Business case for implementation

STATE HIGHWAY 8 BEAUMONT BRIDGE REPLACEMENT

Opus International Consultants Ltd

September 2017

Final

Detailed business case to proceed from initiation to implementation

The copyright of this document is held by the New Zealand Transport Agency. ©
No reproduction of any part of this document is permitted without written permission.

Copyright information

This publication is copyright © NZ Transport Agency. Material in it may be reproduced for personal or in-house use without formal permission or charge, provided suitable acknowledgement is made to this publication and the NZ Transport Agency as the source. Requests and enquiries about the reproduction of material in this publication for any other purpose should be made to:

Manager, Information
NZ Transport Agency
Private Bag 6995
Wellington 6141

The permission to reproduce material in this publication does not extend to any material for which the copyright is identified as being held by a third party. Authorisation to reproduce material belonging to a third party must be obtained from the copyright holder(s) concerned.

Disclaimer

The NZ Transport Agency has endeavoured to ensure material in this document is technically accurate and reflects legal requirements. However, the document does not override governing legislation. The NZ Transport Agency does not accept liability for any consequences arising from the use of this document. If the user of this document is unsure whether the material is correct, they should refer directly to the relevant legislation and contact the NZ Transport Agency.

More information

NZ Transport Agency
Published September 2017

If you have further queries, call our contact centre on 0800 699 000 or write to us:

NZ Transport Agency
Private Bag 6995
Wellington 6141

This document is available from the NZ Transport Agency on request.

APPROVAL

PREPARED BY	REVIEWED BY	ENDORSED BY	ENDORSED BY
Megan Crossen (Opus) Natalie Veale (Opus)	Peter Kortegast (Opus)		
		Proposal sponsor	P&I Case Manager
Date:	Date:	Date:	Date:
13 June 2017	12 June 2017		

REVISION STATUS

REVISION NUMBER	IMPLEMENTATION DATE	SUMMARY OF REVISION
Draft 1	June 2017	Draft Detailed Business Case
Final	September 2017	Final Detailed Business Case

Contents

GLOSSARY OF TERMS

Abbreviation	Term
AEE	Assessment of environmental effects
AO	Approved organisation
BCR	Benefit-cost ratio
CAPEX	Capital expenditure
CBD	Central business district
CEMP	Construction environmental management plan
CVIU	Commercial vehicles investigation unit
D&C	Design and construct
DE	Design estimate
EEM	*Economic evaluation manual*
EIR	Environmental impact report
EOI	Expression of interest
EPA	Environmental Protection Agency
FYRR	First year rate of return
GPS	Government Policy Statement
HCV	Heavy commercial vehicle
HNO	Highways and Network Operations
HPMV	High productivity motor vehicle
HPT	Historical Places Trust
IAP2	International Association for Public Participation
ILM	Investment logic map
IRS	Investment and revenue strategy
ITS	Intelligent transport systems
KPI	Key performance indicator
LLR	Lessons learnt review
LTMA	Land Transport Management Act
MOU	Memorandum of understanding
MVKT	Million vehicle kilometres travelled
NES	National environmental standards
NIU	National infrastructure unit
NLTF	National Land Transport Fund
NLTP	National Land Transport Programme
NOR	Notice of requirement

NPC	Net present cost
NZCID	New Zealand Council for Infrastructure Development
NZTA (or the Agency)	The New Zealand Transport Agency
NZTS	New Zealand transport strategy
OPEX	Operating expenditure
P&I	Planning and Investment
PI	Performance indicator
PMS	Project management services
PoPS	Portfolio procurement strategy
PPFM	Planning Programming and Funding Manual
PPM	Principal Project Manager
PPP	Public Private Partnership
PT	Public transport
PWA	Public Works Act
RAMM	Road Assessment and Maintenance Management
RFP	Request for proposal
RLT	Regional Land Transport
RLTS	Regional Land Transport Strategy
RMA	Resource Management Act
RoNS	Road of national significance
SAR	Scheme assessment report
SE	Scheme estimate
SH(#)	State Highway (number)
SOI	Statement of intent
SSC	State Services Commission
SSEMP	Site specific environmental management plan
TA	Territorial Authority
TDM	Traffic demand management
TOC	Total outturn cost
VAC	Value Assurance Committee (formerly SSRC)
VMS	Variable message sign
WEBs	Wider economic benefits

EXECUTIVE SUMMARY

The Beaumont Bridge is a single lane, wrought iron truss bridge constructed in 1884. It now requires significant maintenance work to keep it in service for the current live loads experienced on SH8 between Dunedin and Queenstown.

A report for Point of Entry was completed on behalf of the New Zealand Transport Agency (the NZ Transport Agency) in March 2016 which concluded:

> "The key issues are both level of service and condition. There is an increasing risk of a sudden failure under load changes (e.g. HPMV) and material characteristics, leading potentially to significant effects on freight movements. The bridge has reached 'end of life' – in effect the bridge cannot be effectively managed despite the on-going significant cost of management."

During this Detailed Business Case assessment the problems opportunities and constraints were re-confirmed and further developed. The outcome is that the predominant problem facing the existing Beaumont Bridge is due to it having reached 'end of life'. It is therefore uncertain how long the bridge can be maintained for and the associated costs of the maintenance works to keep up with traffic demands along this route. Due to this ongoing maintenance work and poor pedestrian and cycling facilities there is a perceived unsafe environment.

The project outcomes are focussed around three key benefits:

- **Benefit One:** Improved resilience (80%).
- **Benefit Two:** Improved safety and connectivity for pedestrians and cyclists (10%).
- **Benefit Three:** Improved capacity both for traffic flows and heavy loads (10%).

An Indicative Business Case (IBC) was not completed by the NZ Transport Agency and therefore no specific options for a new alignment and structure had been developed. Therefore, during this Detailed Business Case (DBC) process, a long list of options was developed including:

- Do nothing
- Replace the existing bridge
- An option that retains the alignment as closely as possible downstream of the existing bridge (Ribbon A)
- An option that travels through the township of Beaumont, crossing the Clutha River at the old ferry crossing (Ribbon B)

The long list of options was reduced to two preferred options, Ribbon A and Ribbon B which was taken to public consultation.

