



Waikato Expressway: Te Rapa section

Benefits Realisation Review

ABOUT BENEFIT REALISATION REVIEWS

Benefit Realisation Reviews assess how well improvement projects* which received National Land Transport Programme (NLTP) funding have achieved their main expected benefits.



ABOUT THIS REVIEW

| | |
|--------------------------|--|
| PROJECT NAME: | Te Rapa section of the Waikato Expressway. The route was officially renamed Mangaharakeke Drive after opening. Also referred to as the Te Rapa bypass. |
| RESPONSIBLE ENTITY: | NZ Transport Agency |
| DATA ANALYSIS DATES: | Travel time and crash data up to December 2018 used. |
| REPORT PUBLICATION DATE: | April 2019 |

* Includes state highway and local road improvements, public transport, walking & cycling, and regional improvement projects.

SUMMARY

TE RAPA SECTION OF THE WAIKATO EXPRESSWAY IS DELIVERING ITS EXPECTED BENEFITS

The Te Rapa expressway project

The Te Rapa expressway was the first of seven sections of the Waikato Expressway to be constructed.

It is a four lane median divided expressway which redirects state highway traffic away from the previous route through the commercial area of Te Rapa in north west Hamilton.

Successful project

This review has found the Te Rapa expressway is successfully contributing to the expected overall benefits of the Waikato Expressway, including improved safety and more efficient travel conditions.

The construction cost for the Te Rapa section of \$136.1m was 19% under budget. The section was officially opened six months earlier than planned in December 2012. However, repair work started in early 2019 to address rutting problems on the expressway's road surface is likely to cost several million dollars.



Actual summary results

1

Travel time savings

Average travel time savings of more than 4 minutes on the Te Rapa expressway are better than predicted.



2

Journey time reliability

Travel times on the expressway are predictably between 5 and 7 minutes, compared with greater variability up to more than 12 minutes on the previous route.



3

Safety

There has been significant reduction in crashes since the expressway opened, although minor rear-end crashes are common on its more congested southern end.



4

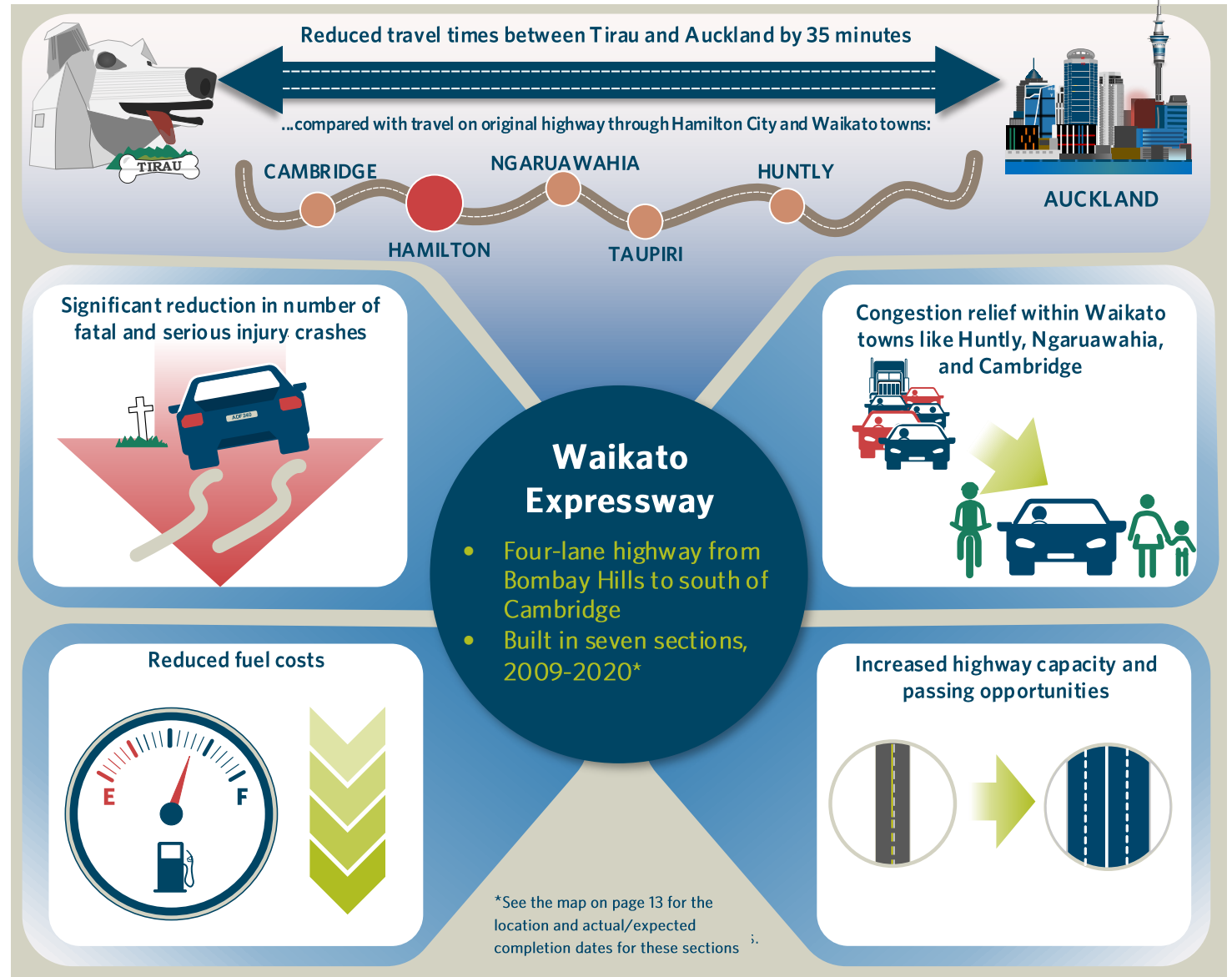
Other benefits

The four lane expressway has increased highway capacity and passing opportunities. Reduced travel times will have helped reduce fuel costs for expressway users.



