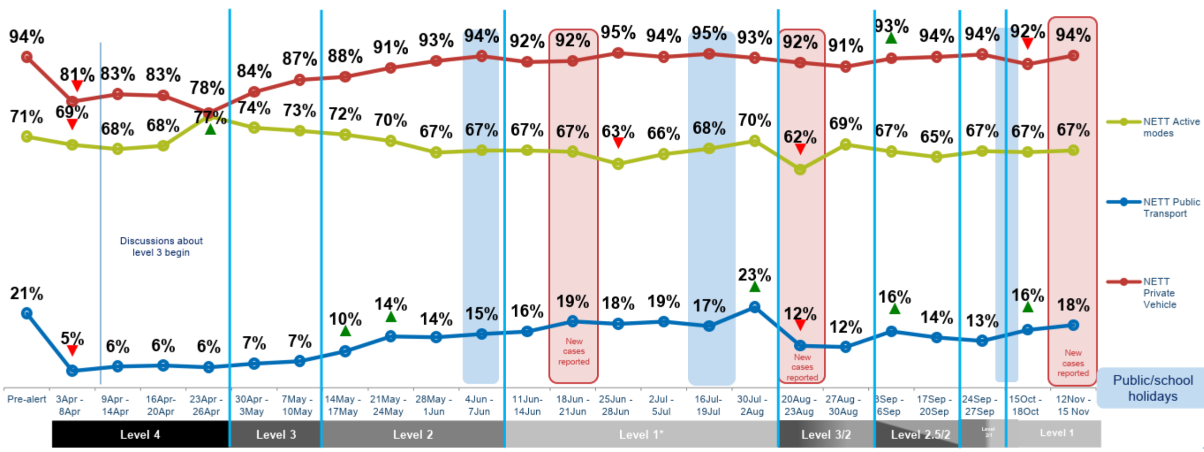
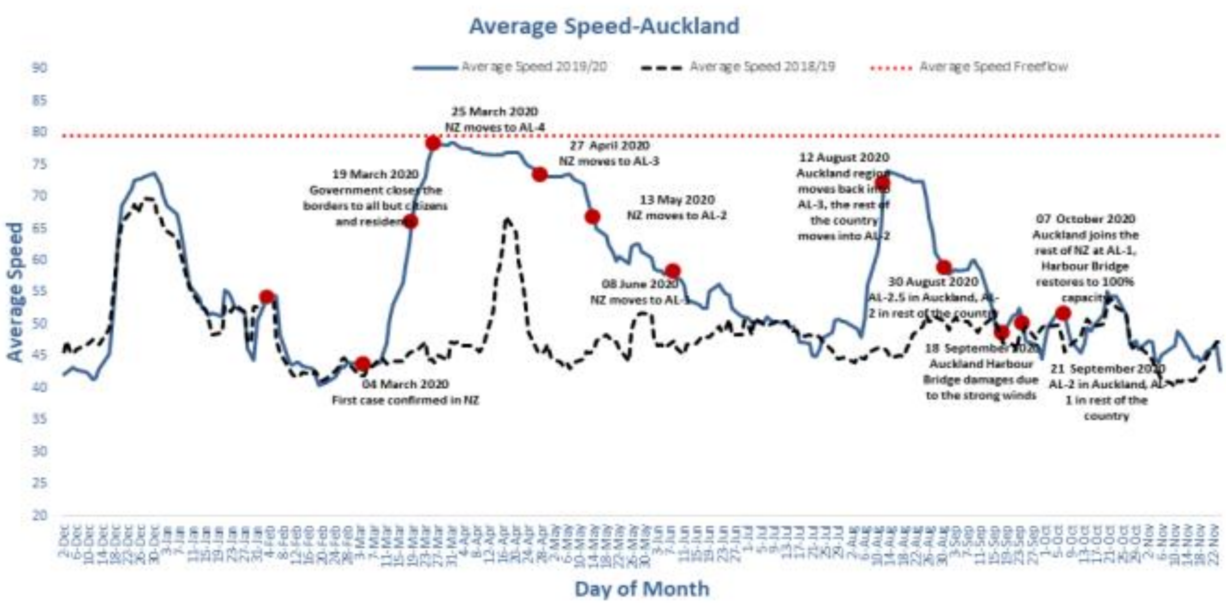