Following public engagement, Ribbon A was selected to be developed. This corridor alignment consists of a new 200 metre long two-lane bridge located approximately 40m downstream of the existing bridge structure.

The new bridge has a slight curve to allow for the retention of the existing bridge structure, avoid existing properties and utilise the rock outcrops for the pier positioning.

This curve also allows vehicles to navigate the new alignment more safely at higher speeds. Higher speeds are likely to result from the increased bridge width and removal of the traffic lights, which are currently used to act as a speed restriction over the existing bridge.

Figure 1: Preferred Alignment

The proposed bridge cross-section is:

- Two 3.5m wide traffic lanes (one in each direction)
- 1.0m wide carriageway shoulders
- A 3.0m wide (minimum) barrier separated shared path facility over the bridge (downstream side)

In addition to the new bridge the recommended approach road alignment and improvements includes:

- approximately 900 metres to SH8;
- improvements (including closure) to seven local junctions; and
- a shared path linking the Clutha Gold Trail (eastern bank of the Clutha River) and the local facilities at the Beaumont Hotel (western bank) using both the old and new bridges avoiding crossing SH8.

A new two lane bridge presents a number of opportunities for improvement in road safety, resilience, capacity, travel time and public perception of SH8. The main issue with this works however is that an improved alignment with two lanes removes the current pinch point on this section of road, which has benefited local cyclists crossing SH8 on the Clutha Gold Trail and parking outside the hotel. This issue was carefully addressed through the options assessment phase.

Due to the noted heritage value of the existing bridge. it is intended to not demolish it. It has been concluded to have high aesthetic and cultural value, and exceptional historic, contextual, technological, scientific and archaeological value. Whilst the existing bridge is

currently at the end of its life and provides no certainty for the current loading, should this load be removed then it is believed the structure may be retained for a new use, i.e. cyclists.

The expected estimate for the project is $14.5M, including allowance for property purchase and excluding the maintenance of the existing historic bridge.

The do minimum option is to construct a single lane bridge along the preferred alignment. The incremental increase in net value for the preferred the project has a Benefit Cost Ratio (BCR) of 1.1. Due to the current and forecasted traffic flows and no other single lane bridges between Dunedin and Queenstown there are additional benefits to the wider network to justify two lanes.

The most significant project risks relate to property purchase and resource management consenting approvals impacting on the delivery schedule; however at this stage it is considered that these risks can be adequately managed.

The next phase of the project is pre-implementation, which will involve the preparation of design drawings as necessary, and specifications and schedules for the proposed works.

PART A – THE CASE FOR THE PROJECT

BACKGROUND

The Beaumont Bridge is a 133 year old, single lane wrought iron truss bridge. It is a vital link for the Beaumont Township as well as for those travelling between Dunedin and Queenstown on State Highway 8. The allowance of 62 tonne vehicles combined with age-related structural integrity issues result in a high level of maintenance required and give uncertainty around the long-term serviceability of the bridge. This business case has therefore been developed to investigate viable options for a bridge replacement.

This Detailed Business Case (DBC) has been prepared on behalf of the New Zealand Transport Agency (the NZ Transport Agency) to investigate and recommend a preferred solution for the State Highway 8 (SH8) crossing of the Clutha River at Beaumont.

