Traffic Network Resilience

Introduction

Transportation authorities (e.g. New Zealand Transport Agency) have a particular interest in understanding a transport networks performance so as to better inform future investment decisions. The performance is affected by many aspects, from the time of day, to commuters varied mode of transport, and direction of travel. Travel time through the network is of interest to transportation authorities, as well as the public, especially during peak loading times as they want to have a resilient network. Based on feedback from NZTA and Ministry of Transport their current analysis tools and processes are lacking to provide effective insight about transport network performance.

To address these challenges we developed a web application that displays transport network data, for cities and state highways, using different visualization techniques such as geospatial mapping, isochrones, and heat map timelines. The urban isochrones are outlines of areas of equal travel on a map, and are like contours for mountains on a topographical map (Figures 1-3). The isochrones show areas of similar travel time to the "centre" of the city, for Auckland, Wellington and Christchurch. The rural holiday peak visualisation (Figures 4-5) displays travel trends from the Christmas & New Year Holiday 2018/19 for 30 roads across the country on a heat map annotated scrolling timeline.

Design & Visualisations

The source data for the visualisations was obtained from the Google Maps Distance API. The API was used for rural road travel times for various roads on the State Highway Network over the holiday period. Travel times were derived for cars, buses and trains. For cars, the API derived travel times from real-time data, not factoring in parking time. For public transport, the API assumes a time to walk to a public transport stop, added to the scheduled services travel time.

The isochrone visualisations (Figures 1-3) supports animation through the day to show how travel trends change across the city depending on the time of day. When animating, the isochrones are at 15 minutes intervals, creating a unique visualisation for the change in road use. The visualisation can also be used for other comparisons, such as between transport types. The holiday visualisations (Figures 4-5) show the time it takes to travel along state highway routes (`corridors') around holiday periods, and illustrates the significance of additional holiday travel delays. The delay is visualised as an increase in travel time. The scrolling time line provides a visualisation for the change in delay through time for comparison between roads.
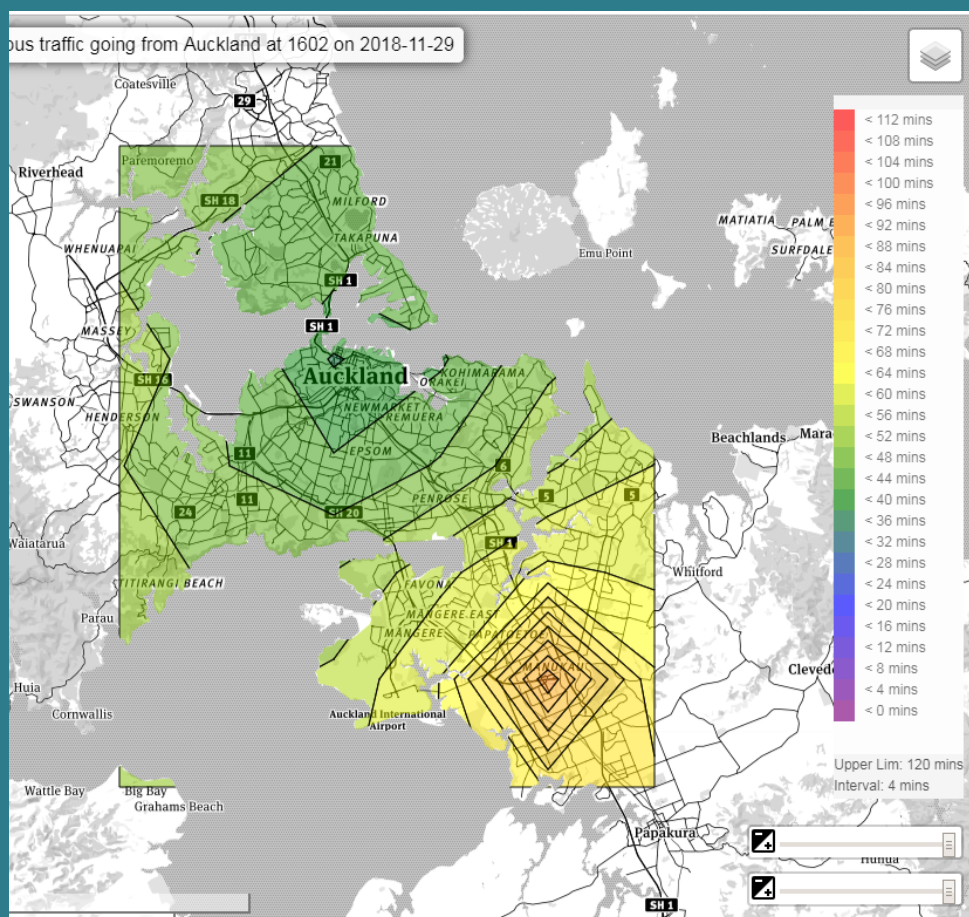

