NZ TRANSPORT AGENCY
WAKA KOTAHI

Post Implementation Review

Ohingaiti–Makohine Realignment

Manawatu/Whanganui Highways and Network Operations

November 2016

The purpose of NZ Transport Agency Post Implementation Reviews are to:

- assess how well a project (or package) has delivered its expected benefits

- explain any variation between actual results and expected benefits and costs

- identify any lessons learned that can be used to improve future projects

Executive summary

This project realigned a section of State Highway 1 (SH1), approximately 30km south of Taihape in the Rangitikei District.

The main objective of the realignment was to address safety concerns arising from a high crash rate in the area. The project also aimed to reduce travel times and vehicle operating costs.

Summary assessment of project outcomes

Overall, this Post Implementation Review (PIR) found that the Ohingaiti–Makohine realignment project has had a positive impact on safety in the area. The new alignment removed a dangerous stretch along SH1 and the steep and winding road on Makohine Hill, making the road safer for the travelling public. A traffic overpass on the new road alignment also addressed safety issues associated with a former rail level crossing.

The project has been highly successful with improving safety, and crash rates have reduced significantly since the opening of the project.

Travel times and average speeds also improved initially, but these gains are now starting to erode to levels similar to those prior to construction. We were unable to determine with any confidence the causes for this deterioration in the travel benefits, particularly given traffic volumes have not increased proportionately.

Project delivery and cost

Project construction started in March 2008 was completed in May 2011, four months ahead of schedule.

The final out turn project cost was $13.6 million, 8% under the estimated cost of $14.9 million. The cost savings were attributable to a good tender price received and the project being completed earlier than planned.

Good practice identified

Some good practices were identified with the delivery of this project included:

- The grade separation of the SH1 and the Makohine Gorge realignment was packaged to optimise earthworks and minimise construction costs.

- An extensive consultation with the local community and other affected parties was conducted, and continuous feedback of construction progress was provided to the community to ensure successful outcomes.

- The project's sensitivity to environmental impacts was carefully considered, as demonstrated by the diversion of the Makohine Stream.

Lessons learned

Lessons with relevance for other future projects are listed below and discussed in more detail in *Section 4: Lessons learned* of this report:

- Pre–project traffic surveys or monitoring report would have been beneficial for a more effective assessment of the project's success or failure.

- A timely review of the contingency allowance would have prevented the request for additional funding after project has been completed.

Figure 1: Ohingaiti-Makohine proposed alignment plan
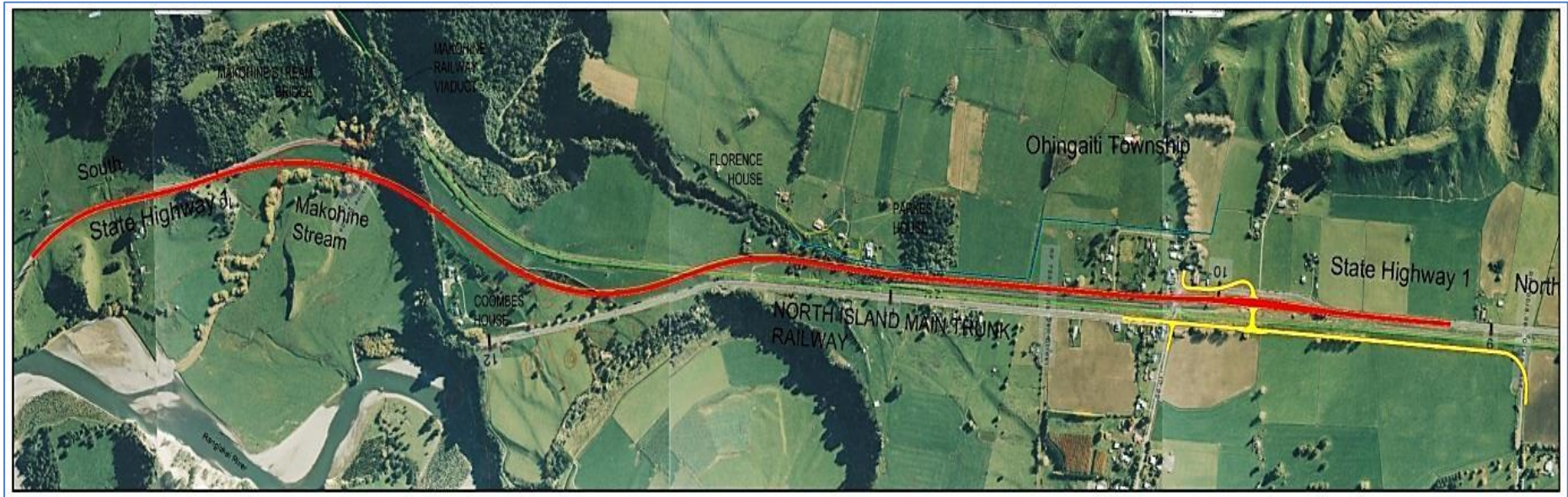
1. Project benefits