Figure 8 Survey results for mode usage across all journeys during both waves- national (Waka Kotahi, 2020)

In conclusion, given the percentage increase in working from home and reductions in travelling to work and other journey types, the unwavering traffic volumes can only be explained by the increased use of private motor vehicles and the reduced demand for public transport. This of course is the opposite of the desired outcome hoped for travel behaviour change. Most travel demand management measures encourage mode shift for people to use public transport and active modes instead of private motor vehicles as this is one of the most effective ways of battling congestion. NZ in particular is a country with higher congestion levels in urban and semi-urban areas despite the lower population due to reliance on the private motor vehicle to access economic, social, cultural and recreational opportunities So, this indeed is a negative outcome on the road network.

5. Road Safety Impacts of Covid-19

Average speeds recorded during lockdowns have been higher than that of 2019. Especially in Auckland, the most populated region in NZ, the speeds were around 60-70% higher on specific links than the averages observed in 2019 during March and April when the country was in a complete level 4 lockdown (Figure 9). The observed average speeds almost reached the average free-flow speeds during lockdown, a target that otherwise would have been impossible to achieve on Auckland roads due to a congested network. However, this does not come as a surprise as when there is free flow traffic, usually higher speeds are observed. Although this speeding increase is not justifiable, roads being ghosted during the lockdown with no traffic at all was certainly an incentive. Similarly, during the second lockdown, average speeds were higher than that of the previous year. Overall, towards the end of year, it is noticeable that the average speeds were slightly higher in comparison to 2019 in most regions going against national road safety campaigns to reduce overall mean speeds on certain road types and outlier top end speeds (e.g. 85% percentile speeds).



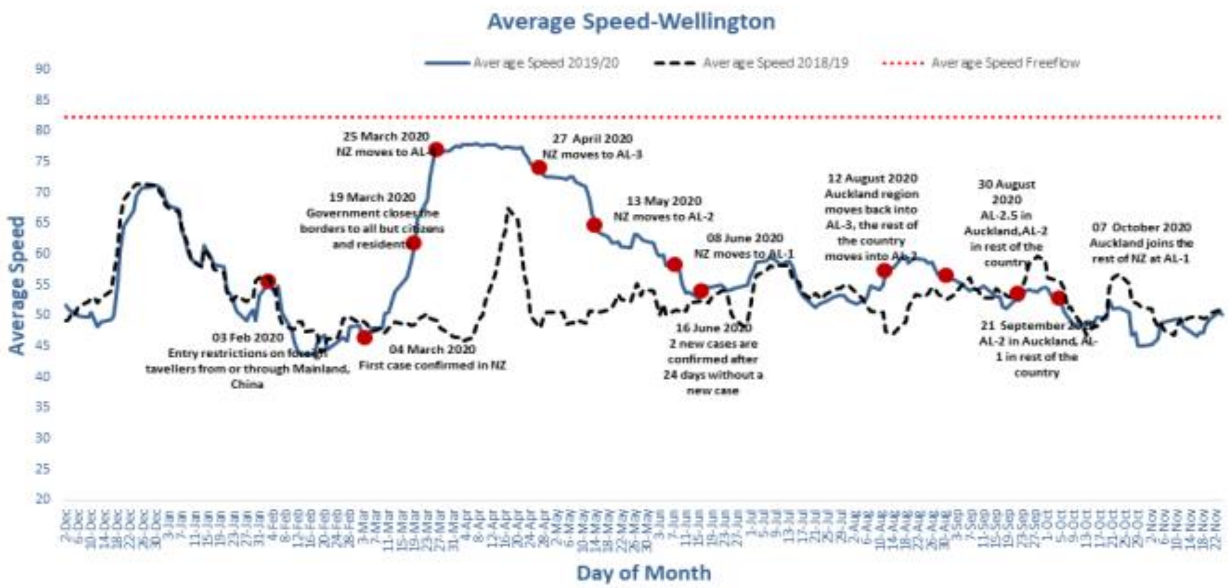


Figure 9 Comparison of average speeds recorded between the year 2020 and 2019 for different regions in NZ (adapted from Waka Kotahi, 2020)