WAIKATO EXPRESSWAY MAIN EXPECTED BENEFITS

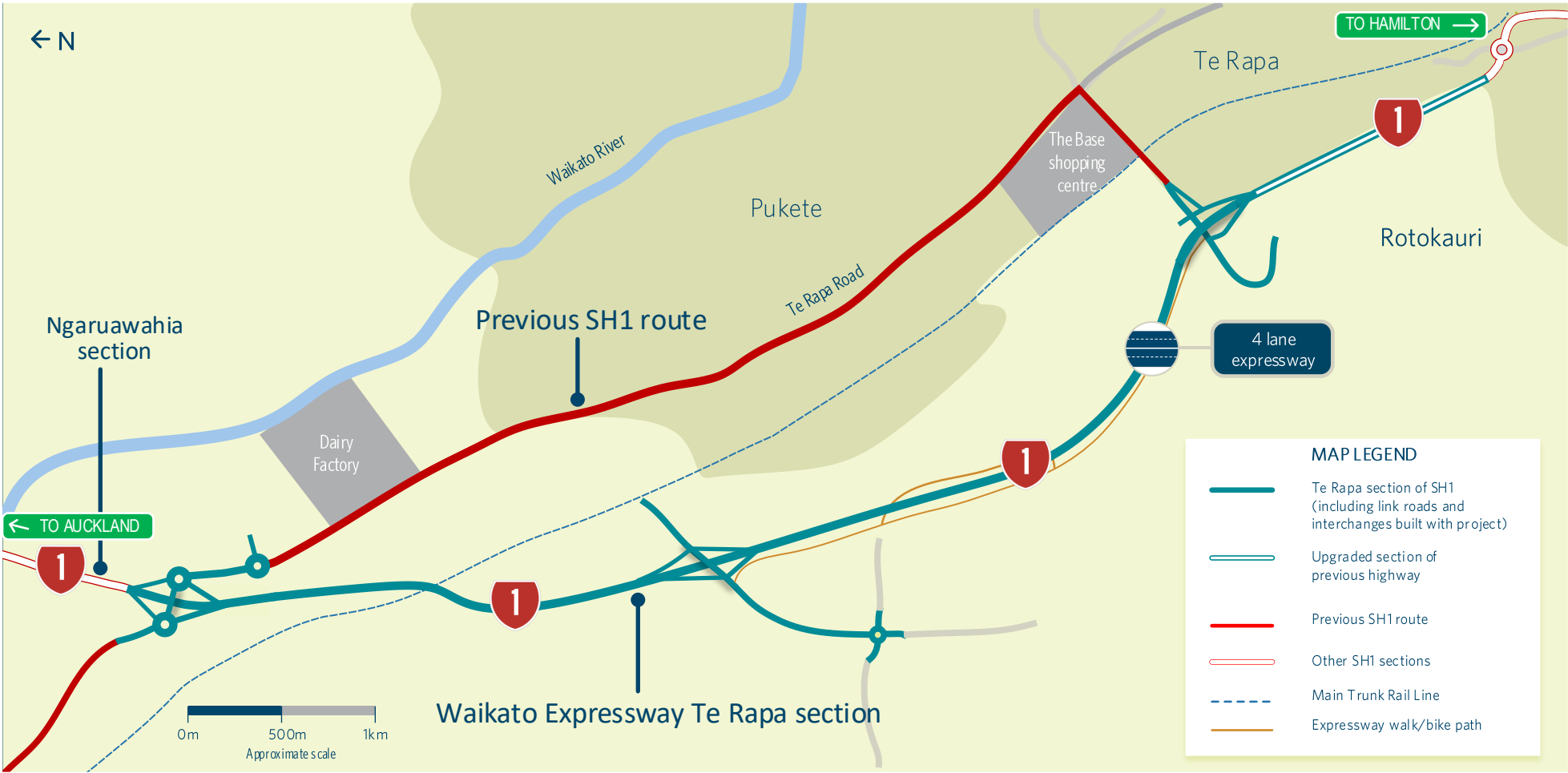
Forming one of the Roads of National Significance (RoNS), the Waikato Expressway is described by the NZ Transport Agency as a key strategic corridor in the Waikato region, connecting Auckland to the agricultural and business centres of Waikato and the Bay of Plenty. The Expressway is predicted to improve growth and productivity through more efficient movement of people and freight.



