

# **Bespoke Design – SH2 Ngauranga to Petone Real Life Cycling Design**

## **Author Details**

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## **Abstract**

### **Background**

*Since its inception in August 2008 the New Zealand Transport Agency has increasingly recognised the role and value of cycling has in the transport system and that this mode needs to be catered for as a real modal choice for today and tomorrow.*

*This paper will describe how NZTA is working with cyclists in the Wellington area to develop facilities on State Highway Two between Ngauranga and Petone. This has been a location for years that has created issues for cyclists. These facilities recognise the day to day riding choices cyclists are making as well as attempting to be innovative.*

### **Project Aims**

*The facilities provided in this project seek to;*

- *Improve safety for cyclists*
- *Recognise and enhance existing cycling journeys*
- *To develop these facilities within the existing highway infrastructure*
- *Be innovative and forward thinking in best practice and*
- *To create best practice that has widespread applications across the highway network of New Zealand*

*The aim of the project was also to set out how cyclists might be catered for in a high speed environment. To offer new concepts in best practice in engineering, consultation and education to a wider New Zealand audience of engineers, planners and regional cycling champions. In addition it is hoped this work might offer solutions to similar problems found elsewhere in the country.*

### **Paper Content**

*The paper will illustrate the consultation process with users and stakeholders RCAs and how the extra value that cyclists offered influenced the end product. How having cycling engineers involved in the design and implementation benefited the project and how the concepts introduced have awoken mainstream highway engineers minds to how simple designing for cyclists can be within their own projects. The lessons learned will be reported and how the value of the facility has been expanded through road user education.*

*The paper describes the detail and forms the background to the presentation with the presentation illustrating by way of a slide show the content of the project.*

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## **Introduction - Background and issues**

Cycle groups have highlighted the deficiencies in the Petone to Ngauranga cycleway over a number of years. There is a segregated cycleway for much of the length of SH2 on the Eastern side but there are access problems for northbound cyclists and width / maintenance issues for any user of the cycleway.

The principal deficiency with the cycleway is that the segregated off-road portion commences 800m south of the Petone Interchange. The cycleway is thus only realistically usable by southbound cyclists. Thus no practical off-road facility operates in the northbound direction. Northbound cyclists generally use the shoulder of SH2 for their journey. This means cyclists must ride through several higher risk locations where traffic merges or crosses their path. Northbound shoulders vary from 0.5 to 2.5m wide but are typically in the order of 2m.

Following a high profile fatality near this route in 2008 there was a further concerted effort to improve the Petone to Ngauranga route. The interim solutions outlined in this report are seen to be relatively low cost, especially when compared with the likely cost of the long term solutions. When last scoped in 2006 these were estimated to be in the order of \$10-15M. The long-term solution for the cycleway between Petone and Ngauranga will be determined by the Ngauranga Triangle Strategic Study which is due to report back in late 2009.

In consultation with the Cycle Advocates Network, Cycle Aware Wellington, BikeNZ and local individual cyclists NZTA developed a set of short term interim solutions aimed at improving the level of service for cyclists in both north and southbound directions.

There are four sites between Ngauranga and Petone where improvements have been introduced. These are:

- Petone Interchange
- BP Service Station Entrance/Exit Crossing Points northbound
- Horokiwi Intersection Crossings Points northbound
- SH2 Hutt Road/Ngauranga Intersection

## **State Highway Two before the project**

### **Physical layout**

- SH2 between Ngauranga and the Petone Interchange (RP 962/12.00-16.97) is a dual lane highway it includes the interchange and Hutt Road/Ngauranga intersections.
- This length (7km) is separated by a median New Jersey concrete barrier with a break at Horokiwi Rd to allow turning traffic. The harbour side of this length of SH2 runs adjacent to the main Hutt Valley railway line and separating these transport facilities are lengths of w-section guardrail or wire rope barrier and for most of this length is the existing cycle path.

- On the Northbound side of SH2 a shoulder runs the full length but is variable in width (0.5m to 2.5m).
- Next to the shoulder the land varies but is generally rock cliff face. In other locations there is a drainage channel, power poles or a grass verge.
- The alignment is relatively straight with generally gentle radius curves. The current lane configuration provides nominal widths of 3.50 metres for traffic lanes (two in each direction).
- Carriageway width is constrained by steep slopes on the western side along much of the length and the railway line to the east, which borders Wellington Harbour. The speed limit is 100km/h over most of the section length, reducing to 70km/h just before the Petone.
- The lack of adequate shoulder and inconsistent width is a major issue for cyclists, particularly as debris often reduces the effective shoulder width further. Target minimum shoulder width is 2.0m.