Based on these traffic volumes and speeds, next the crash numbers, severities and types were evaluated. As expected towards the end of March when the first lockdown was imposed, crash numbers plummeted by approximately 80% in comparison to 2019 (Figure 10). In 2019 around March/April, the daily crash numbers varied between 100-120 across the country. The crash numbers for the same period dropped notably in 2020 to a range of 15-30 crashes per day. The rate again dropped to approximately 20-30 crashes per day towards the latter half of July. This was around the time new Covid-19 cases started emerging forming a second wave and NZ decided to move to level 3/2 on 12th of August. There has been a 13% decline in overall injury crash numbers in 2020 compared to 2019. This indeed is a great positive outcome on crash numbers. However, reduced crash numbers are desirable, the real value in road safety is achieved in the reduction of serious and fatal crashes. This is the very core of all the road safety strategies developed since 2010 which is to make sure that in the event if a crash is to occur, it should not result in death or serious injury. So, it was paramount to assess the impacts Covid-19 had on crash severity.

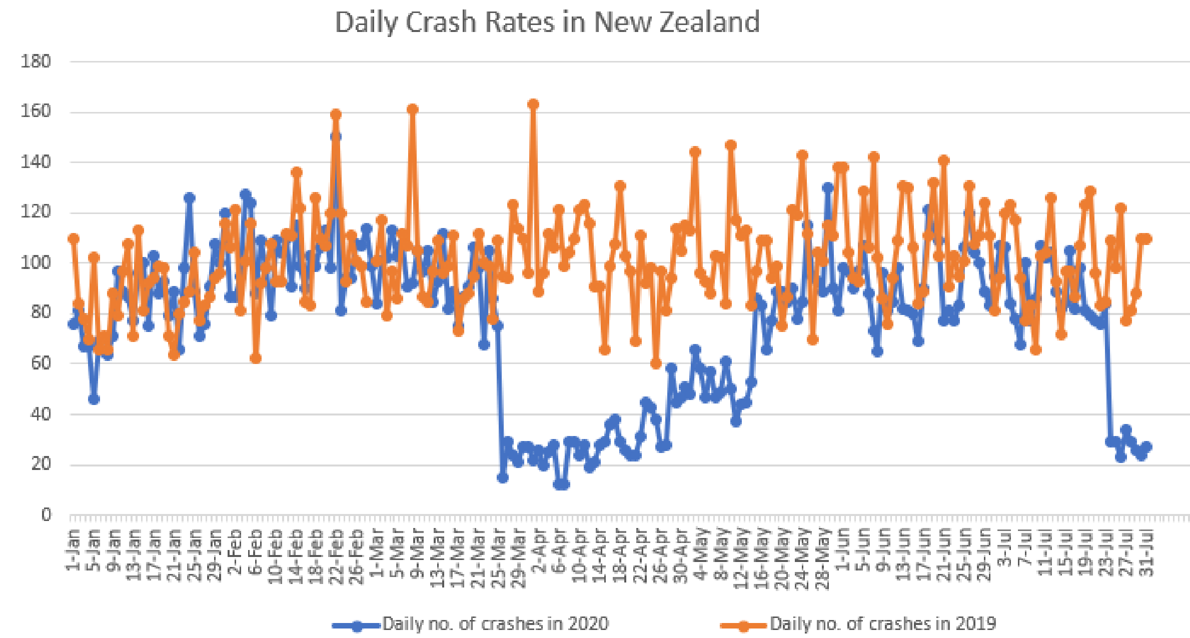


Figure 10 Daily crash numbers in NZ during years of 2019 & 2020 (CAS, 2020)