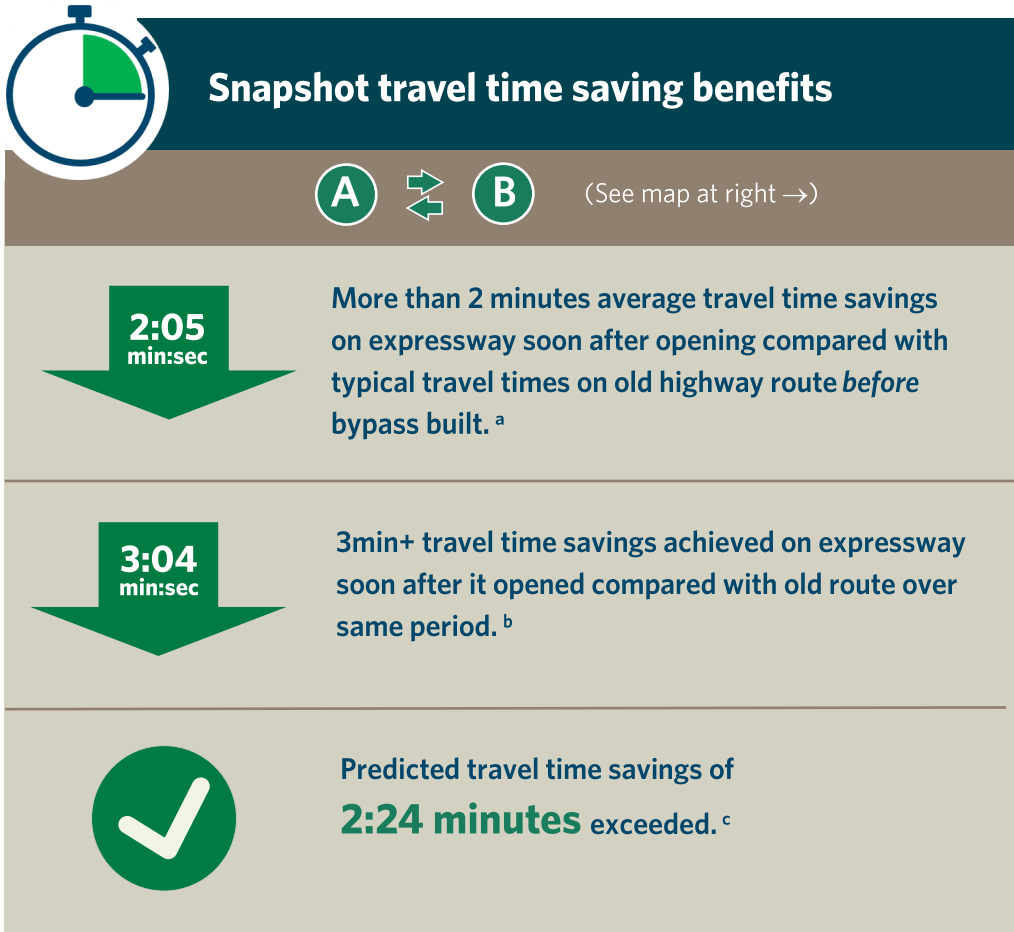
MAP

TE RAPA SECTION OF WAIKATO EXPRESSWAY

The Te Rapa section of the Waikato Expressway is a 4 lane median separated expressway largely through semi-rural land. It was built to bypass the previous SH1 route through Te Rapa and Pukete, which is an increasingly intensified and traffic-congested industrial/commercial area of Hamilton City. The Te Rapa section was also designed to provide improved access to planned residential and industrial development in Rotokauri.



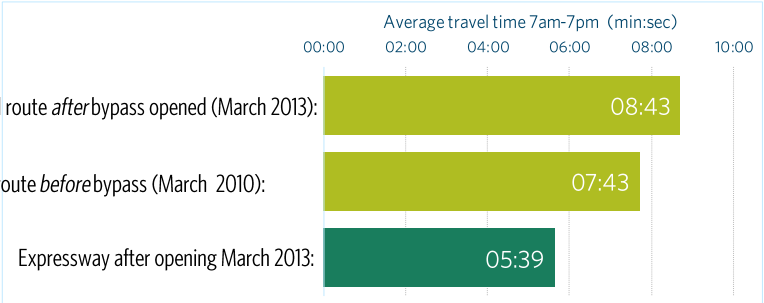
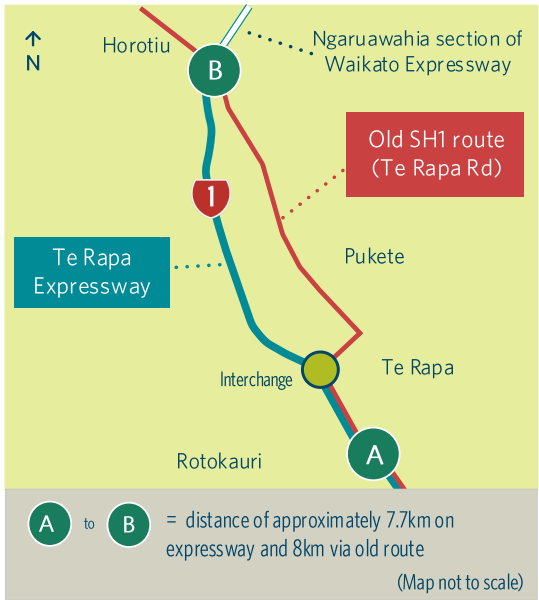
TRAVEL TIMES AND RELIABILITY BENEFITS FROM TE RAPA EXPRESSWAY SOON AFTER OPENING
THE EXPRESSWAY IMMEDIATELY ACHIEVED TRAVEL TIME SAVINGS



Snapshot travel time saving benefits

(See map at right →)

- 2:05 min:sec** More than 2 minutes average travel time savings on expressway soon after opening compared with typical travel times on old highway route *before* bypass built. ^a
- 3:04 min:sec** 3min+ travel time savings achieved on expressway soon after it opened compared with old route over same period. ^b
- 2:24 minutes** Predicted travel time savings exceeded. ^c



Coverage and terminology notes:
^a Average weekday travel times 7am-7pm were compared between on the expressway in March 2013 (a couple of months after it opened) and in March 2010 on the old highway route before expressway construction started.
^b Average weekday travel times 7am-7pm were compared between on the expressway and old highway route in March 2013 (this is to give an indication of the immediate realisation of benefits from the completed project).
^c Source: MIN-0991—RoNS travel time savings for completed sections.
 Public holidays were excluded from analysis. Average results for northbound and southbound travel times were used as these showed no significant differences. Data source: TomTom Traffic Stats.