Project description and objectives

The project involved realignment of a section of State Highway 1 (SH1), located 30 km south of Taihape. The works included 4km of new road including a rail tunnel, a northbound passing lane, and a new bridge near the Makohine viaduct. Figure 1 on page 3 shows the proposed alignment plan.

The Ohingaiti–Makohine road realignment aimed to address an area of safety concern by removing the steep, winding road on Makohine Hill that has been the site of several injury crashes. Other objectives of the road realignment included improved travel times and reduced vehicle operating costs.

Key expected benefits supporting the project's (original) application for funding included: accident cost savings 44%, travel time savings 38%, vehicle operating cost savings 17%, and reduced emissions 1%.

Safety outcomes

Improving safety was the main objective of the SH1 Ohingaiti to Makohine realignment project.

The main features of the project seeking to improve safety were:

- Straightening of the steep winding road on Makohine Hill, and
- Removal of a dangerous 'S' bend where the state highway previously crossed the main trunk rail line at a level crossing.

Overall, the project has been highly successful with improving safety. Crashes have fallen from 42 recorded between 2002 and the start of construction of the project in early 2008 to only seven crashes recorded between project completion in early 2010 and the end of 2015 (figure 2). Between these same periods, injury crashes more than halved from 10 to four.

Figure 2: Comparison of recorded crashes Ohingaiti–Makohine before and after realignment
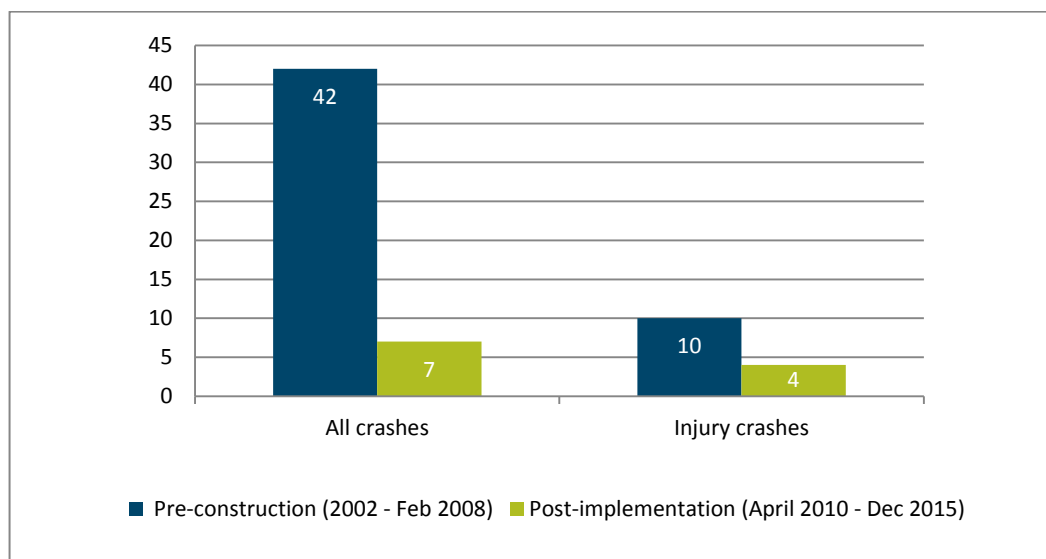
Source: NZ Transport Agency, Crash Analysis System (CAS)