As seen in overall crash numbers, crashes of all severity levels were lower than that of 2019 during the lockdown periods. When focused on serious injury and fatal crashes during the first lockdown, it was revealed they only declined by around 65% although the traffic volumes declined by 87% compared to 2019 (Figures 11 & 12). During the second lockdown, the observation was even worse where a rise of 15% was seen in fatal crashes despite the decline of traffic volumes by around 45%. After both lockdowns were lifted (level 1) all crash severity types except fatal crashes matched the numbers seen during 2019. Fatal crashes were higher than that of the previous year after both lockdowns with numbers in October (the month following level 3 lockdown in Auckland) being 35% higher than what was observed in 2019.

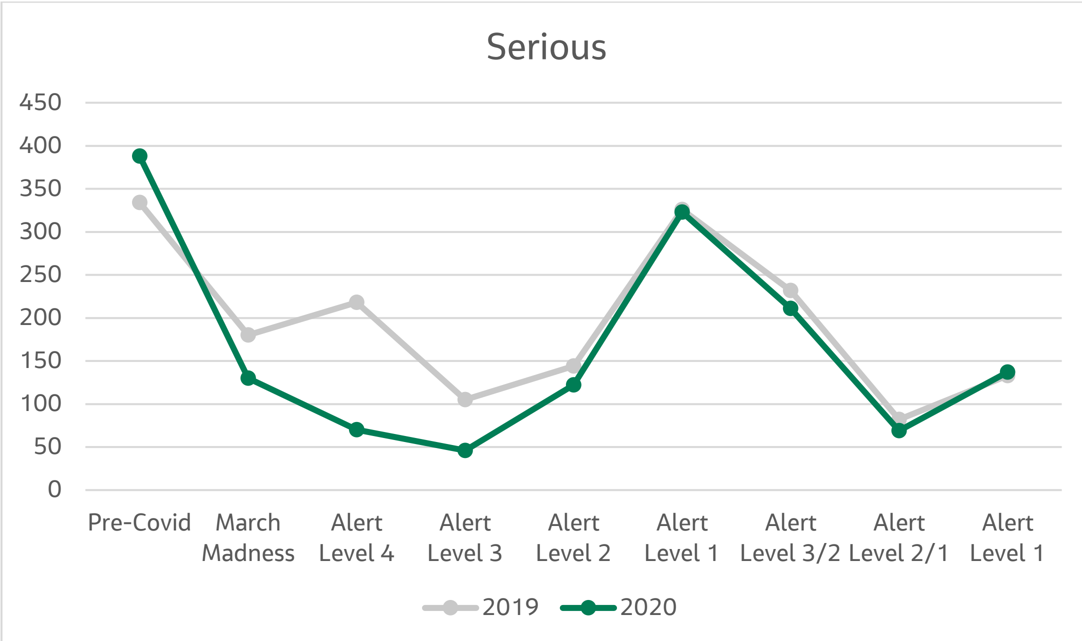


Figure 11 Comparison of serious injury crash numbers between 2019 and 2020 across NZ

