Malvern Hills Small Bridge Replacements

Low Volume Roads Workshop Tauranga
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Introduction

• Four timber bridges in the Waianiwaniwa Valley of the Malvern Hills had weight or speed restrictions
• The restrictions limited heavy vehicle access into and out of the area (16 km additional travel)
• Three of the bridges had weight restrictions and one had a speed restriction only
• The three weight restricted bridges were included in a replacement project
Introduction

• The Waianiwaniwa Valley was an option for a dam and flooding as part of the Central Plains Water Scheme
• When this option was discounted Council funded the bridge replacements over a two year period (2014/2015)
• Council’s Road Maintenance Contractor (HEB Construction Ltd) was engaged on a design and build basis to replace the three weight restricted bridges
• The speed restricted bridge was replaced in 2016 as a separate project
Location Details

1. Malvern Hills Rd, Waianiwaniwa River – weight restricted
2. Auchenflower Rd, Waianiwaniwa River – weight restricted
3. Malvern Hills Rd, Waianiwaniwa River branch – weight restricted
4. Malvern Hills Rd, Oyster Gully – speed restricted

All roads in the Malvern Hills are low volume (<100 vpd) and unsealed
Location Details
Contractor Engagement

• HEB Construction Ltd commenced as the Road Maintenance Contractor in July 2010
• Bridge maintenance was part of the contract but replacements and new builds were not
• HEB had a Structures Team based in the region
• When this bridge replacement project was confirmed HEB was asked to price the replacements on a design and build basis
• The Structures Team did the design and build for the bridge and the Maintenance Team did the removal and new approach construction
Design - General

• A site and geotechnical survey was arranged by Council for each site
• The geotechnical survey found the soil consists of silt, fine sand and gravel layers with a dense underlying gravel base 7 m below ground level
• The bridges were designed in accordance with the NZTA Bridge Manual (SP/M/022) dated May 2013
• The design was for single lane, vehicle loading of Class 1 and waterway area for a 1 in 100 year flood
Design - General

- With the similar existing bridge lengths and site conditions the same design was used for each bridge

<table>
<thead>
<tr>
<th>Bridge</th>
<th>Waterway</th>
<th>Old Bridge</th>
<th>Replacement Bridge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malvern Hills Rd</td>
<td>Waianiwaniwa River</td>
<td>Timber 2 span @ 6.6m</td>
<td>Composite steel &amp; concrete 1 span @ 13m</td>
</tr>
<tr>
<td>Auchenflower Rd</td>
<td>Waianiwaniwa River</td>
<td>Timber 2 span @ 6.3m</td>
<td>Composite steel &amp; concrete 1 span @ 13m</td>
</tr>
<tr>
<td>Malvern Hills Rd - Bush Gully Bridge</td>
<td>Waianiwaniwa River branch</td>
<td>Timber 2 span @ 5.5m</td>
<td>Composite steel &amp; concrete 1 span @ 13m</td>
</tr>
</tbody>
</table>
Design - Substructure

• Precast concrete abutments, 4.2 m long at each end supported on 310 UC x 137 kg/m driven steel piles at 2.6 m centres
• The abutment cap beam is 500 mm high x 800 mm wide and the abutment headwall is 150 mm thick x 910 mm high
• The steel beam flange is 245 mm wide x 20 mm thick
• The hold down bolts are M24 grade 8.8/S hot dip galvanized at 140 mm pitch and embedded 300 mm into the abutment
Design - Substructure
Design - Superstructure

- Two 700WB130 kg/m welded steel beams at 2.6 m centres x 13 m long in composite action with a 185 mm thick precast concrete panel deck
- The beams are braced by diagonal and horizontal 90 x 90 EA sections at each end and at mid span
- The precast concrete deck panels are 4 m wide x 2 m long and tied together by a transverse in-situ concrete stitch at the junction between panels
- The concrete deck panels are connected to the steel beams by the use of shear studs welded to the beam at 150 mm centres aligning with a 100 mm gap in the deck panels and placement of 50 MPa concrete in the gap
Design - Superstructure