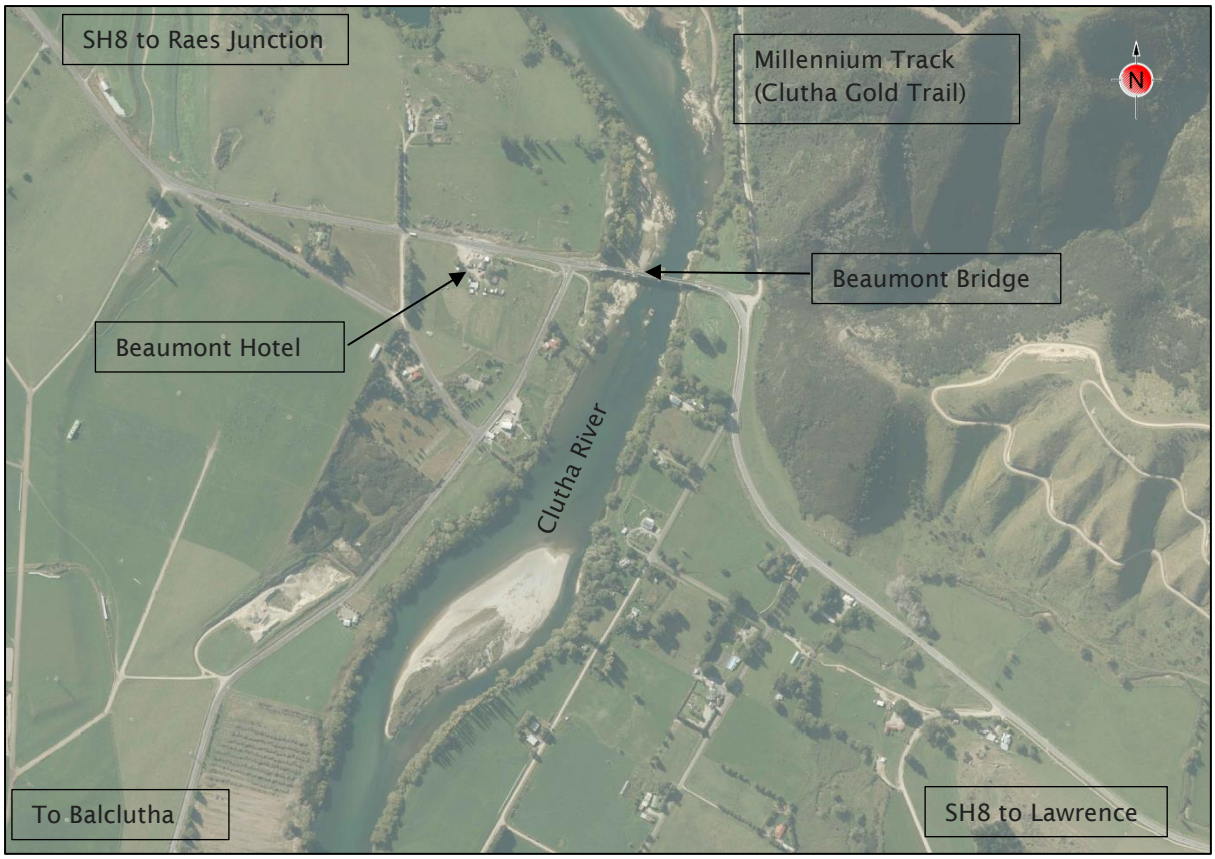


Figure 1: Location Map

The Beaumont Bridge (Bridge 4072) is a single lane, wrought iron truss bridge constructed in 1884 and is a SH8 crossing point over the Clutha River. In addition to this, the bridge is of significant importance to those travelling between Dunedin and Queenstown, as it currently provides the most direct route between the centres. The Beaumont Township is separated by the Clutha River, and this bridge now forms the only connectivity between the two parts of the town.

Over three stages, the Beaumont Bridge has been strengthened to permit the use of full High Productivity Motor Vehicles (HPMV) in order to provide efficient freight services. As part of these ongoing maintenance improvements, traffic lights were installed to ensure traffic would be forced to slow down and cross the bridge at 30km/h. This has resulted in the extension to the life of the bridge and allowance of 62 tonne vehicles using the bridge. The demand for the higher loads on the Beaumont Bridge has come about as a result of the distance of alternative routes.

A Report for Point of Entry was completed by Opus in February 2016, outlining existing conditions, current maintenance works, and the deterioration of the bridge. This report is included as Appendix A.

The Beaumont Bridge is an aging wrought iron structure with manufacturing defects in the riveted trusses, making it susceptible to fatigue cracking. Given the current traffic loading on the bridge, it is a credit to the original 1883 bridge designers that it has performed as well as it has. However, due to the existing timber deck (which also has limited residual life) and trusses, a significant amount of continuous maintenance is done each year, but to replace these would cause significant disruption and costs.

The condition of the bridge is not noted to be an immediate public safety risk; however, the condition and age means it is at the end of its serviceable life. Therefore, the NZ Transport Agency is unable to retain confidence in it as a long term solution, particularly when considering current and future traffic conditions.

The project has been discussed and postponed over a number of years, predominantly due to the proposal of constructing a dam at Tuapeka Mouth. This proposal was abandoned in 2012, and the Beaumont Bridge replacement has regained momentum.

This DBC has been developed to investigate the viable options for replacing the Beaumont Bridge and protection of SH8 following on from the Report for Point of Entry.

The objective of this DBC is to identify and assess the current and alternative bridge locations and associated highway alignments and make a recommendation on a preferred option which will meet the goals set out in the ILM.

The Investment Logic Map developed for the business case is included as Appendix B.

Work completed to date

Work completed to date relating to the Beaumont Bridge business case is summarised below.

Point of Entry Report

The *"SH8 Beaumont Bridge Report for Point of Entry, March 2016"* was produced for the business case process and is therefore the most relevant document completed to date. The report is appended for reference (Appendix A).

The report outlines the level of service the bridge currently provides, which is substandard for both safety and seismic standards. It also discusses the deterioration and failure mechanisms, and maintenance undertaken to reduce the likelihood of these.

A management strategy is currently in place to manage and record the deterioration of the bridge. Maintenance tasks include annual maintenance of the timber decks, tracking crack propagation and traffic calming. For full details refer to Appendix A.

In addition to the management strategy, surveillance maintenance for the Beaumont Bridge is undertaken and includes:

- 6 month Non Destructive Testing (NDT), Eddy Current and Mag Particle testing;
- 2 month Visual inspections - includes photograph record; and
- Annual inspection review by Senior Structural Engineer.

A number of uncertainties relating to the structural integrity exist despite the level of surveillance and monitoring. Any closures or restrictions required for bridge repairs would affect a minimum of 200 freight movements per day and would result in undesirably lengthy detours.

Due to the age of the bridge, and the associated uncertainties, the report concludes that "there is an increasing risk of a sudden failure under load changes (e.g. HPMV) and material characteristics, leading potentially to significant effects on freight movements. "The bridge has reached 'end of life' - in effect the bridge cannot be effectively managed despite the on-going significant cost of management."

Business case process

It is noted that the NZ Transport Agency have combined the Indicative and Detailed Business Case stages for this project. Neither a strategic nor a programme business case has been developed. This approach has been adopted as best reflects the urgency and significance of the problem.

Project governance

The project governance arrangements for the business case development phase is outlined in Figure 2.

The SH8 Beaumont Bridge Replacement DBC project is a NZ Transport Agency project. Simon Underwood is the NZ Transport Agency's Project Manager and is responsible for ensuring the project follows NZ Transport Agency processes and will champion the reports on this project to the NZ Transport Agency's executive team.