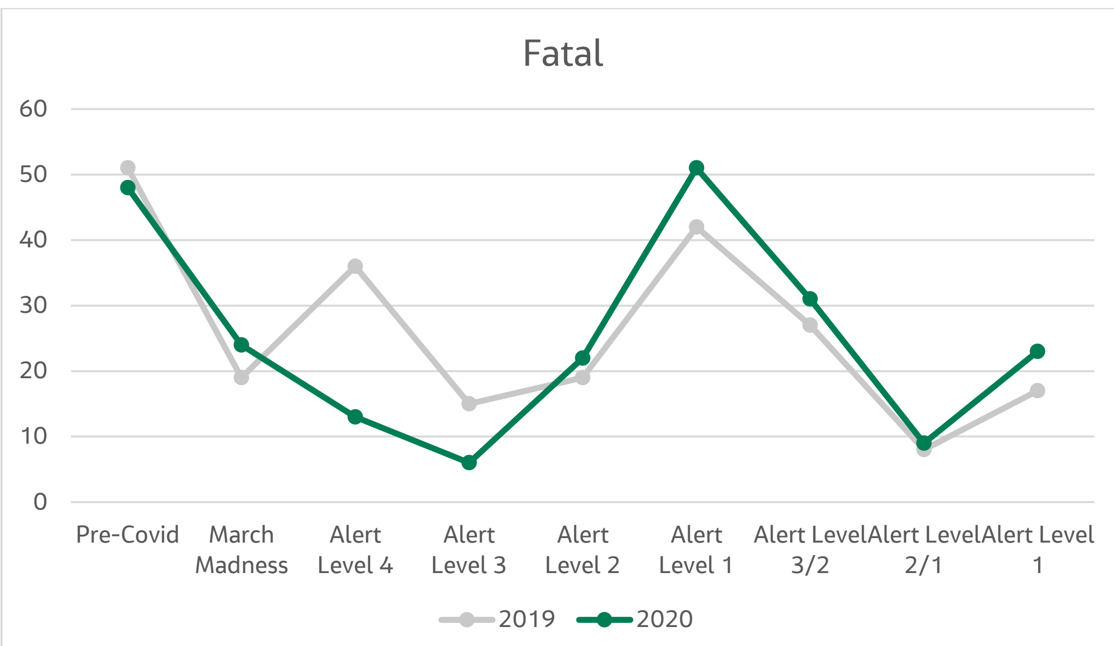


Figure 12 Comparison of fatal crash numbers between 2019 and 2020 across NZ

This concludes the decline in serious injury and fatal crashes were substantially lower than that seen in the traffic volumes and that immediately after the lockdown periods driver behaviour seemed to worsen resulting in higher crash numbers. However, it should be remembered the number of fatalities is quite small even though the percentage differences may seem notably high. Nevertheless, the rise in fatal crashes may have been a result of the increase in average speeds during lockdown and potentially a pent-up demand for travelling after the lockdown period. Hence why congestion is often considered a conundrum. Although congestion is likely to cause more crashes and impose travel time delays on journeys, the one positivity of it is the reduced speeds. Though more crashes occur during congested periods, due to the reduced speeds, the severity is low. As a function of reduced traffic volumes and traffic density, higher mean speeds and 85th percentile speeds are observed creating free flow conditions leading to a LOS A/B

Obviously, these trends observed in fatal crashes are clearly a negative outcome on the overall road safety aspect. One fatal crash may involve a single fatality or multiple fatalities. Therefore, the actual road fatality casualties are higher than that of the number of fatal vehicle crashes. In 2019 the number of fatal crashes were 300 but the fatality casualties were 352. Similarly, in 2020, the number of fatal crashes were 278 but the fatality casualties were 310. The number of fatal crashes for the year of 2020 was only 7% lower than 2019 despite the reductions seen in exposure of around 11%. Due to these negative trends observed it was decided to undertake a more detailed statistical analysis on the monthly road fatalities recorded in NZ for the past 10-year period 2010-2019. The past 10-year period was selected because it provides sufficient data to carry out the analysis and includes the most recent trends observed in the data. Therefore, a time series analysis was carried out to forecast monthly road fatalities for 2020 based only on the historic patterns seen in road fatalities for the past 10-year period. The type of time series analysis method used was an Autoregressive Integrated Moving Average (ARIMA) model as discussed under Section 3. The forecasted values were then compared with the actual fatalities recorded in 2020 to identify the scale of the impact of Covid-19 on road fatalities. With the use of a Box and Jenkins method (1976) stated under Section 3, first the model form was identified, next the model parameters were estimated and finally the predictions were undertaken and model accuracy was checked.