### **Traffic details**

- In the location of the proposed works, SH2 carries approximately 67,000 vehicles per day (AADT).
- Approximately 12,900 vehicles use the SH2 northbound Ngauranga on-ramp and approximately 10,300 vehicles per day use the SH2 southbound Ngauranga on-ramp.
- Heavy vehicles make up 9% of the total traffic flow.
- Cycle counts indicate that around 470 cyclists use this section of SH2 per day (AADT calculated from 7am to 9am counts). This route is popular with commuter and recreational/sports cyclists, particularly in the weekends when groups of cyclists are common.
- Only 3 - 5% of cyclists use the currently provided off-road southbound facility. This is likely to be due to the fact that it suffers from debris, major drainage and flooding issues, is narrow and only to a moderate pavement and surface quality.

The SH2 / Centennial Highway / Hutt Rd intersection is traffic signal controlled and has multilane approaches. The intersection is under the control of Wellington City Council and has limited off road cycling and pedestrian facilities provided within its configuration. This intersection delivers cyclists heading north into the offside of a merging lane from Ngauranga at the end of a tight left hand bend.

### **Previous Crash History**

A review of NZTA's crash database along the route between and including the Hutt Road / Ngauranga intersection and the Petone Interchange revealed a total of 12 cyclist crashes over the 10 year period 1998-2008. Of these cycle crashes;

- One was fatal
- Three were serious
- Six minor and
- Two non-injury.

Of these, two occurred in the vicinity of the Hutt Road / Ngauranga intersection, including one on the Ngauranga northbound on-ramp. Ten were on SH2 between Ngauranga and Petone. These were split evenly north and southbound (5/5).

Despite the existence of a facility in the southbound direction this does not seem to have offered a safer environment as indicated by five crashes involving southbound cyclists. In all of these southbound “on road” incidents cyclists have chosen not to use the cycle facilities. All the reported crashes occurred on weekdays with morning and evening peak crashes accounting for three quarters of the incidents. This reflects the highest traffic and cycle flow conditions.

It is expected that the treatments proposed in this report would address seven of the twelve reported crashes. Two crashes involve cyclists hitting cyclists and two involve a single cyclist riding into the rear of a stationary vehicle in the shoulder.

*Table 1 - Annual Distribution of Cyclist Crashes (1998 – 2008)*

<b>Year</b>	<b>Fatal</b>	<b>Serious</b>	<b>Minor</b>	<b>Non-Injury</b>	<b>TOTAL</b>
<b>1998</b>	-	-	-	1	<b>1</b>
<b>1999</b>	-	-	1	-	<b>1</b>
<b>2000</b>	1	-	2	-	<b>3</b>
<b>2001</b>	-	-	-	-	<b>0</b>
<b>2002</b>	-	-	1	-	<b>1</b>
<b>2003</b>	-	-	-	-	<b>0</b>
<b>2004</b>	-	1	-	-	<b>1</b>
<b>2005</b>	-	-	-	-	<b>0</b>
<b>2006</b>	-	-	-	-	<b>0</b>
<b>2007</b>	-	1	2	-	<b>3</b>
<b>2008</b>	-	1	-	1	<b>2</b>
<b>Total</b>	<b>1</b>	<b>3</b>	<b>6</b>	<b>2</b>	<b>12</b>

Safety issues for cyclists included;

- Lack of a consistent shoulder width (northbound)
- General low level of service (provision of facilities, maintenance of the facility – debris/flooding)
- Narrow highway widths below and across Petone Overbridge
- Sight lines at Horokiwi, Petone Overbridge, Ngauranga
- On ramp merge area at Petone when travelling from Lower Hutt
- Off ramp crossing traffic at Petone when travelling to Lower Hutt
- On ramp merge area at Ngauranga when travelling to the North
- Crossing of on and off-ramps at the BP service station
- Cyclists when merging having to move and weave through high speed traffic at acute angles
- On road cycling facilities (and the lack of on road facilities) at Hutt Rd traffic signals
- Traffic crossing the path of cyclists at intersections at acute angles and with high speed differentials.

## **Design Concept to Address Cycling Issues**

The concept therefore focused on upgrading the on-road facilities to improve the conspicuity of cyclists to motorists particularly where traffic merges or crosses the path of the cyclists and to provide guidance for cyclists in terms of riding lines. It also seeks to recognise the existing riders and riding lines that need to be catered for rather than trying to “invent” something that meets the design standards. Recreate and enhance existing riding lines rather than trying to develop a new riding line.