TRAVEL TIMES AND RELIABILITY BENEFITS FROM TE RAPA EXPRESSWAY **SOON AFTER OPENING** CONTINUED... JOURNEY TIMES ON THE EXPRESSWAY ARE MORE RELIABLE


The expressway improved journey time reliability for motorists travelling in and out of north-west Hamilton

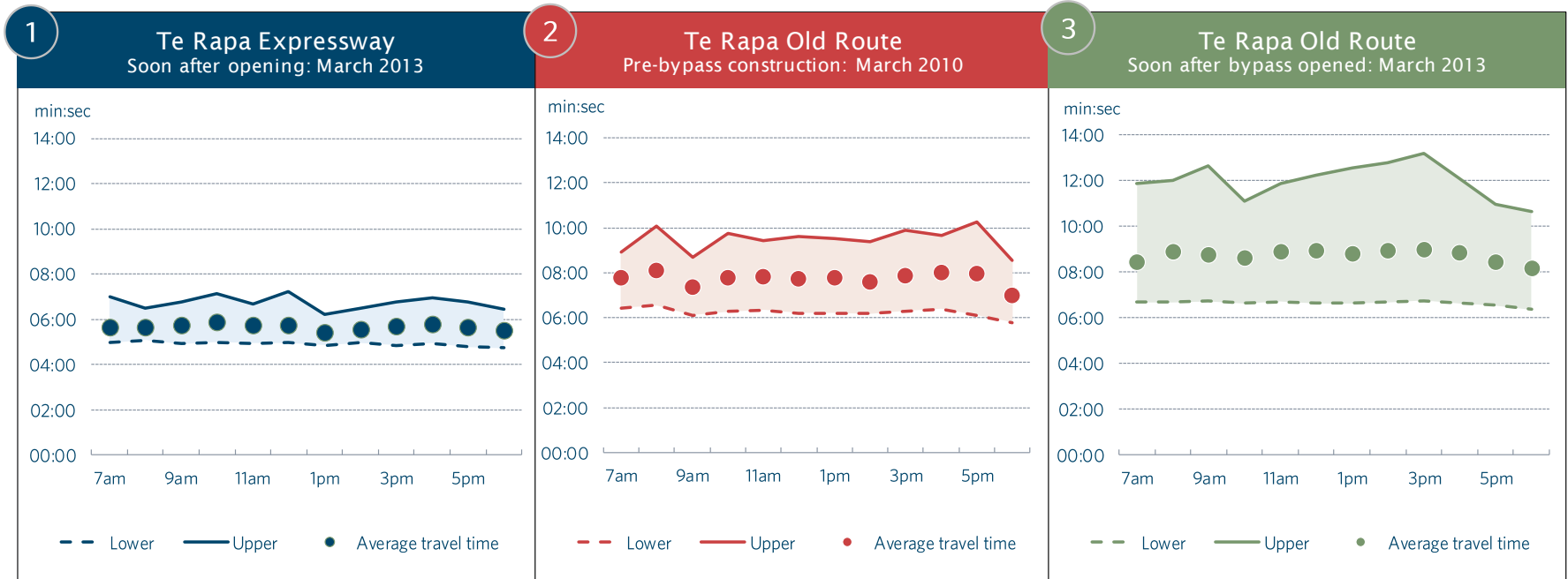
Journey time reliability was immediately improved for people using the expressway instead of the old state highway route. Most trips on the expressway would take between just under 5 minutes and 7 minutes (fig 1). In contrast, before construction of the bypass, most trips on the old state highway route would take between 6 and 10 minutes (fig 2).

Traffic conditions on the old route were worse after the bypass opened compared with before its construction.

Journey time reliability on the previous highway route along Te Rapa Road had deteriorated by the time the bypass opened in late 2012. By early 2013, most journeys along this route could be expected to take between 6 ½ and more than 12 minutes depending on the time of day (fig 3).


Reasons for this include: the bypass' opening introduced two new signalised intersections for traffic entering the old route from the south; traffic signals replaced a roundabout outside the Base shopping centre in late 2012 to cope with increased traffic; the speed limit on the northern section of Te Rapa was reduced from 100kmh to 80kmh in 2012; and there is ongoing growth of Te Rapa as an industrial/commercial centre for Hamilton.


TIP
See Page 14 of this report for guidance on using these graphs.



Coverage and terminology notes: Travel times compared are average travel times 7am-7pm on weekdays in March for the given years. Public holidays are excluded. The average results for northbound and southbound travel times are presented as these were very similar. Data source: TomTom Traffic Stats.

MORE RECENT (2018) TRAVEL TIME AND RELIABILITY BENEFITS FROM TE RAPA EXPRESSWAY
TRAVEL TIME RELIABILITY AND SAVINGS BENEFITS HAVE BEEN SUSTAINED



Snapshot findings

March 2018

A
↔
B
(See map below)