The reduction in crashes at Ohingaiti–Makohine is statistically significant. This means it can be concluded with a high level of confidence that the fall in the crash rate can be attributed to the safety improvements made by the project and not merely the result of random fluctuations in the incidence of crashes. This review also tested whether the observed reduction in crashes along the realignment might have been affected by wider safety trends by testing it against crash rates over all open roads in Rangitikei District. The crash reduction at Ohingaiti–Makohine was still statistically significant with this trend adjustment.

The safety risk previously presented by State Highway 1 using the tight 'S' bend across the railway line has been eliminated. There were 29 crashes recorded at this intersection between 2002 and 2010. Since project completion there have been no recorded crashes at this site.

More detailed commentary on the crash analysis performed for this review is provided in the Appendix.

Travel time saving outcomes

The realignment project was predicted to improve travel times along the section of SH1 at Makohine–Ohingaiti by straightening the road up Makohine Hill and removing the S bend over the railway line at Ohingaiti (and its 25kph speed limit). Travel time savings made up 38.3% of the expected benefits in the benefit cost ratio supporting the project, with lower vehicle operating costs (a derivative of reduced travel times) accounting for a further 16.8%.

This review used historical traffic data from the TomTom Traffic Stats database to evaluate this project's travel time outcomes. This database is a collection of anonymised floating car data taken from TomTom navigation devices, in–dash systems, and apps. Its data goes back to 2008. Since construction of the realignment started in March 2008, the available traffic data to measure average speeds and travel times on the previous highway alignment and route was limited to January to March 2008.[1]

Average speeds initially improved resulting in significant travel time savings

Average speeds on State Highway 1 at Makohine–Ohingaiti initially increased by around 10km/h or more as a result of the alignment, as shown in figure 3. On the previous alignment, speeds of around 83–86 km/h were typical on average along the whole pre-alignment route. After the realignment average speeds increased to around 96km/h.

Figure 3: Comparison of average vehicle speeds on State Highway 1 Ohingaiti–Makohine before and after realignment
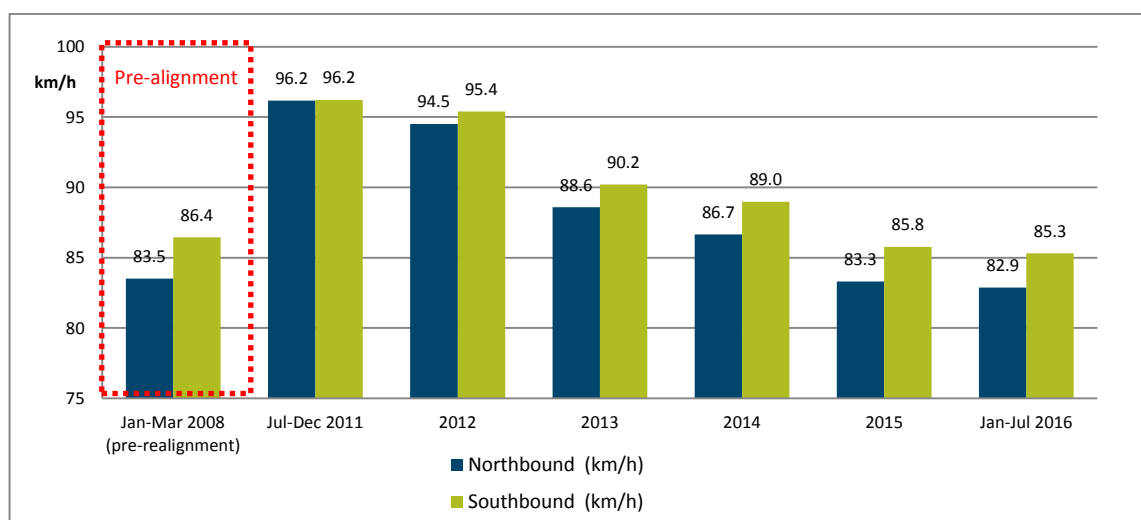
Source: TomTom Traffic Stats