Organisation structure

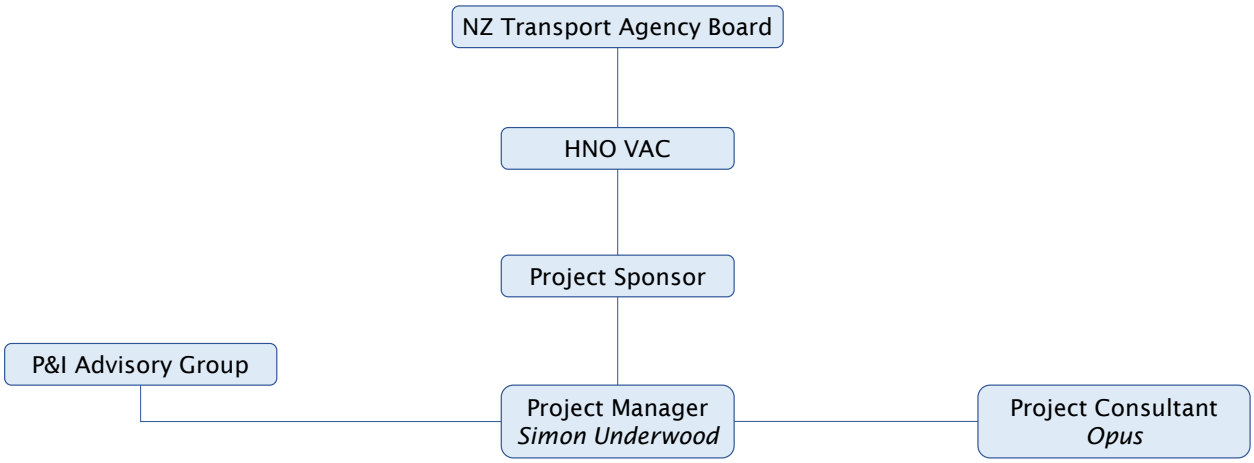


Figure 2: Organisation Structure

NZ Transport Agency Board

The NZ Transport Agency Board has overall responsibility for NZ Transport Agency projects. The Board reports directly to the Minister of Transport and is responsible for:

- Land transport planning;
- Managing the state highway network;
- Regulating access to, and participation in, the land transport network; and
- Promotion of land transport safety and sustainability.

Highways and Network Operations Group Value Assurance Committee

The HNO Group Value Assurance Committee (VAC) is the most senior project decision making team within the HNO group, which comprises the National Manager Professional Services and various other senior managers and technical specialists.

Project sponsor

The project sponsor is responsible for:

- Ultimate authority and responsibility for the project;
- Endorsing changes to scope, schedule, budget and quality;
- Endorsing escalation and championing recommendations to the Highways VAC;
- Providing policy guidance to the Project Manager;
- Endorsing the Project Management Plan to confirm that project scope and deliverables are correct;
- Reviewing progress and providing advice on resolution of issues;
- Supporting the Project Manager; and
- Resolving issues beyond the Project Managers authority.

PROBLEMS, OPPORTUNITIES AND CONSTRAINTS

This chapter outlines the existing problems and opportunities the project faces, as well as any issues and constraints. The predominant problem identified in the Point of Entry Report is the age and defects in the existing structure, which is at its 'end of life'. An Investment Logic Mapping workshop was undertaken and identified the lack of pedestrian and cycling facilities and retention of HPMV as two other key problems. The removal of the current 'out of context' local speed restriction on the bridge would remove the throttle point, resulting in the increase in speed and in turn safety risks.

Problems and opportunities

Defining the problem

As outlined in the Point of Entry Report, there are the following problems with the existing bridge:

- Does not meet current standards for width;
- Seismic capacity is considerably lower than today's standard for a structure on a State Highway route; and
- Fatigue/corrosion.

As outlined in the Opus "*SH8 Beaumont Bridge Report for Point of Entry, March 2016*" report;

> *The existing bridge does not meet a number of standards. Both the lane width and 'footpath' widths are narrow and the seismic strength is inadequate. The bridge requires regular inspections and testing, and maintenance is continuous.*
>
> *The safety margins previously relied on for the bridge have been reduced since the allowance of heavier vehicles. Strengthening work was undertaken to allow for this reduction, but it is not possible to eliminate fatigue, resulting in an unknown risk of if or when the bridge may fail. Due to the age of the bridge, and associated uncertainties, the report concludes that "there is an increasing risk of sudden failure".*
>
> *The bridge has reached 'end of life'.*

Based on information available to date the statement *'it is not possible to accurately predict when the wrought iron will fail due to fatigue'* remains unchanged.

The bridge is currently under a high maintenance regime which costs approximately $500k per year. As the bridge remains in use for traffic (in particular HPMV), fatigue deterioration under these load conditions and material characteristics has led to: increased surveillance, real time monitoring, strengthening and increased risk of closing the bridge to traffic.

Whilst the condition of the current bridge is a key driver, the possibility of additional maintenance work can be undertaken to continue the extension of the life of the bridge for a number of additional years.

An informal Investment Logic Mapping (ILM) workshop was held with the project team, including the NZ Transport Agency, to determine and define the problem statements and benefits of undertaking the project. Three key problems were identified:

- Resilience for SH8 crossing the Clutha River (80%);
- No walking and cycling facility link exists on the existing bridge or provided for the community across the Clutha River that complies with current standards (10%); and
- Maintaining HPMV rating for SH8 (10%).

Resilience for SH8 crossing the Clutha River

The problems associated with the Beaumont Bridge relate to the overall performance of SH8 and its role in the transport network.

It is intended for resilience of SH8 that the crossing point of the Clutha River at Beaumont meets current seismic requirements, traffic loads (including HMPV) and has an operational life of at least 50 years.

The loss of a crossing point at Beaumont would not only segregate SH8 but also push a large number of vehicles on smaller local roads, many of which are not designed to handle the large volumes of vehicles.

When the bridge has been closed overnight for maintenance it has been observed that traffic travelling between Lawrence and Roxburgh travel via Clydevale or Balclutha, which increases the trip time from 40 minutes to 1.5 hours or 2.25 hours, respectively.

The only other crossing between these two bridges of the Clutha River is the Tuapeka Mouth Ferry which operates daily 8am till 10am and 4pm until 6pm, river level permitting and strict weight restrictions. These restrictions make this unreliable as a crossing point.

Due to the condition of the Millers Flat Beaumont Road (single car width for the majority of this 20km shared path), it is not encouraged as an alternative route and therefore not discussed.

Walking and cycling Facilities

The current bridge is narrow with a small walkway which was installed between 1960 and 1980 and whilst it provides a crossing point, very few have been seen using it. The current handrails are installed as part of the scaffolding for the ongoing maintenance works.

As shown in Figure 3 the 0.65m wide walkway feels narrow especially when high sided vehicles are also travelling over the bridge. The bridge is approximately 140m long and cannot be crossed at a walking pace in between the current traffic light phases.

The traffic lights have a cyclist button provided to allow them a head start on traffic as the width does not allow for a car and a cyclist to travel side by side. In general, conditions are not favourable and do not meet the guidelines for all road users.