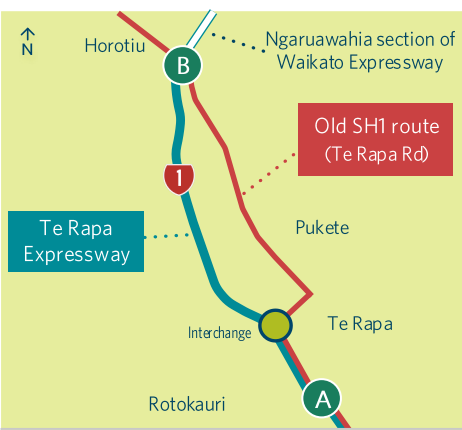
4:15

min:sec


Typical travel times on expressway now nearly half that on old SH1 route

Average travel times March 2018


| | |
|------------|-------|
| Old route | 10:02 |
| Expressway | 05:47 |



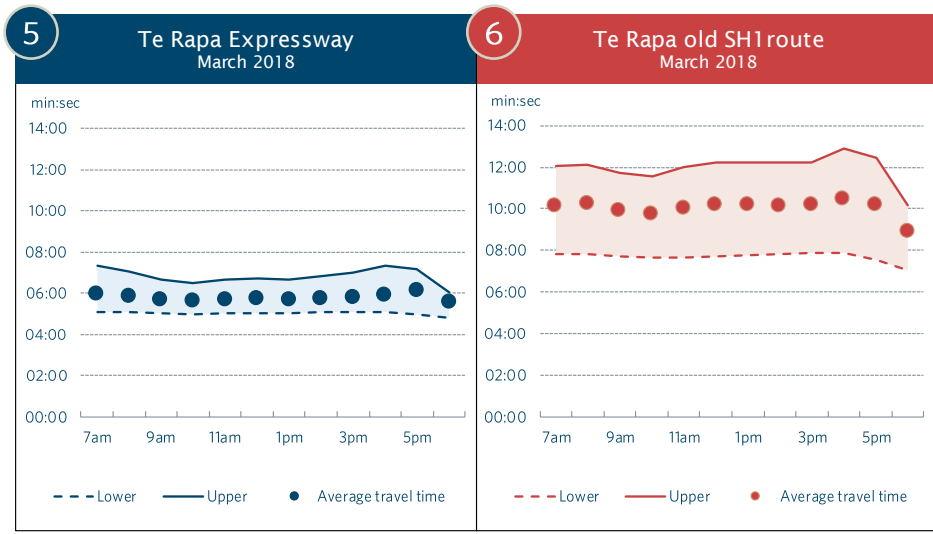
A to B = distance of approximately 7.7km on expressway and 8km via old route
(Map not to scale)

- 

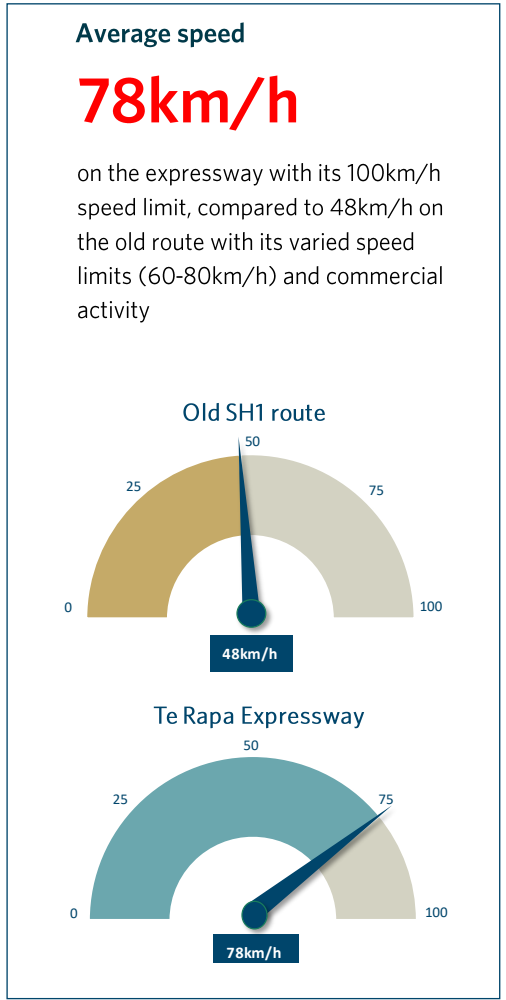
The expressway remains an efficient route in and out of Hamilton, with predictable journey times

The expressway continues to provide travel time savings benefits, with average travel times of around 6 minutes (fig 5). Users of the expressway experience predictable journey times of between around 5 and 7 minutes.
- 

In contrast to the expressway, the continued commercial growth of Te Rapa has meant on average it now takes around 10 minutes to drive the previous state highway route, compared with around 8 minutes soon after the bypass opened (fig 6). Users also experience greater unpredictability with their travel times. Most trips along the entire route can take between 8 and 12 minutes depending on traffic conditions.



Coverage and terminology notes: Travel times compared are average travel times 7am-7pm on weekdays in March 2018. Public holidays are excluded. The average results for northbound and southbound travel times are presented as these were very similar. Data source: TomTom Traffic Stats.



SAFETY

TE RAPA EXPRESSWAY HAS IMPROVED SAFETY



There has been a statistically significant decrease in crashes since the Te Rapa Expressway opened

Crashes tend to have a random element with how and when they occur. This makes it difficult to attribute observed crash trends to safety improvements a project may make. Benefit Realisation Reviews use a crash analysis methodology to help reduce the random effect so that conclusions can be made on a project’s safety outcomes with a sufficient level of confidence. (See the guidance page on page 15 of this report for more information about crash analysis.)

It was found using this methodology that there was a significant reduction in crashes on both the Te Rapa Expressway and the previous state highway route compared with might have been expected based on crash history over nearly 10 years on the previous route before expressway construction began (fig 7 at right).

This decrease is statistically significant, meaning it can be concluded with sufficient confidence that the Te Rapa expressway has successfully delivered expected safety benefits. (Fig 8 summaries the crash trend by severity since 2002.)



To check that wider regional trends with crashes weren’t influencing the expressway’s crash record, the crash analysis was adjusted to take account of all crashes in the Waikato Region 2013-2018. This still produced a statistically significant reduction in crashes on the Te Rapa expressway and previous state highway route.