The improvement in average speeds as a result of the realignment successfully lowered average travel times initially, as evident in figure 4. Before the realignment it tended to take more than six minutes on average to travel by motor vehicle the more-than 8km from just south of the Makohine Viaduct to 1km north of Ohingaiti. This average travel time was reduced to around five and a half minutes after the realignment was completed. This reflects the improved travel efficiencies of the straightening of the highway and removal of its 25km/h S bend intersection at Ohingaiti.

Figure 4: Average travel times along State Highway 1 Ohingaiti-Makohine before and after realignment project
(minutes:seconds)

	Northbound	Southbound
Jan-Mar 2008 (Previous SH1 route pre-alignment)	06:21	06:08
After realignment:		
Jul-Dec 2011	05:31	05:30
2012	05:36	05:33
2013	05:59	05:52
2014	06:07	05:57
2015	06:22	06:11
2016	06:24	06:13

Source: TomTom Traffic Stats

Erosion of travel time savings since 2012

Average speeds recorded on SH1 at Makohine-Ohingaiti have trended downwards since around 2012, as evident in figure 1, to the extent that average speeds have returned to about the same as they were on the old highway alignment. This has eroded the travel time savings achieved by the realignment project to the extent that average travel times are now back to the same level or even slightly slowly that existed on the old alignment (Figure 2).

It is unclear why this reduction in average speeds and consequent erosion of the project's travel time savings has occurred since 2012:

- There have been no design specification changes along the route, such as reduced speed limit designations, which might have lowered average speeds, and

- Traffic volume trend data measured north of the site at Mangaweka do not show significant growth in State Highway 1 traffic volumes in the region which could have influenced local speeds and travel times.

A new northbound passing lane has been provided

A new north-bound passing lane of about 1.3km was built up the Makohine Hill which has enabled safer passing opportunities. This component of the project is complementary to the overall SH1 passing lane strategy of providing passing lanes at 5-10km spacings.

Infrastructure and environmental improvements have been achieved

The grade separation of the state highway and the Makohine Gorge realignment was packaged to optimise earthworks and minimise construction costs. The cutting of the Makohine Hill involved the removal of around half a million cubic metres of earth which was used to fill the underpass and approaches for the new road bridge, and completing the southern end of the project. This innovative approach resulted in significant cost savings to the project.

The Makohine stream was carefully diverted from its former course to cut through farmlands, and a new three-span bridge was constructed over the stream.

The surrounding area at the bottom of the Makohine Hill was also improved. A part of improvement initiatives in the area included a native planting scheme, in coordination with local iwi and the Horizons Regional Council.

2. Project cost and timeframe

Project construction started in March 2008 was completed in May 2011, four months ahead of schedule and over a million dollars under budget.

During the mid-phase of the project in December 2009, the remaining project risks were assessed and found that there was substantial contingency fund. The contingency fund was then reduced accordingly, resulting in a surplus of nearly $1.6 million. When the project was completed and nearing handover, the reduced contingency fund had been exhausted and a minor top-up was required to finish off the project completely.

The final out turn project cost was $13.6 million, 8% under the estimated cost of $14.9 million (see figure 5 below). The saving was attributable to a good tender price being received.