Figure 1. (Isochrone Bus): Travel times from Auckland CBD by **bus** on the urban isochrone tool. The visualisations use red for slower speeds, purple for faster (scale on right). Each line is another step in time from the CBD. We can see that the travel time increases significantly more headed south towards Manurewa than other areas of the city.
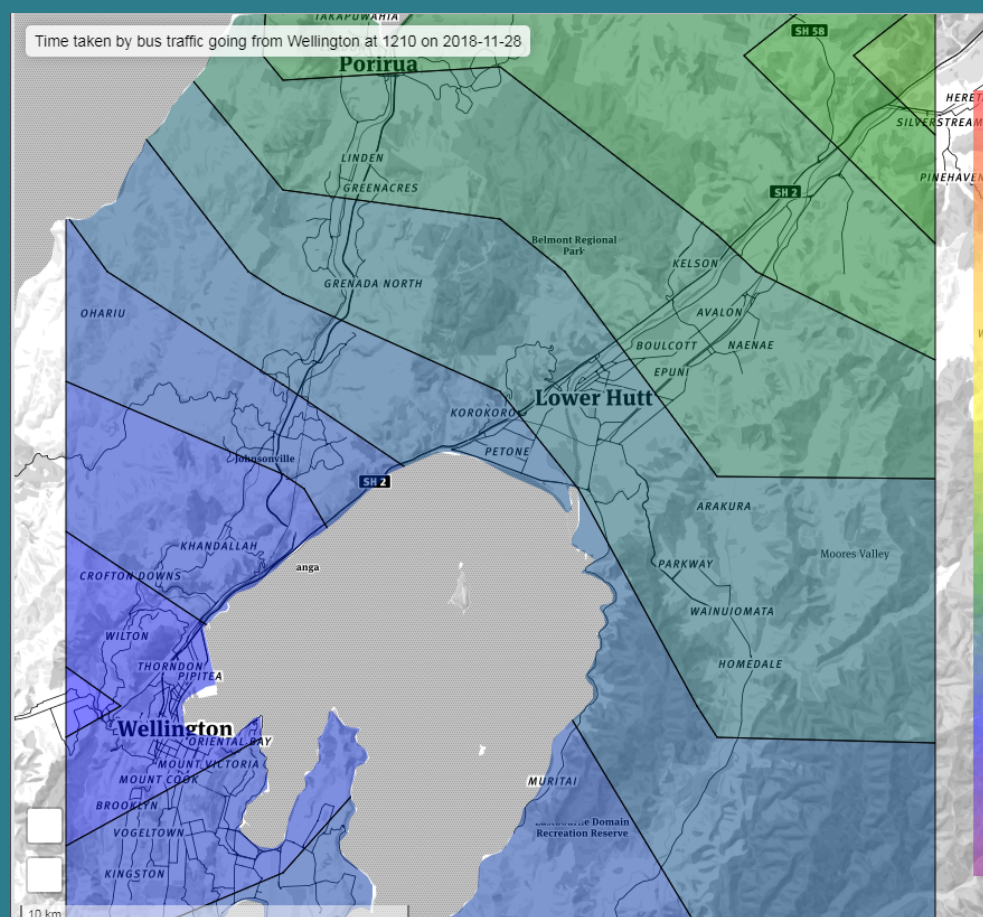