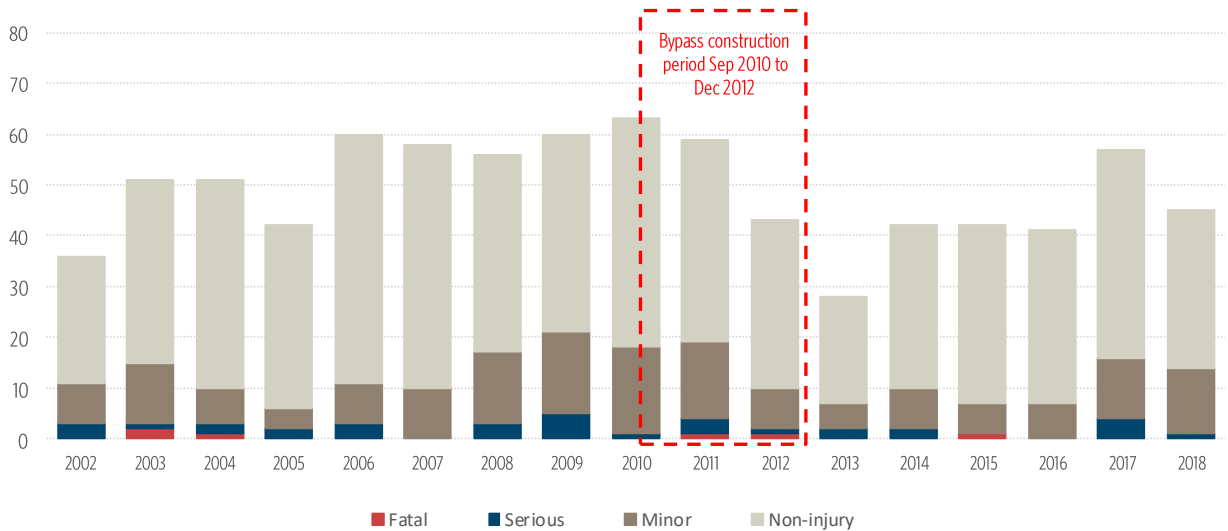
Figure 7: summary crash analysis results for Te Rapa expressway project

| Crashes pre-project construction 2002 to August 2010 | Expected crashes post-construction 2013-2018* | Actual crashes post-construction 2013-2018 | Probability project has improved safety |
|--|---|--|--|
| 456 | 314 | 255 | Statistically significant decrease in crashes |



* Based on crash history before project construction.

Figure 8: crashes by severity on Te Rapa expressway and previous highway route, 2002-2018



Source: NZ Transport Agency: Crash Analysis System (CAS).

SAFETY CONTINUED...

NON-INJURY CRASHES ARE COMMON ON EXPRESSWAY

+ More than 100 crashes have occurred on the expressway

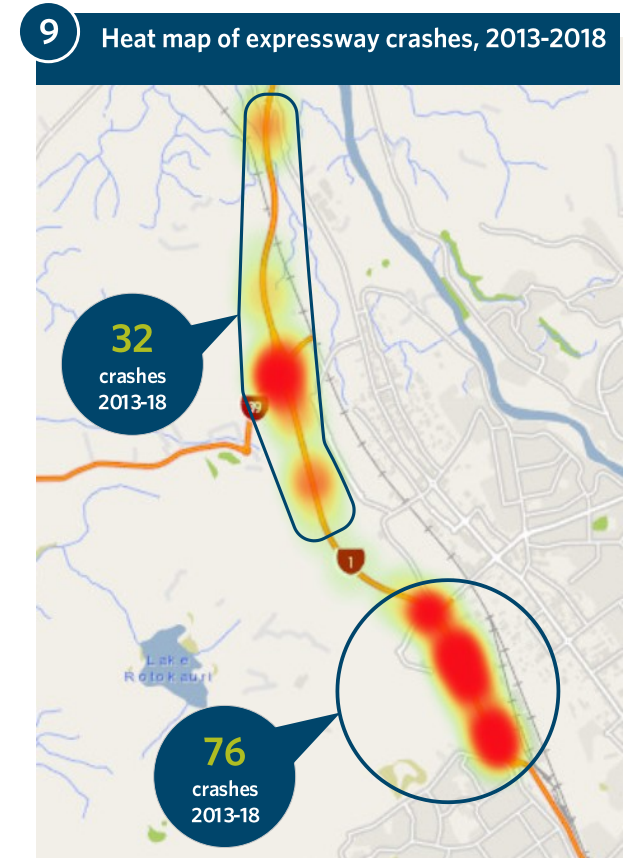
Non-injury crashes are relatively common on the Te Rapa expressway. In the six years 2013-18, 108 crashes were recorded on the expressway. Eighty two percent of these crashes were non-injury (see Snapshot figure below).

+ Most crashes are concentrated on the southern section of the expressway.

Seventy percent of expressway crashes have occurred on the southern section of the expressway, south of the interchange with Wairere Drive. This is apparent from the crash heat map in fig 9 at right.

+ Congestion-related factors are mainly to blame for these crashes

The southern section is substantially busier than the rest of the expressway since it is used by both state highway traffic and local traffic to and from Te Rapa via Wairere Drive. (The southern section has average daily traffic volumes of around 40,000 vehicles, compared with around 15,000 north of the Wairere Drive interchange.) As a result, the most common crash types on the southern section are non-injury rear end crashes.



**SNAPSHOT:
CRASHES ON EXPRESSWAY SINCE IT OPENED**

Jan 2013 to Dec 2018*

108 recorded crashes: 5 serious injury,
14 minor injury, 89 (82%) non-injury

Most common crash types:



41x rear end/obstruction



23x lost control on
straight road



17x overtaking crashes

* There can be a lag of up to 3months for all crash records to be entered in the Crash Analysis System (CAS).

Source: NZ Transport Agency: Crash Analysis System (CAS).

OTHER BENEFITS

FUEL COSTS LIKELY REDUCED; HIGHWAY CAPACITY AND PASSING OPPORTUNITIES IMPROVED

The expected benefits from the Waikato Expressway of reduced fuel costs, and increased highway capacity with more passing opportunities were not specifically evaluated for this Benefits Realisation Review. However, the following observations are made on the basis of the design of the expressway and other benefits' results.

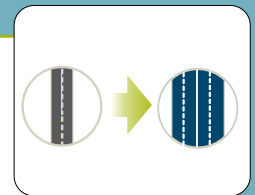
Reduced fuel costs



The Te Rapa expressway's travel time and journey time reliability improvements will have contributed to reduced average fuel costs for vehicles travelling on it compared to the previous route.

This is because the expressway offers more opportunities for free-flow steady travel, compared with stop and start conditions, variable speed zones, and increased congestion on the old route through the Te Rapa commercial area. All of these factors generally cause vehicles to consume more fuel.