Figure 3: Existing Bridge Configuration

HPMV Route

The route along SH8 between Dunedin and Queenstown, which passes through Beaumont, was classified in June 2016 as being "available for full High Productivity Motor Vehicles (HPMV) following bridge strengthening work", according to the NZ Transport Agency (see Figure 4). The strengthening work required was undertaken in July 2016 and the route is available for full use for 62 tonne HPMVs.

This is the only single lane bridge along the SH8 section between Milton and Cromwell (the main HMPV distributor between Dunedin and Queenstown) and due to the speed restrictions, traffic lights and ongoing maintenance can cause a pinch point or major diversionary detour.

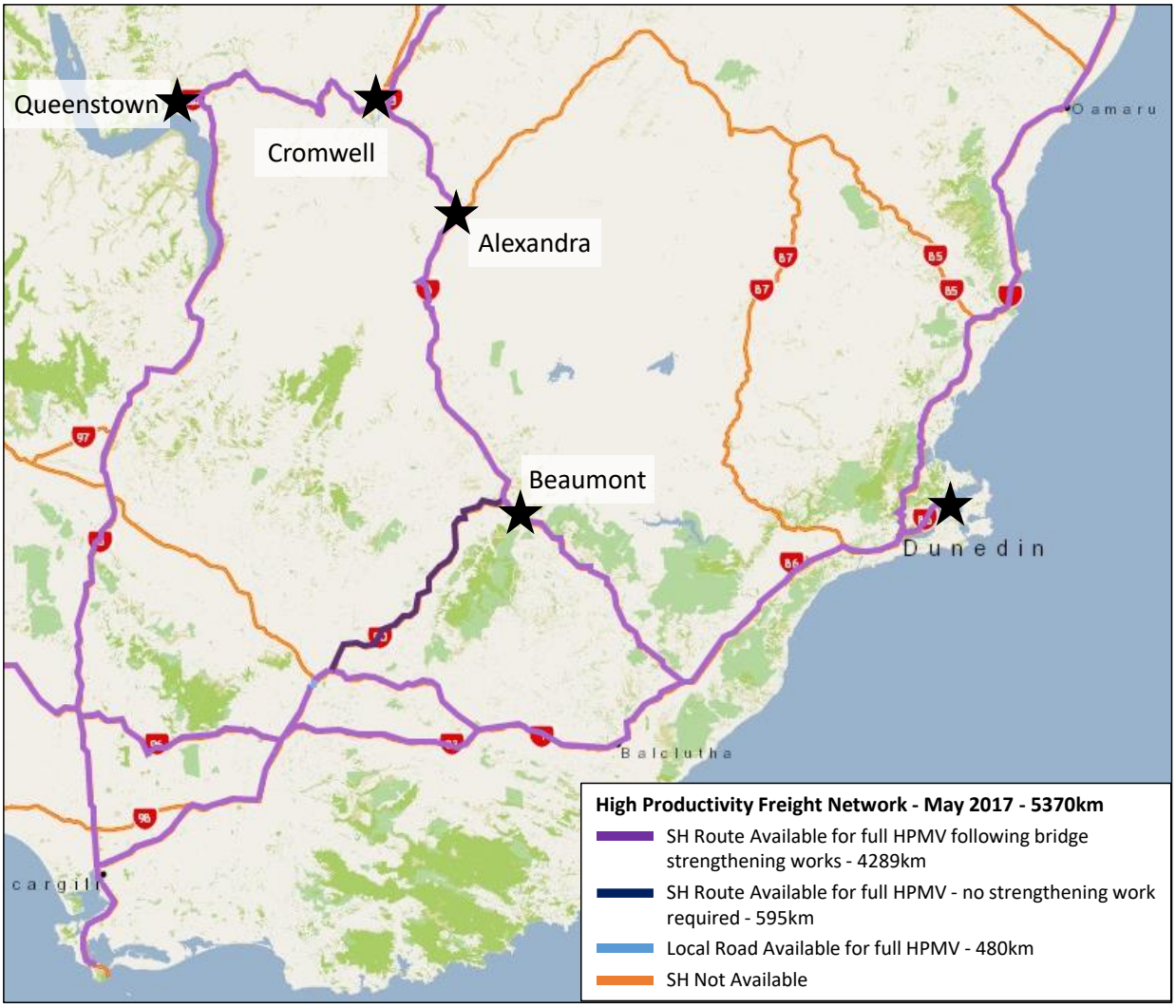


Figure 4: High Productivity Freight Network[1]

It is clear that if HPMVs were unable to use the SH8 route through Beaumont, their journeys will significantly increase in both distance and travel time.

Table 1 outlines the route options for HPMVs travelling between Dunedin and Queenstown. Option 1 uses the Beaumont Bridge, while options 2-4 are the alternative routes, which would also be used for detours. Routes outlined in orange in Figure 4 are not available for full HPMV, therefore no options exist for these.

[1] New Zealand Transport Agency High Productivity Freight Network
http://nzta.maps.arcgis.com/apps/webappviewer/index.html?id=e00b3ac6ab524cb19a369fc5c2b4e6fa

Table 1: HPMV Route Options - Dunedin to Queenstown

Option	Description	State Highways	Distance (km)[2]
1	Dunedin → Beaumont → Alexandra → Queenstown	86 → 8 → 8B → 6	282
2	Dunedin → Balclutha → Gore → Alexandra → Queenstown	86 → 1 → 90 → 8 → 8B → 6	343
3	Dunedin → Balclutha → Clinton → Mataura → Winton → Queenstown	86 → 1 → 93 → 96 → 6	358
4	Dunedin → Balclutha → Clinton → Mataura → Invercargill → Queenstown	86 → 1 → 93 → 1 → 6	392

The distances of the three alternative routes are significantly longer than the existing route, with a minimum of an additional 60 kilometres to be travelled. The added distance to journeys would increase travel time, resulting in an inefficient journey.

Despite being available for full HPMV, the Beaumont Bridge has restrictions for overweight vehicles. These restrictions depend on the vehicle's configuration and due to the narrowness of the bridge, wide loads are not possible. This is a problem when providing an efficient transport network as vehicles that do not meet the restrictions may be required to travel excessive distances in comparison to using the SH8 Beaumont Bridge route.