Figure 2. (Isochrone Bus): This isochrone shows the travel time to outside Wellington from the CBD on a weekday at noon by **bus**. The centre of the city can be seen in blue/purple. It uses 3min steps. The faster the colours change, the faster the travel time increases. This visualisation can show us where the network comes under stress by the shapes of the isos, such as when heading in to Upper Hutt.
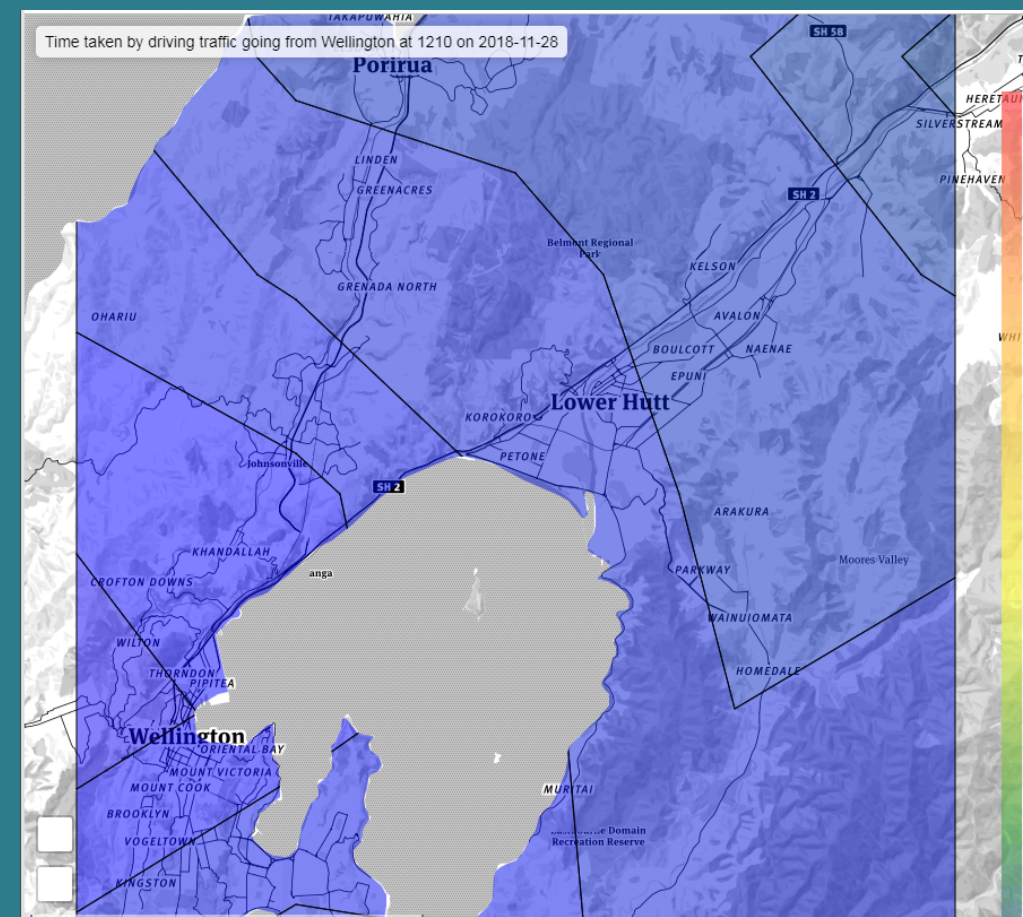