Highway capacity and passing opportunities



The Te Rapa expressway's four lanes provided greater highway capacity and more passing opportunities than the previous state highway route.

This previous route is a mix of two and four lane road, with various passing restrictions along its length.

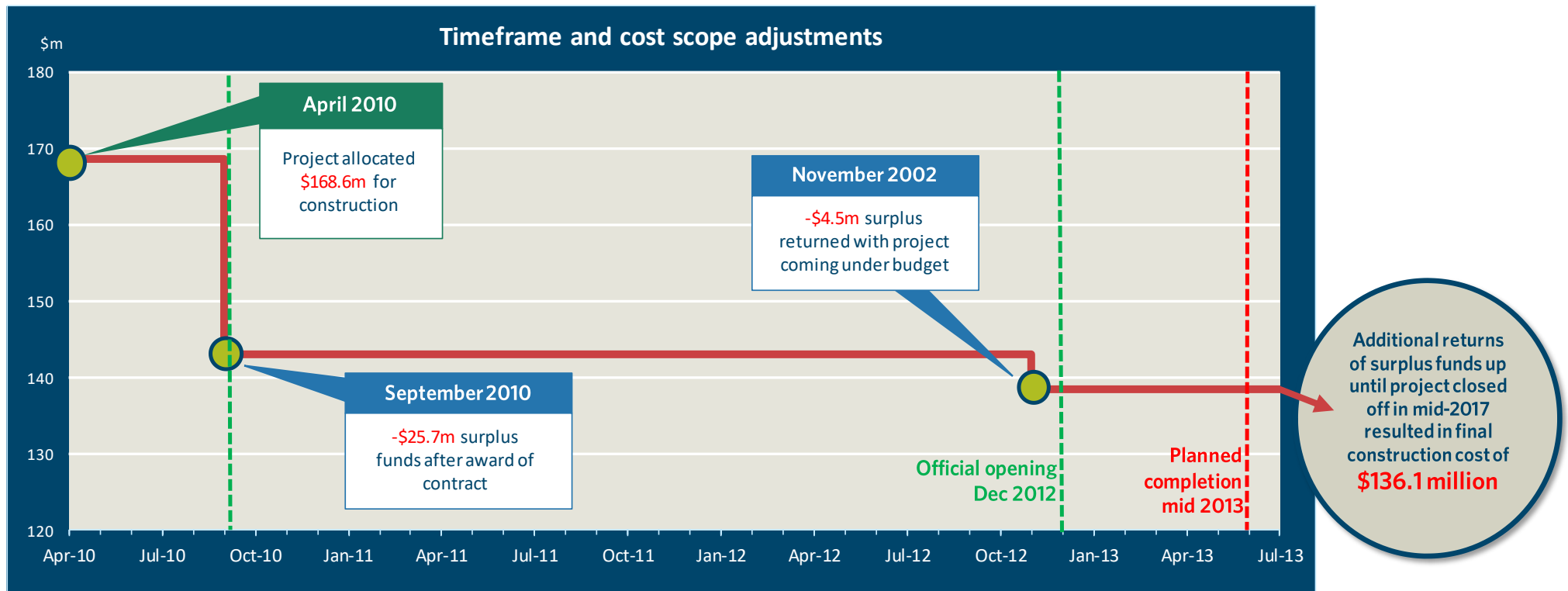
PROJECT CONSTRUCTION TIMEFRAME AND COST

TE RAPA SECTION OPENED TO TRAFFIC EARLY AND UNDER BUDGET

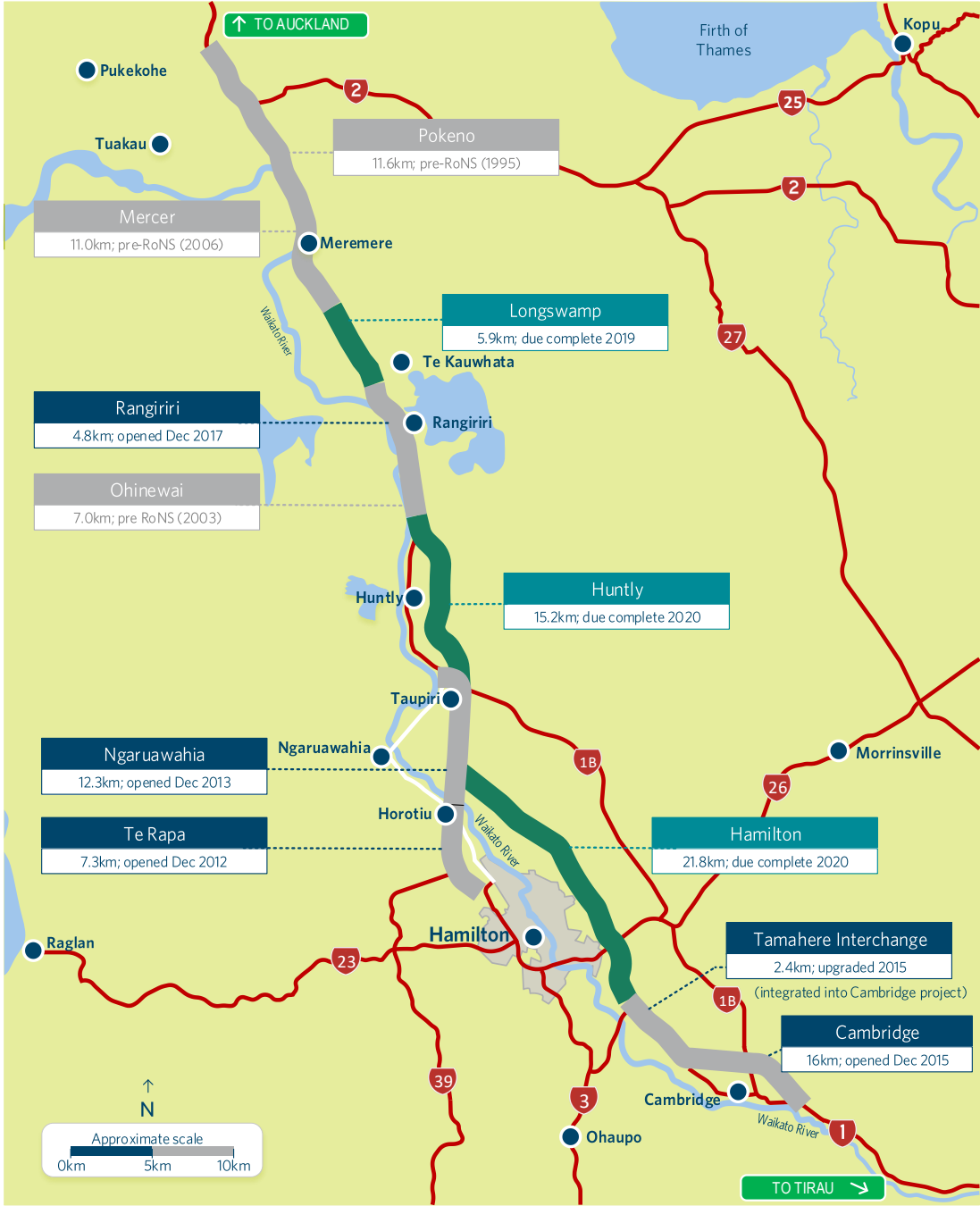
Expressway constructed for **\$136.1 million**
19% below budget mainly because of early completion of project and lower-than-expected contract tender price