The continuation of allowing 62 tonne HPMV vehicles to cross the Clutha River is a strong business driver for the project, and providing a bridge that is capable of doing this with significantly reduced maintenance requirements results in a resilient transport network.

Opportunities

A replacement to the current Beaumont Bridge offers numerous opportunities to not only increase the resilience of SH8 but also the experience for all road users. These are outlined in the sections below:

i) Road Geometric and Safety Improvements

The Beaumont Bridge currently has an 'out of context' local speed restriction of 30km/h which is controlled through the use of traffic lights on the single lane bridge as part of the maintenance regime. This in turn has helped keep the severity of crashes low. The history of crashes within the proximity of the bridge are noted to be head on, lost control, cornering and rear end. The head on occurred on the bridge and the majority predate the installation of traffic lights.

The current bridge with the lights and speed restrictions currently form a throttle point. As above these were installed for maintenance and not road safety reasons, however due to the duration of time these have been installed and the construction and use of the Clutha Gold Trail (which uses the Millennium Track) many are used to these slower speeds. Therefore, the removal of this speed restriction and lights would see an increase in speeds, and in turn could see an increase in accidents.

[2] Google Maps 2017

Replacing the bridge provides an opportunity to consider road realignments to improve the existing road geometrics, sight lines, junctions and crossings.

In addition, geometric improvements may be necessary to address the predicted increase in traffic speeds through the township as a result of the bridge upgrade to increase safety.

ii) Walking and Cycling

As the Beaumont Township is segregated by the Clutha River, a bridge is crucial to provide connectivity for all residents without access to a vehicle. On the eastern side is the community hall and on the western side is the Beaumont Hotel which is the only public house in the township.

In addition, the Clutha Gold Trail travels along the Millennium Track which follows the eastern bank of the Clutha River. As above the Beaumont Hotel is on the other side of the river and this provides accommodation and facilities for cyclists.

A new structure potentially allows for walking and cycling facilities to be provided separate from highway vehicular traffic. This will improve access and safety for walkers and cyclists crossing the bridge.

In addition, the eastern and western crossing points should where possible go underneath the structure to avoid walkers and cyclists from having to cross the live lanes.

iii) Improved Vehicle Live Load Capacity

The new bridge will be designed to modern HN-HO-72 design loading, allowing HPMVs and significant overweight vehicles access across this bridge.

iv) Improved Journey Experience

A new two lane structure to current highway standards will result in a reduction in delays and consistency in travel times, reducing driver frustration. The current single lane bridge requires significant maintenance. This causes regular delays to traffic, and significant detours via local roads that are not designed to state highway standards.

The new bridge will not require the current level of maintenance and traffic management that the existing bridge does, therefore reducing inconvenience and creating for a more efficient journey.

v) Retention of Existing Bridge

The Beaumont Bridge has high archaeological, aesthetic and cultural value; and exceptional historic, contextual, and technological value. The settlement of Beaumont also has high cultural, archaeological, historic and social value.

An opportunity exists to retain the existing bridge to maintain these values and give it a new purpose. This will mean the heritage value the bridge holds will be retained, and a secondary crossing point may be available for pedestrians and cyclists. Using the existing bridge in this manner would provide a facility for those using the Clutha Gold Trail who want to access the Beaumont Hotel.

Retaining the existing bridge and using it as a cyclist and pedestrian facility would rely on another party taking over the ownership or management of the bridge.

vi) Community Engagement

SH8 travelling through Beaumont along its current alignment provides passing trade for the local hotel, and as mentioned earlier the maintenance work and discussions about replacing the Beaumont Bridge has been ongoing for a number of years. The Beaumont community therefore has a vested interest in the project as any changes to the existing situation may potentially have significant impacts on the community.

As part of this project, an important opportunity exists to include the community's ideas and opinions in the design process. This will be completed through official liaisons as well as open days in Beaumont. The bridge is located in their community so these forums provide a good opportunity for locals to have input. At the present time, a number of properties in Beaumont are for sale, which may result in pressure to progress with the project quickly.

Issues and constraints

Issues

i) Safety

The main issue associated with the replacement of the SH8 Beaumont Bridge is the risk that a wider structure could increase vehicle speeds through the town, as the current structure forms a throttle point.

Both options have wider traffic lanes and this factor, with the aesthetics of the bridge, may encourage drivers to travel at higher speeds. Therefore even a new single lane bridge would result in an increase in vehicle speeds over the structure, even if considerable signage and thresholds are installed. This could result in an increase in both the frequency and severity of accidents at the site.

A proposed single lane bridge would still require traffic calming due to the length of the bridge, however a two lane bridge would remove the need for traffic signals entirely.

To address this significant issue, the alignment of the new bridge needs to carefully consider the desirable speed for the curves of the bridge and approaches. In addition, the alignment needs to carefully consider the geometry and sight lines for all of the junctions on the approaches.

Constraints

Various constraints have been identified as part of the DBC. These key constraints are related to the overall project as opposed to solely the delivery of the business case.

i) Extent of Corridor

The focus of this DBC is on the Beaumont Bridge and retention of the SH8 crossing of Clutha River at Beaumont. Any new bridge and supporting alignment works was required to fit between the junctions of SH8 and Chinaman Flat Road (to the east) and SH8 and Westferry Street (to the west).

ii) Heritage Value

A Heritage Significance Assessment was undertaken by Opus in September 2016. The assessment is included as Appendix L.

The assessment found that the bridge is listed as a historic structure in Clutha District Council's Register of Heritage Buildings, item no. H61; and is recognised with an IPENZ Heritage Record. However the bridge is not on the New Zealand Heritage List.

The heritage assessment made a number of recommendations, with the most important being that the existing bridge is retained. The other recommendations are:

- a new use for the bridge should be found;
- repair works should be undertaken so that permanent scaffolding is not required;
- a complete clean of the structure should be undertaken;
- replacement options should consider the heritage significance of both the existing bridge and the Beaumont settlement;
- a full and comprehensive Conservation Management Plan for bridge should be prepared; and
- a full and comprehensive Archaeological Assessment should be prepared.

The significant constraint to the design is determining whether the existing bridge is able to be retained and maintained by the most appropriate party.