Figure 3. (Isochrone Car): This isochrone shows the travel time to outside Wellington from the CBD on a weekday at noon by **car**. It uses a step of 1min (more lines than Figures 1 & 2). Comparing this to Figure 2, we can see that colours never reach green, and so cars are much faster at travelling around Wellington.
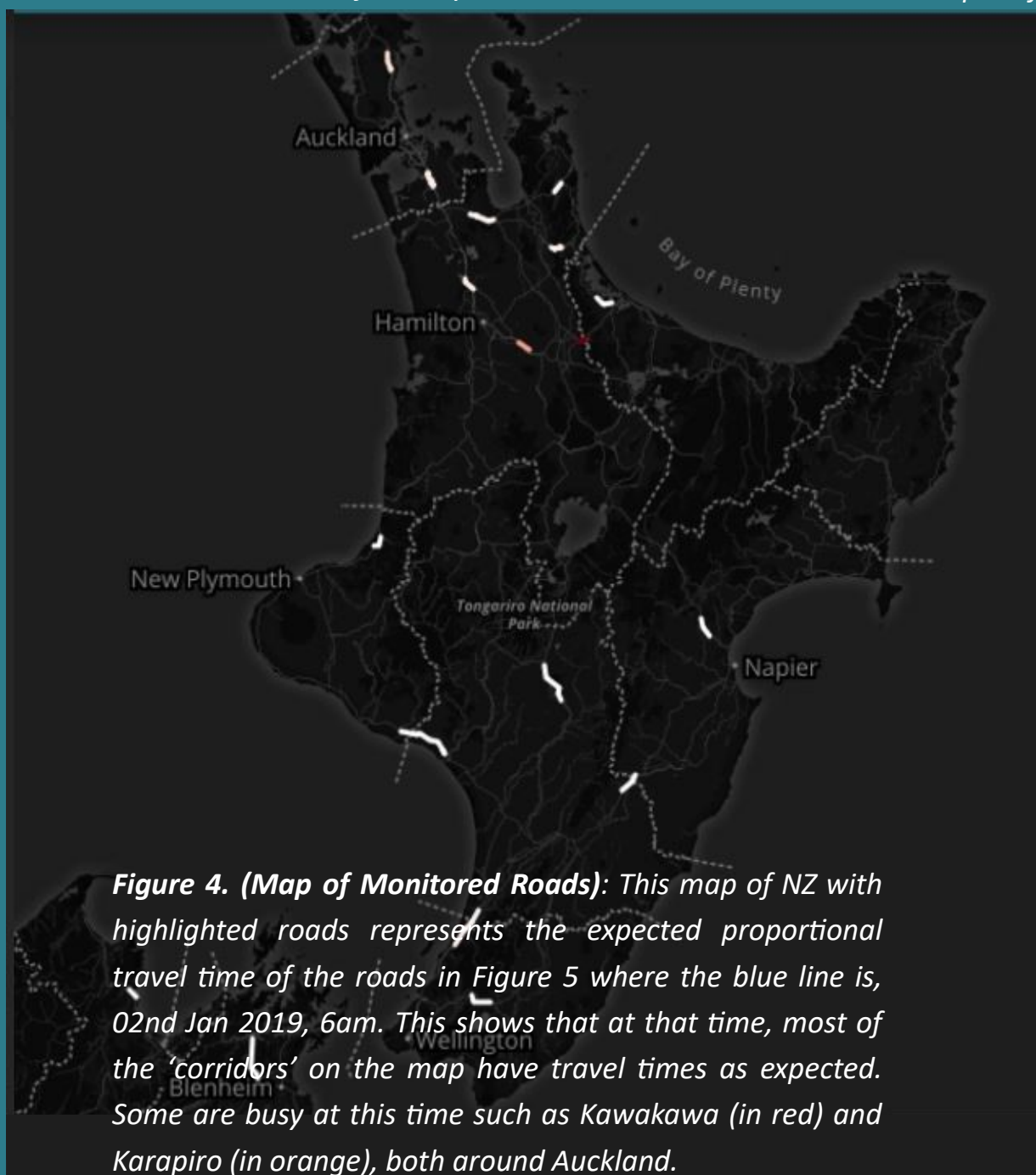