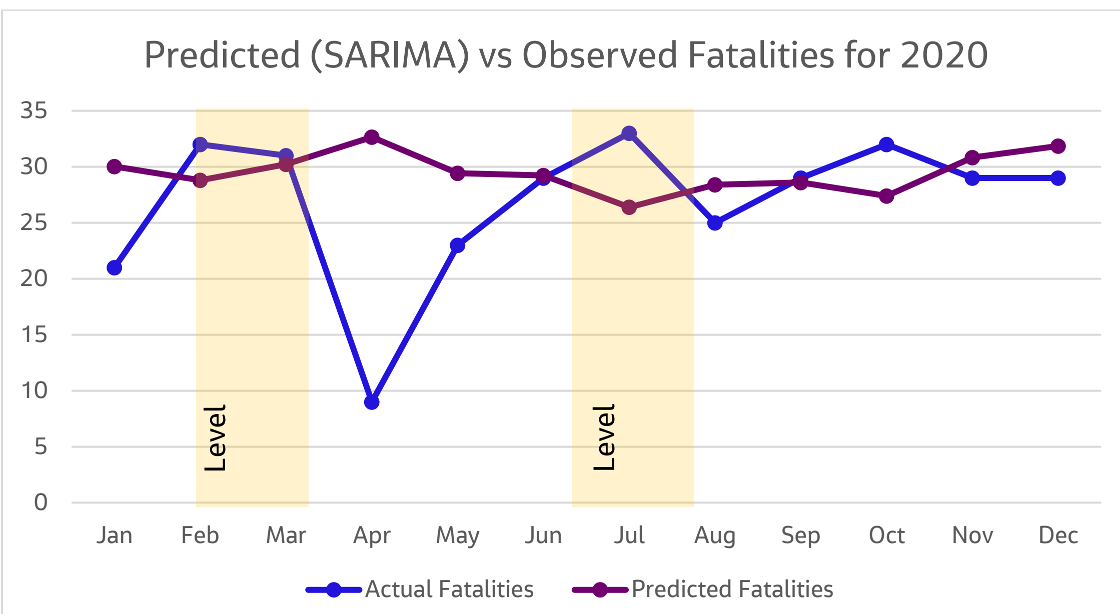


Figure 13 Predicted (SARIMA) vs the observed road fatalities for 2020

Following the process outlined under Section 3, the SARIMA model developed was as below

$$(0,1,1)(1,0,0)[12]$$

Where [12] represents the lag indicating the seasonality occurs yearly **Equation 1**

The predicted values for 2020 based on the past 10 years were then plotted against the actual values obtained from Ministry of Transport (2020) are illustrated in Figure 13. Since March when the first restriction levels came into effect, the observed fatalities have significantly varied from the predicted fatalities till the end of the year. During level 4 (April) and level 3/2 restrictions (August), the fatality numbers significantly reduced in comparison to the predicted values. However, in months immediately post Covid-19 lockdowns the observed fatalities are higher than predicted which is a negative outcome from a road safety perspective meaning driver behaviour has seems worsened. This may have been due to the increased traffic volumes witnessed immediately after Covid-19 lockdowns when people were able to resume travel. Although the overall rise in fatalities observed in 2020 in comparison to historical data may be due to several different factors, the major phenomenon that occurred in 2020 as opposed to the past 10 years is the Covid-19 pandemic. Hence it is fairly conclusive that Covid-19 had a major impact on the negative trend observed in road fatalities during 2020.

The causes of this negative trend could be many ranging from microscopic to macroscopic factors. Within the constraints of the data that could be collected, it was possible to run an assessment of the effect of four macroindicators on road fatalities in order to develop a fatality prediction model based on historic data. The four indicators were population, Vehicle Km Travelled (VKT), no. of registered vehicles and Gross Domestic Product (GDP). The last 10-year period were assessed in terms of these factors. Often crash data has a variance greater than the mean (overdispersion) and it is not recommended to assume a Poisson distribution (Turner, 2000). Hence the negative binomial regression technique is used to model the effects of the macroindicators. The four macroindicators were used as the independent variables (X) and the annual number of road fatalities as the dependant variable (Y) as listed below