Figure 5: Budgeted and actual cost comparison

Description of cost	Date	Project cost
Cost estimate for design	February 2008	$416,800
Cost estimate for construction	February 2008	$14,521,932
Total project cost estimate when funding was approved	February 2008	$14,938,732
Surplus returned	December 2009	$1,570,000
Actual cost after surplus	December 2009	$13,367,732
Additional contingency cost	February 2012	$241,500
Final outturn cost		$13,610,232
Under budget		$1,328,500

3. Good practice identified

Some good practices identified were as follows:

- The grade separation of the SH1 and the Makohine Gorge realignment was packaged to optimise earthworks and minimise construction costs. The fill for the underpass

and approaches for the new road bridge was sourced from the removal of around half a million cubic metres of earth from the cutting of the Makohine Hill. This is a good example of cost-efficiency initiatives.

- An extensive consultation with the local community and other affected parties was conducted, and continuous feedback of construction progress in form of meetings and monthly circulars was provided to the community to ensure successful outcomes.

- The project's environmental impact was sensibly considered as demonstrated by the careful diversion of the Makohine Stream.

4. Lessons learned

Lessons with relevance for other future projects were identified as follows:

- Pre-project traffic surveys or monitoring report is necessary for a more effective assessment of the project's success or failure.

- A timely review of the contingency allowance might have prevented the request for additional funding after project has been completed.

# 5. Manawatu/Wanganui Highways and Network Operations' response to findings

In the absence of a relevant project manager, this report was provided to the Palmerston North Highway Manager for comment on the findings. He was satisfied with the report and no comments were made about this review.

6. Illustrations

- Realignment project plan looking north (Transit NZ files)

- Realignment project plan looking at intersection (Transit NZ files)
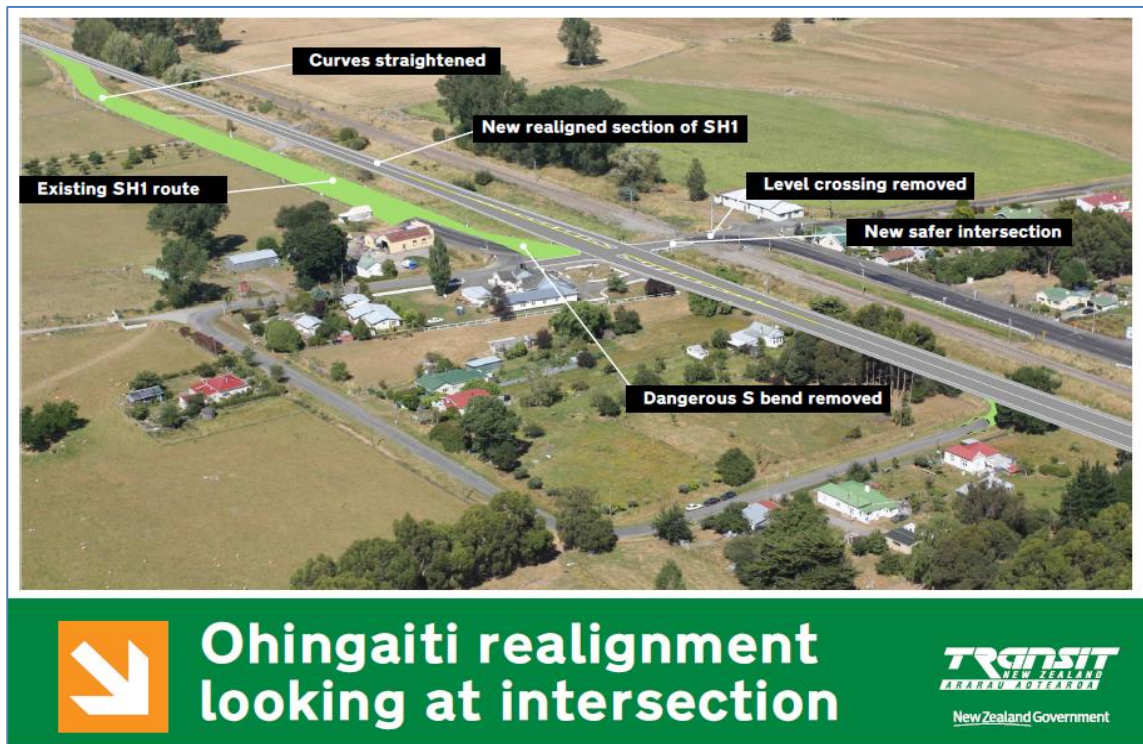
Appendix: Detailed crash analysis

This appendix discusses in more detail the crash analysis and its findings summarised in Section 1 which was used to assess how well the Ohingaiti–Makohine realignment project achieved its predicted safety benefits.