The assessment also notes the settlement of Beaumont has a high cultural, archaeological, historic and social value. There are no known registered archaeological sites within the ribbons identified, however it is possible based on the sites found within 1km of the bridge that that there was pre-European occupation of the area and this should be considered throughout design and construction.

iii) Stakeholders and Affected Parties

Project constraints may come from stakeholders, affected landowners and/or business owners in the area.

In order to mitigate any issues and constraints these parties may have, a number of consultation steps have been planned. A land plan has been produced, allowing the project team to determine which landowners may be affected by the works. Formal letters regarding consultation have been sent to these owners, who will have an opportunity to have their input into the project through planned consultation meetings.

Until property negotiations are progressed with the directly affected landowners this remain an issue.

iv) Geotechnical Aspects

Two significant geomorphological observations were made during the geotechnical investigation:

- the close proximity to the Tuapeka Fault; and
- the soils on the eastern approach to the bridge and the floodplains.

The area of the recorded Tuapeka fault line was inspected as part of the site walkover. The alignment of the fault roughly aligns with the former ferry road south of the existing bridge.

Further away from the proposed alignment the fault trace is visible in the hillside to the west.

The soils on the eastern approach are colluvium/alluvium soils which are likely to be relatively fine grained. For these reasons, the soils may be susceptible to liquefaction and/or larger amounts of consolidation settlement. Additionally, it is deemed that cut from these soils would not be appropriate for use as bulk or engineered fill.

It is identified that the floodplains of the Clutha River are likely to be loosely deposited sand, silt and gravel, which may also be susceptible to liquefaction as well as static and creep settlement effects.

Further details, in addition to specific aspects of geotechnical design and the testing and contamination testing schedule are outlined in the "*SH8 Beaumont Bridge Realignment Preliminary Geotechnical Appraisal Report*", included as Appendix H.

These geomorphological observations have formed a constraint on the type of foundation and alignment options of eastern approach.

While other factors result in constraints at the site (i.e. topography, river profile, ecology etc.) these have had a lesser impact on the choice of the preferred final alignment.

OUTCOMES

This Chapter identifies the project outcome objectives. Strategic outcomes are those outlined in the NZ Transport Agency's Statement of Intent, and relate to the three key benefits outlined for the project:

- Improved resilience of SH8;
- Improved safety and connectivity for pedestrians and cyclists; and
- Improved capacity both for traffic flows and heavy loads.

Strategic outcomes

As earlier mentioned, the project progressed from a Point of Entry Report to this combined Indicative and Detailed Business Case.

The NZ Transport Agency Statement of Intent 2015-2019 describes the Agency's purpose, and states the following desired outcomes:

- Effective - moves people and freight where they need to go in a timely manner;
- Efficient - delivers the right infrastructure and services to the right level at the best cost;
- Safe and Responsible - reduces the harms from transport; and
- Resilient - meets future needs and endures shocks.

Each outcome is directly related to the Beaumont Bridge replacement, however the effective and resilient outcomes and the primary focus of this business case.

Programme outcomes

The project directly supports the NZ Transport Agency's National Bridge Replacement Programme. This programme supports projects that will:

- Increase resilience and reliability of the State highway network and provide connectivity and predictable travel.
- Contribute to the economic growth of Otago by improving the load and traffic capacity of the crossing for which demand is anticipated to increase.
- Support the high strategic fit of this crossing for this primary collector route for employment, tourism, freight and economic opportunities.
- Provide a safe bridge crossing.

Project outcomes

The NZ Transport Agency's primary outcome is to be able to have confidence in Beaumont Bridge's long term serviceability. To achieve this outcome, the project outcomes are focussed around three key benefits:

- Improved resilience (80%);

- Improved safety and connectivity for pedestrians and cyclists (10%); and
- Improved capacity both for traffic flows and heavy loads (10%).

Each benefit above has an investment benefit associated with it, as outlined in Table 2.

Table 2: Investment Benefits

PROJECT BENEFIT	INVESTMENT BENEFIT
Improved resilience	Improved resilience for the transportation corridor over the Clutha River.
	Improved seismic resilience.
Improved safety and connectivity for pedestrians and cyclists	Providing connectivity for the Gold Rail Trail users to local facilities.
	Improved crossing for local pedestrians and cyclists.
Improved capacity both for traffic flows and heavy loads	Allowing capacity for future traffic flow growth.
	Providing resilience and potential increase to the HPMV allowances at the Beaumont crossing point of SH8.
Improved safety to road users	Improved road geometrics of SH8 and local roads.
	Closure of junctions with poor line of sight.
	Provide turn right lanes.

The improved safety to road users was added as an additional project benefit as it was identified as an issue and opportunity for the project, as outlined in the earlier sections of this DBC. These improvements will be made for the final alignment and were not used as a Key Performance Indicator (KPI) to assess the options. However, if it was deemed that an option could not have any negative impacts designed out then this option would not be taken forward.

KPIs have been identified from the benefits and investment benefits to ensure the improvements can be measured. Some of the KPIs have set baseline and target values to ensure benefits are SMART and therefore can be measured easily. There are some however that do not have baseline and target KPIs. These benefits will be realised when a new bridge is constructed to all relevant standards as they relate more to the presence of bridge and its purpose.

The project benefits and associated KPIs are outlined in Figure 5. The KPIs are those shown in red.