- Y- Annual number of road fatalities
- X1- NZ population
- X2- No. of registered vehicles
- X3- Vehicle km travelled
- X4- GDP

The negative binomial regression was performed stepwise in a backward elimination manner as the no. of candidate variables were less than the sample size. The stepwise regression resulted in choosing a model with the variable X3 which had the strongest statistical relationship with the Y variable. Based on the model results, it can be interpreted, for one unit increase in VKT, the expected log count of annual road fatalities increases by 0.207. The variable VKT also had a P-value 1.15e-15 much less than 0.05 indicating a strong statistically significant relationship with the number of annual road fatalities. Then following a series of negative binomial regression analyses, models were produced targeting on the relationship between VKT and road fatalities, no. of fatal crashes and no. of DSI crashes. The relationship with VKT was proven to be positive for all three models.

$$\text{Log (Annual road fatalities)} = 4.7274 + 0.0243\ (\text{VKT})$$

Equation 2

$$\text{Log (Annual no. of fatal crashes)} = 4.7934 + 0.0202\ (\text{VKT})$$

Equation 3

$$\text{Log (Annual no. of DSI crashes)} = 6.4588 + 0.0287\ (\text{VKT})$$

Equation 4

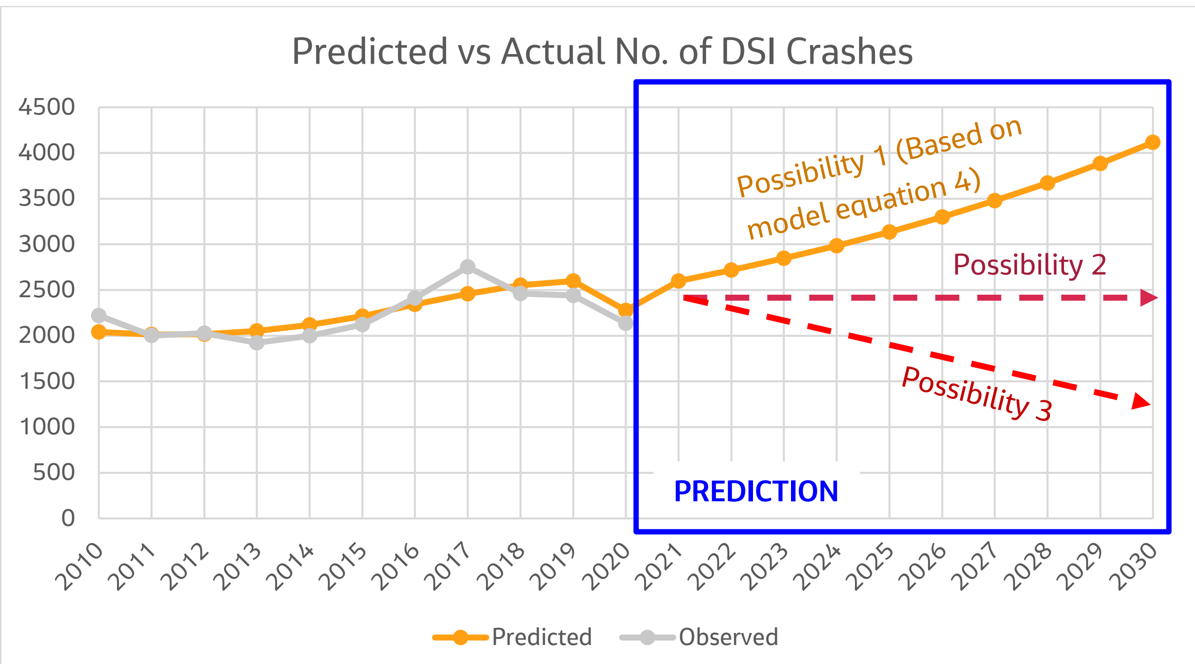


Figure 14 Predicted vs Actual No. of DSI Crashes

The predicted vs actual DSI rates observed based on the above model are depicted in Figure 14. Again, a similar effect is seen on DSI crashes whereas, after 2017, crashes have started to decline although the VKT continued to increase until 2020. And as seen in all the above scenarios, once travel returns to normal with no fear of Covid-19, the VKT will again rise affecting both fatal and serious injury crash numbers (unless new intervention measures are introduced). Assuming in 2021 the VKT return to the same levels seen in 2019, three major possible trends can be expected within the next 10-year period as demonstrated in Figure 14.