This will be achieved by:

- Highlighting potential conflict points with the use of green surfacing.
- Running a trial of surface materials on site to gauge reaction from cyclists.
- Providing allocated space for cyclists by creating a “cycle lane” where appropriate.
- Assisting cyclists at crossing points by installing hold rails and improved kerb cut downs. This represents an alternative for cyclists to use rather than merging with moving traffic which they do at present. The existing merge option will remain.
- Warning motorists of cyclists by installing cyclist activated advance warning signs at locations where width and visibility are restricted or cyclists are crossing.
- Using Audio Tactile Profiled (ATP) markings to discourage vehicles from encroaching on to the shoulder
- Shoulder widening where feasible, and the use of catch fences to prevent debris from falling on the shoulder.
- Mirroring riding lines with facilities to enhance those cycling choices
- Involving cyclists in the evolution of the design and having cyclists in the design team.

Cycle routes are proposed in the vicinity of conflict points to provide lead-in and exit guidance for cyclists and where it is desirable to discourage vehicles from using the shoulder. The existing shoulder will be retained for the majority of the northbound carriageway to allow vehicles to pull over if necessary and not specifically marked as a cycle lane.

The proposed cycle routes will be the width of the existing shoulder. This will be at least 1.5m wide throughout the scheme except where shoulders cannot be widened. At such pinch points they will narrow to a minimum of 1.2m. Where cycle routes cross off-ramps a 1.5m width is proposed in order to retain consistency and to avoid obscuring the exit point for motorists.

### **Coloured surfacing**

Coloured surfacing is increasingly used to highlight locations for cycling on busy roads, at pinch and stress points, where side road traffic crosses the path of cyclists creating a hazard, lengths of narrow cycle lane and at intersections. Green surfacing has been used where cycle routes cross on and off-ramps. In general the surfacing has been installed from just prior to and to just beyond the conflict point. Green surfacing is being used to highlight locations of higher risk to cyclists. These are typically the locations where traffic crosses the path of cyclists at an acute angle and with a high speed differential. The green surface will indicate to motorists’ areas of the highway where they should anticipate cyclists being present and raise general awareness of cyclists. Additionally the green surfacing mirrors existing riding lines through

intersections. The material proposed is that used successfully on SH1 Centennial Highway and in a trial of materials on SH2 prior to this project. This is “Synthite” a high wearing material that also gives good skidding resistance.

Cycle symbol markings have been included where it has been deemed that further emphasis of the cycle “lane” is required.

### **Electronic Cyclist Activated Warning Signs**

The design also includes something completely new - the use of cyclist activated advance warning signs. The electronic cycle activated warning signs are based on the bike symbol from a PW-35 sign but only the bike symbol will be displayed when activated by a cyclist’s presence. These signs warn motorists of cyclists ahead crossing their path or merging with them at locations where width and visibility are restricted or cyclists are moving at acute angles where riding paths and speeds may be harder to determine.

The signs will be blank until activated at which time they display an orange bike symbol. Later in the project corner flashing amber lights on the signs will be switched on.

Signs are activated in one of two ways.

- Loops will be installed in the shoulder or at crossing points to detect the bike and trigger the signs.
- Alternatively to give cyclists another option or to reactivate the sign in heavy traffic “call button” units will be installed at crossing points (for instance at hold rails). This will also allow them to proactively ensure the signs are operating by pressing the button.

Signs remain illuminated for 20 to 30 seconds protecting cyclists for the duration of the crossing manoeuvre or while they clear the intersection when they are most exposed.

A cycle hold rail and a crossing island have been provided at one location (Hutt Rd) and a hold rail and hook turn with hold rail at Petone off Ramp. At Hutt Rd Cyclists currently merge between live traffic lanes at Hutt Rd (the Petone on ramp lane and the SH2 southbound lane is also a future phase with this scenario). Cyclists merge at an acute angle and look to their left to gauge traffic speeds and pick a suitable gap to select to move across the merge area to access the shoulder area. This is both a hazardous and difficult manoeuvre that requires riding skill and judgement. The distance over which cyclists are exposed is the initial gore area and the diagonal path ridden during the merge manoeuvre. This isn’t large but at Hutt Rd the cyclists are partially hidden by a large rock face. The project recognises this merge manoeuvre will continue (some experienced road or commuter cyclists might still want this option) but the island and hold rail will offer a protected waiting area as an alternative. This informal crossing will allow cyclist to stop and make clearer decisions about traffic speeds and gaps. It will also shorten the crossing distance by making the manoeuvre a right angle reducing exposure times.