Completed December 2012
6 months earlier than planned.

Repair work started in early 2019 to fix rutting problems on the road surfaces of both the Te Rapa and adjoining Ngaruawahia section of the Waikato Expressway. This remedial work will cost several million dollars.



MAP
WAIKATO EXPRESSWAY SECTIONS
AND COMPLETION DATES



GUIDANCE

UNDERSTANDING THE TRAVEL TIME & RELIABILITY CHARTS

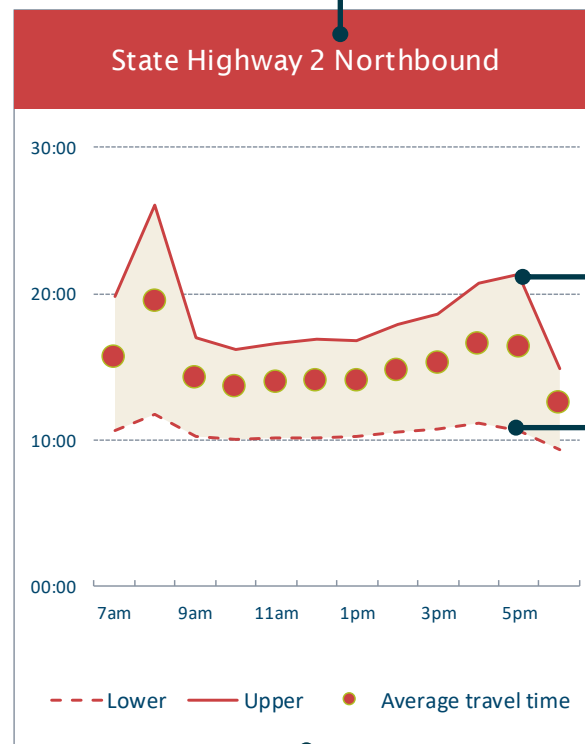
This page explains the travel time and reliability charts used in this report.

Results presented are averages over a month.

Weekdays are used in this report with holidays excluded.

Travel times vary during different times of the day

- Charts show typical travel times observed each hour between 7am and 7pm.
- Peak periods in the morning and late afternoon are common in urban areas, when commuter traffic volumes and congestion are greatest.
- Inter-peak traffic (travelling between around 9am and 4pm) generally faces faster travel times and less journey time variability.



The wider this range, the less journey time reliability

- The majority of vehicles covering the route at this time of day travelled within this time range.
- A project which narrows this range successfully improves journey time reliability.
- Improved reliability means people can better predict their travel times because of less variability.

Source: All travel time data presented in this report was sourced from TomTom Traffic Stats

GUIDANCE

CRASH ANALYSIS USED TO EVALUATE SAFETY OUTCOMES

This page summarises the crash analysis methodology used for this review.

1

Crashes tend to occur randomly

Crashes tend to be random in how often and where they occur. Road design can influence crash incidence, but many other factors can feature which are impossible to predict (for example, a wasp flying in through a window may distract a driver causing a crash).

2

Reducing the effect of random occurrence

The purpose of safety assessments in these reviews is to try and remove the influence of this random causation so that any observed crash reduction can be attributed with sufficient confidence to safety improvements made by a project.

3

Crash trend history pre-project is used to predict post-completion crash numbers

At least several years crash trend history is used. Typically this is the five-year crash history used in project business cases *plus* crashes recorded between that period and the start of project construction. (The construction period is usually excluded because it often presents atypical road conditions.)

4

Several years of post-completion crash records are needed

Generally several years of crash records *after* a project is completed is needed to evaluate its safety outcomes. This is to allow enough crash history to be collected to help differentiate between random crash causation factors and the safety improvements made by a project.

5

Statistical probability is used to help determine safety outcomes

Observed crash numbers post-completion are compared with the expected number based on the pre-project crash history. These are applied against the *Poisson* probability distribution* at 90% confidence level to evaluate if observed crash reduction can be attributed with sufficient confidence to the project.

* Due to their chance nature of their occurrence, crashes tend to vary randomly over time in a way best represented by the Poisson probability distribution. This Poisson distribution applies when a relatively small number of uncommon independent events occur over time.