- Possibility 1 is purely predicted using the model Equation 5.4 and relies on VKT alone. Based on the patterns seen during the past 10 years for VKT, it is assumed VKT will continue to rise at an average of 3.2% per year (a high growth rate is used for the purposes of comparison only). And if this is the case and no improvements to road safety are carried out within the next decade, by the end of 2030 DSI rates are predicted to be double the rates seen in 2021.

- The trend seen in Possibility 2 where the DSI rates remain fairly stable for the next decade without a rise in numbers may be achieved by continuing the current measures and strategies in place to promote road safety such as making improvements to road infrastructure, policies, and vehicles at the current pace

- Possibility 3 is where a 40% reduction in DSI rates is achieved at the end of 2030 as per the targets set in Road to Zero 2020-2030 (Ministry of transport, 2020b). And this target may only be achieved if significantly different proactive measures are taken as opposed to the current measures and strategies in place. A good example is the collective approach taken by Sweden which led to halving the road fatalities within a decade (Government Offices of Sweden, 2015):

6. Key Conclusions & Recommendation

Key conclusions include:

- Although Covid-19 significantly impacted the travel behaviour patterns during the lockdown periods in NZ, it was only temporary. People returned to normal travel behaviours as soon as the lockdown ended. This suggests the travel preferences of people only changed during Covid-19 due to the perception of risk and enforced travel restrictions. Once these two risk elements were mitigated or eliminated, people returned to normal travel behaviour. Even though, increased telecommuters are a positive effect on the congested road networks in NZ, this was only a short-term effect of Covid-19.

- Traffic volumes were low and artificially restricted during Covid-19 lockdowns in NZ and resulted in a decline in the annual VKT observed in 2020. Furthermore, a new speeding trend is observed in several regions following the lockdowns negatively affecting road safety outcomes. It is a possibility this was a result of higher speeding habits adopted during lockdowns due to hardly any traffic on roads

- Due to the reduced risk of exposure, the overall crash numbers of all severity levels declined in 2020 especially during the lockdown period as opposed to the rates observed in 2019. This indeed was a positive impact of Covid-19. However, it appears the decline in fatal and serious injury crashes especially during the lockdown periods is substantially smaller than the declines seen in traffic volumes. Possible contributing factors include increased speeds observed during lockdown, reduced alertness when driving due to low traffic volumes and lack of road infrastructure to protect road users from fatal or serious injury.

- Further statistical analysis proved VKT is still one of the major influencers of crash numbers in NZ and Covid-19 is a good example where immediate positive results can be achieved in road safety with the reduction of travel exposure. Conversely on a long-term basis, it was found these positive effects will not be retained when VKT begins to ascend after Covid-19 is no longer a threat. As set out in Road to Zero strategy for 2020-2030 the target is to achieve a 40% reduction in death and serious injuries by 2030. Based on statistical modelling undertaken, it can be concluded if this target is to be achieved, a significantly different approach needs to be taken as opposed to the current practices in place. Otherwise, the possibilities are road fatalities may tend to follow increasing VKT as has occurred in the last decade. If we continue to make minor staged improvements to transport safety, then DSI numbers may float around the same levels with no real increase for the next 10 years, however we will not be able to achieve the significant crash reductions targeted by the Road to Zero Strategy.

Key recommendation include:

- Continue research to determine how the travel behaviours and road safety outcomes are affected within the next couple of years to get a wider perspective of the long-term travel behavioural changes and associated effects on road safety.

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