Audio Tactile Pavement (ATP) markings are proposed only where shoulder widths are greater than 2.0m or where vehicles are known to encroach on the shoulder. This is because this route is popular with groups of recreational cyclists who usually ride two abreast and if shoulder width is insufficient the presence of ATP could result in cyclists choosing ride outside of the ATP in the trafficked lane. Audio Tactile Profiled (ATP) road marking is an established marking system used to separate traffic streams. Gaps in the ATP will allow cyclists to access the areas they wish to ride in a smooth fashion without the ATP detracting from their riding surface

### **The Improvement Details by Location**

The improvement at each location is not always strictly a departure from standard, but rather a new application of existing treatments. For example, the use of signs, such as those detailed above a use of current practice combined with new technology. The main “departures” from standards are from the guidance that relates to cycling facilities on a state highway of this volume and speed (primarily cycle route width), and the layout of green surfacing at crossing points. Ideally in such environments, cycling facilities would be fully segregated from traffic, and failing this, cycle lane provision would be 2.5m wide with a recommended minimum width of 2.0m. In both situations space and width constraints mean this is not a low cost option.

<b>Issue and Location</b>	<b>Hazard</b>	<b>Improvement</b>
Cyclists merging with traffic 1) Ngaranga / SH2 on ramp 2) Petone off ramp 3) Petone on ramp (later phase of works)	Merging speeds and distances of exposure	<p>The merge area will be improved by locally widening the shoulder. Where possible improved guidance for cyclists will be provided by installing green surfacing and a small traffic island and hold rail. Green surfacing in the waiting area and on the approach to it will be provided. This crossing facility would give cyclists the option to stop and make clearer decisions about traffic speeds and gaps. It will also shorten the crossing distance by making the manoeuvre a right angle reducing exposure times.</p> <p>Cyclists will still have the option of crossing from the gore area (as they currently do) and without stopping. Warning motorists of the presence of cyclists will be by a cyclist activated warning sign given these locations restricted width and visibility to where cyclists are crossing. These signs will be illuminated in one of two ways. Detection loops installed in the shoulder or at crossing points detect the bike and trigger. Alternatively to give cyclists extra peace of mind “push button” call button units are installed at crossing points (for instance at hold rails) to allow them to proactively ensure the signs are operating by pressing the button.</p> <p>Signs remain active for 20 to 30 seconds protecting cyclists for the duration of their crossing manoeuvre or while they clear the intersection area where they are most exposed.</p> <p>The existing bus stop lay by will be reconfigured to eliminate the cycling pinch point on leaving the traffic signal stop line.</p>

		At Petone off ramp loop detection will be used to trigger electronic signs as described above. These are linked to each other and to / from the hold rail by wireless technology. Signs remain active for 20 to 30 seconds to protect cyclists for the duration of their crossing manoeuvre and while they ride under the overbridge beyond the intersection area.
Traffic crossing the path of cyclists 1) BP Service station 2) Horokiwi 3) Petone off ramp	Traffic crossing the path of cyclists	<p>Cycle routes are proposed starting just prior to the locations where traffic crosses the path of cyclists. These will be coloured green. The cycle route width will generally be 1.5m minimum. Green surfacing will be provided which diverges at the off-ramps to cover both the shoulder and the path of a cyclist riding straight across the throat of the off-ramp. This will raise driver awareness of cyclists and highlight to motorists that cyclists may be turning left or continuing straight across the off-ramp. It will also provide guidance to cyclists. Installing additional PW-35 permanent cyclist warning signs will be used as appropriate</p> <p>At BP on ramp a “lazy S” ramp crossing facility replicates general cycling behaviour on the acceleration lane. This connects to the green shoulder facility heading away from BP.</p> <p>At Horokiwi the width of the approach deceleration lane means green surfacing provision is not possible until the intersection is upgraded (currently being consulted upon). The shoulder area crossing the intersection and the on ramp has been green coloured green. This then ties into the shoulder area as a cycle route across and leaving Horokiwi.</p> <p>At Petone off ramp a hook turn and hold rail facility on the off ramp offers an alternative to the direct riding route across the throat of the off ramp. However the green direct route will be marked in the shoulder and the gore area exiting the intersection.</p>
Cyclists in a narrow shoulder 1) Petone Off Ramp 2) Horokiwi 3) SH2 On ramp at Ngauranga	Narrow Shoulder and proximity to traffic	<p>Audio Tactile Profiled road marking (ATP) marking on the approaches and through narrower sections to help protect cyclists on the approach to some of these locations.</p> <p>Petone off ramp and Ngauranga Gorge will see additional signage and green surfacing Where practical extra shoulder width will be created.</p>
Hutt Rd / Ngauranga	Road Space reallocation	Removal of physical islands and reallocating road space to allow for the provision of green on road cycle facilities at the traffic signals.