Figure 4. (Map of Monitored Roads): This map of NZ with highlighted roads represents the expected proportional travel time of the roads in Figure 5 where the blue line is, 02nd Jan 2019, 6am. This shows that at that time, most of the 'corridors' on the map have travel times as expected. Some are busy at this time such as Kawakawa (in red) and Karapiro (in orange), both around Auckland.
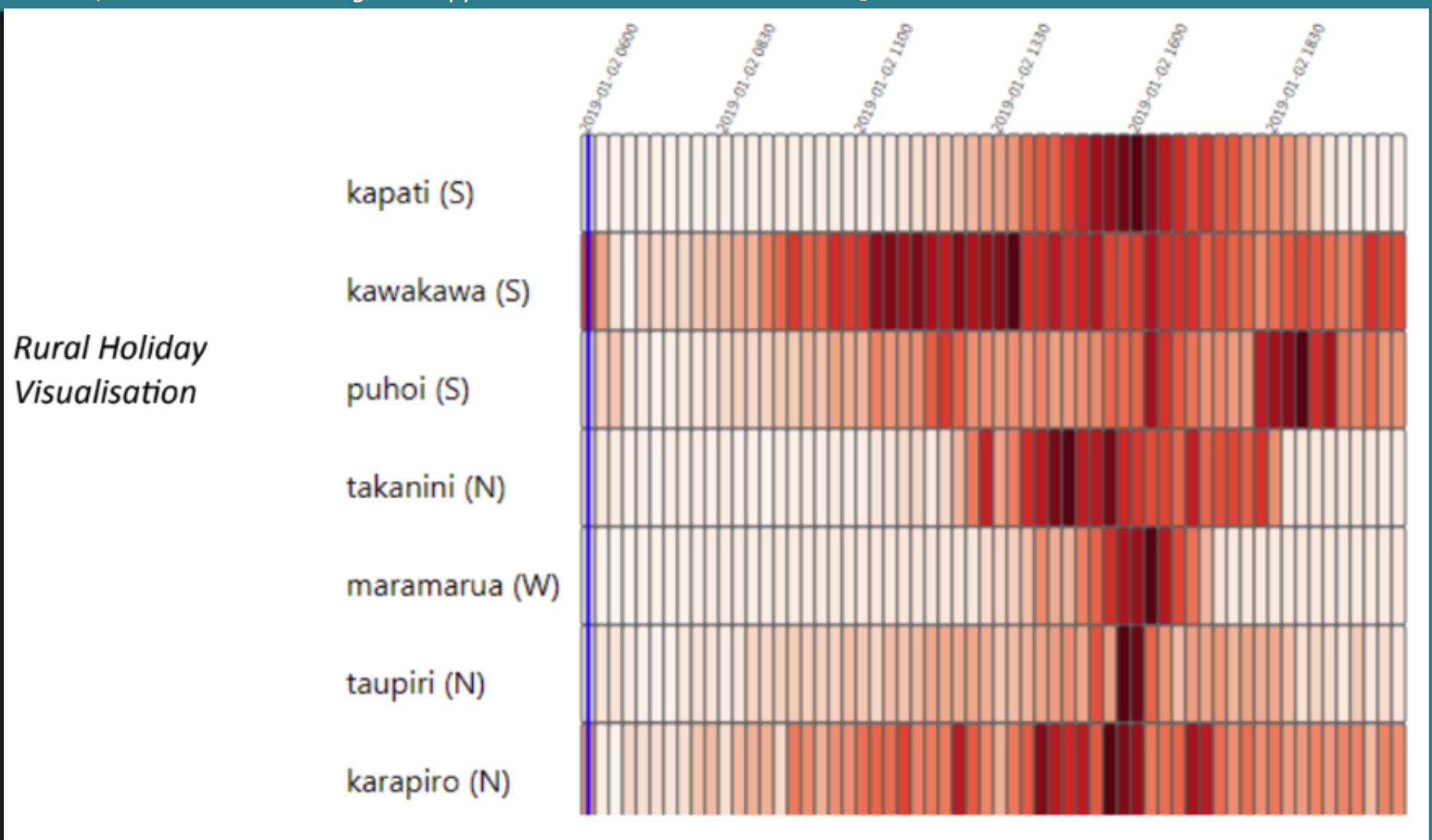

Figure 5. (Heat Map Timeline): Travel times across of major corridors which are road sections on the state highway network (labels left side, direction of travel in brackets). Red represents an increase in the travel time through these sections of the highway. The darker the red the more increase. With this an analyst can quickly compare the relative speeds of recorded 'corridors'. We can see on 02 Jan 2019 that Kawakawa (Hamilton area) changes the most with peak times between 10-2pm.

Students:

Jacob Beal & Chris Todd

chriswilltodd@gmail.com

bealjaco@myvuw.ac.nz

External Supervisor:

Chris Vallyon

Beca

Supervisor:

Dr. Craig Anslow

School of Engineering and Computer Science

Beca

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