Malvern Hills Rd Waianiwaniwa River branch
Construction – Programme

• Remove the existing timber bridge
• Drive steel piles
• Place precast concrete abutments
• Place steel beams and tie into piles and abutments
• Place precast concrete deck slabs
• Construct approaches
• Complete guardrail installation
Construction – Programme and Road Closure

• The first two bridges were done at the same time (April/May 2014) and the third bridge in May 2015
• Road closures were put in place for the construction period
• Signs were placed prior to the construction at each of the sites giving details of the closures to the regular users
• A letter drop was made to the residents in the Waianiwaniwa Valley
• Other road users were contacted – school bus operators, local transport companies, Fire Service, Police, NZ Post
Construction – Programme and Road Closure

• An email list was compiled for those wanting to receive updates during construction
• The contractor supplied a daily report (what was done yesterday, what is being done today, what is planned for tomorrow)
• The detail was sent by Council to those on the email list
Construction – Timber Bridge Removal

• Removal of existing bridge structure

• Retain as much of the existing timber as possible for use on other timber bridge repairs and for the retaining walls on the new bridge
Construction – Timber Bridge Removal
Construction – Substructure

- Placement of steel piles
- Driven to refusal at 10 m at the Malvern Hills Rd sites and 12 m at the Auchenflower Rd site
- Weld in place flange plates to support the precast concrete abutments
- Place precast concrete abutments in preparation for placement of superstructure
Construction – Substructure

Malvern Hills Rd Waianiwaniwa River branch

Auchenflower Rd Waianiwaniwa River

Selwyn District Council
Construction – Substructure

Malvern Hills Rd Waianiwaniwa River

Malvern Hills Rd Waianiwaniwa River
Construction – Superstructure

• Placement of steel beams
• Tie beams into abutment and steel piles
• Place precast concrete deck panels
• Concrete in deck joins
• Install guardrail
Construction – Superstructure

Auchenflower Rd Waianiwaniwa River

Malvern Hills Rd Waianiwaniwa River branch
Construction – Superstructure

Malvern Hills Rd Waianiwaniwa River branch

Malvern Hills Rd Waianiwaniwa River
Construction – Superstructure

Deck connection to beam with welded shear studs

Transverse deck join with knitted reinforcing

Malvern Hills Rd Waianiwaniwa River

Malvern Hills Rd Waianiwaniwa River
Construction – Guardrails

Auchenflower Rd Waianiwaniwa River

Malvern Hills Rd Waianiwaniwa River branch
Construction – Approaches

• Use of timbers from the old bridges for the retaining walls
• Use of locally sourced soft rock for the base of the construction
• Complete the installation of the guardrail and install signs
Construction – Approaches
Construction – Approaches
Construction – Completed

Malvern Hills Rd Waianiwaniwa River

Malvern Hills Rd Waianiwaniwa River branch

Selwyn District Council
Construction – Cost

Total cost for the three bridges was $525,000 (excluding GST) which included:

• Design (including site and geotechnical survey)
• Resource Consent and Building Consent
• Adjustment of overhead power lines
• Demolition of existing bridges
• Construction of new bridges and approaches
• Temporary Traffic Management
Conclusions

• Bridges on low volume rural roads provide a vital link for the property owners and fit for purpose bridges need to be constructed.

• Utilising the skills of the road maintenance contractor and having the construction of the three bridges as one project on a design and build basis resulted in a coordinated project.

• The use of prefabricated components and the attention to detail in the design and planning meant that the construction was completed as programmed with the road closures kept to a minimum.
Conclusions

• With the weight restrictions having been in place for many years and the locals requesting the replacement there was a good acceptance of the work and the disruptions that were part of this

• The good buy-in and communication with the local residents and road users meant that there was no negative feedback during any of the construction or road closures
Questions or Comments?