## **ILLUSTRATIVE PROJECT COSTS**

**Signs** - \$12,000 a pair (ordered in bulk)

**Power Supply Reticulation** - (150m each end), poles, loop cutting and installation - \$15,000.

**2 Loops and 2 counters plus Pocket PC reader** - \$16,000

**Thus a pair of installed electronic signs** - \$45,000 to \$55,000 depending on power supply costs.

**Green Surfacing** (for the project we negotiated a good rate). Budget for in the order of \$90/sq m

**Audio Tactile Profiled road marking** - \$6,000/km

**Overall Project** - \$500,000 (additional seal widening, construction / removal of kerb lines etc)

## **Consultation and User Reaction**

The design team involved Gina Waibl (MWH consultants) and I. Both of us are regular cyclists which is important. Additionally Daren Courtnage from Fulton Hogan on the construction side is also a regular cyclist.

The design concept and ethos evolved quickly to a point where we could discuss issues with neighbouring road controlling authorities (Wellington City Council and Hutt City Council). We also then discussed the detail with representatives of CAN, CAW and BikeNZ.

Redesign then largely took those comments on board and was progressed through internal approvals including SSRC (Scope and Standards Review Committee) given the innovation in the design content of the project.

The design was then more formally presented at a regular CAN meeting in Wellington before NZTA trialled the green surfacing near the BP service station on SH2. This included seeking reaction from regular cyclists to the material types and road marking materials through a media publicised web site and the CAN website.

Based on reaction and desired maintenance rate the material was enhanced to cater with anticipated wear.

We have completed the northbound section and on completing Petone on Ramp we will re-commenced a phase of consultation to ascertain user reaction. To some extent we know the reaction already given the number of that very rare beast the “thank you” letter we have received. We’ve also used the green to a similar layout elsewhere on the network and received a similar positive reaction. Perhaps of most note is that the simple things seem to make the most difference. Also the facility has raised several “can you do this as well?” issues which hopefully we, or our Council colleagues, can revisit.

As part of the SSRC approval was an agreement to attempt to raise awareness amongst all users. The signs and green surfacing are all part of raising awareness of

cyclists and their needs, especially in terms of road space. These relatively new elements in the design needed to be reinforced through road user education.

We developed a combination of leaflets that as the project developed drip feed information to cycle groups and the media. This also was supported by information on the NZTA website.

Education was media, web and leaflet based around what the new markings meant, how the signs worked, what they represented and sharing the road. It also covered such things as how did the cyclist on the reverse of the sign know it was on etc.

### **The Lessons Learned**

- 🚲 Where the street lighting has been the source of power for the electronic signs ensure the battery capacity has enough potential to cover the power needs and number of cycle calls during the day time.
- 🚲 The use of "cycle counter loops" seems to be highly effective in terms of both avoiding the affect of rogue calls on the signs from passing vehicles but also in that this then allows installation of a counter at that location to act as a defacto counter / monitoring site.
- 🚲 Wireless technology does seem to transmit demand calls satisfactorily.
- 🚲 Road user education - This seems to have been effective in at least heading off questions about how it all works. Involving local groups has worked well and the material to date seems a good template. There have been some interesting professional enquiries to date about the signs both from within NZ but also internationally.
- 🚲 The wider consistent shoulder on the initial bit of SH2 from Ngauranga has been a huge success, as has removing the pinch point at the bus stop on Hutt Rd.
- 🚲 Green surfacing at Hutt / Ngauranga has been well received.
- 🚲 Sign up to an agreement to cover the green surfacing, get the supplier to commit to the quality of their product and trial products.
- 🚲 Electronic signs on SH2 (and at Waimea Bridge (SH60)) have all received positive comment.
- 🚲 Petone Off ramp - we are getting feedback from regular riders that the signs have lead to changes in driver behaviour with more driver care, courteous nature and less drivers "cutting" cyclists up.
- 🚲 Cyclists in the design team helps (language, issues understood, ride lines etc)
- 🚲 Cater for the primary user type but try to cater for all. Recreate and enhance existing riding lines rather than trying to create new routes that are less likely to be used.
- 🚲 Involve the local cycling community.
- 🚲 Demonstrates that improvements aren't rocket science (easy to design, even later in the process, simple to build and applications everywhere.
- 🚲 Install signs with and use the flashing amber corner units from the outset.
- 🚲 Supplementary plate, consider the use of a supplementary plate below the electronic sign to describe the cycling manoeuvre ahead that motorists need to anticipate.
- 🚲 Hold Rails – Avoid the use of green or red coloured covers on the activation light by the call button in case it gets miss-interpreted as a go / stop signal.