Crash analysis coverage

It is preferable with analysis of crashes before and after a project to focus on high severity (fatal and serious) crashes. However, there were too few of these at Ohingaiti–Makohine to enable significant conclusions to be made. Therefore, all crashes were analysed.[2]

Three periods were used for the crash analysis:

A pre–project *'before'* period between 2002 and 2006 was used.[3]

- A *'between'* period between 2007 and February 2008 covering the months between the end of the before period and the start of project construction (in March 2008); and

- A post project *'after'* period from April 2011 to December 2015.

Crashes from the construction period March 2008 to March 2011 were excluded from the crash analysis as construction activity can disrupt crash factors and types. (Some of the crashes in the earlier could actually have been included in the 'between' period since historical road video of the project showed the realignment construction activity did not initially impact on the original route. But a cautious approach was adopted to exclude all crashes after the official construction start date.)

Three crash datasets were used:

Crashes within along State Highway from the just south of the southern start of the realignment project to immediately the intersection of the highway with Otara Road 1km north of the level crossing at Ohingaiti.

Crashes recorded as occurring on open roads in the Rangitikei District were used as a control group to assess the potential effect of wider regional crash or reporting trends on the observed number of crashes on the studied section of SH1.

Crashes specifically identified at the 'S' bend intersection at Ohingaiti.

Crashes on State Highway 1, Ohingaiti–Makohine

Figure A1 summarises the analysis of *all crashes* at the Ohingaiti–Makohine location covered by the crash analysis.

On the basis of the crash history in the six year and two months before project construction started, it was estimated that 39 crashes could have been expected in the post construction period between April 2011 and December 2015. The actual result of seven crashes is therefore a substantial reduction on the expected number, which is statistically significant at 90% confidence using the Poisson distribution.[4] This means that it can be concluded that the reduction in crashes since the realignment were very likely an outcome of the safety improvements made, and not merely the result of chance variation in the underlying crash rate.

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[2] All crashes include recorded fatal, serious, minor injury, and non–injury crashes.
[3] Usually for crash analysis the before period used is the one presented in the economic evaluation supporting a project's funding. Details of this crash history were unavailable for this post implementation review. But it was identified that the economic evaluation was prepared in August 2007 and therefore an assumption was made to use the five full preceding years of crash history.
[4] Due to the chance nature of their occurrence, crashes tend to vary randomly over time in a way which is best represented by the Poisson Distribution. This distribution applies when a relatively small number of uncommon independent events occur over a set time period.

Figure A1: All crashes analysis table

	Before period (2002–2006)	Between period (Jan 2007–Feb 2008)	After period (Apr 2011 – Dec 2015)	Crashes expected in after period
	5 years	1.17 years	4.75 years	
Ohingaiti–Makohine site crashes	42	8	7	39
Crash rate (crashes per year)	8.40	6.90	1.47	
Ohingaiti–Makohine – all crashes trend corrected using control group of open road crashes in Rangitikei District				44

To test whether the observed reduction in crashes at the site area have been affected by wider trends in crash rates, the results were also trend adjusted using a control group of all reported open road crashes in Rangitikei District. On this basis, it would have been expected that even more crashes – 44 – might have been expected than without trend adjustment. This is also a statistically significant reduction in crashes, and strengthens the conclusion that the project has successfully achieved its improved safety objective.

Post Implementation Review of Ohingaiti-Makohine Realignment project

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