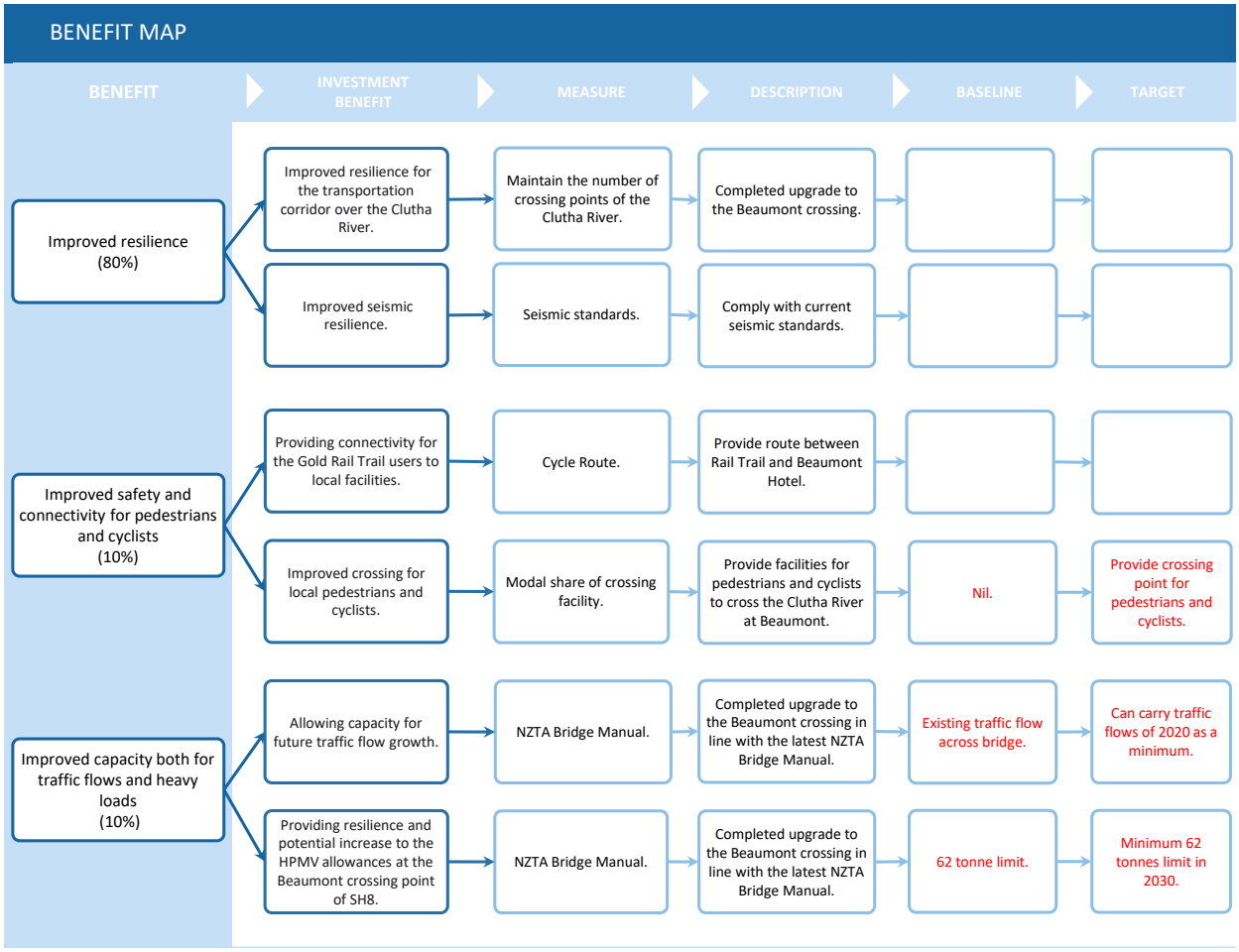


Figure 5: Project Benefits Map

STAKEHOLDERS

Stakeholder consultation was undertaken in two stages: direct consultation with potentially affected property owners and a community open day. The feedback from this consultation was captured and reviewed to ensure the business case highlighted and incorporated the community's views.

Professional engagement was not considered necessary due to Opus' continuing involvement with the bridge.

This chapter outlines the stakeholder consultation and communication strategy used to consult with stakeholders as part of Project Development and the Detailed Business Case process and the views expressed by these stakeholders.

Consultation and communication approach

A project stakeholder is defined as any individual, group or organisation that could affect, be affected by, or perceive itself to be affected by the project. This definition was used to identify those parties who would be directly communicated with.

Two option ribbons were used for consultation purposes with property owners and the Beaumont community to gain an understanding of potential issues, and preferences. The ribbons were first sent to property owners who would potentially be affected by the works, in addition to an information letter and feedback form.

An open day was held on 15th December 2016 at the Beaumont Community Hall. This provided the project team with an opportunity to discuss the potential options with the property owners as well as the Beaumont community. Representatives from the local and regional councils were also in attendance to discuss ideas.

Feedback from the potentially affected property owners and the community was collated and reviewed by the team before progressing the business case.

Professional engagement process

Opus were appointed to the development of the business case due to earlier involvement in the business case process as well as their continuing involvement in the maintenance of the bridge. For these reasons, further professional engagement was not considered necessary.

Stakeholder views

The views of the stakeholders were community-based and concerns raised were predominantly regarding the level of interference with existing properties. The main views raised during consultation were:

- The preferred option should affect as little properties as possible;
- The preferred option should not separate or isolate the community; and

- The hotel is an important part of the community and the preferred option should not restrict access.

It was also noted that the Millennium track would need to tie into the preferred option in a safe manner, for both vehicles and cyclists.

The views outlined above, in addition to the petition received in December 2016, indicated a strong desire for the Ribbon A option. This ribbon option was similar to that of the existing situation, and from the high level concepts discussed with the public, results in a lower number of properties directly affected. This strong preference has resulted in the decision to progress options within Ribbon A.

More detail on the consultation process and feedback from various stakeholders is contained in the Consultation Report, found in Appendix O.

ALTERNATIVE AND OPTION ASSESSMENT

A number of crossing points and alignments were identified both upstream and downstream of the existing bridge. The upstream alignment was omitted in the early stage of the project due to geometric constraints and significant impacts on property. The remaining alignments fell into two areas, outlined as Ribbon A and Ribbon B.

Alternatives analysed

An Indicative Business Case (IBC) was not completed for the SH8 Beaumont Bridge Replacement and the Point of Entry Report did not identify any specific options for a new alignment and structure.

A wide range of options were analysed at an early concept stage of the project. The options investigated potential alignments, which included using the existing bridge location as well as options upstream and downstream. The options can be found in Appendix C.

A Multi Criteria Analysis was undertaken on the long list options, using the weighting of the benefits from the Investment Logic Mapping.

From these options a short list was produced, and upon further review the options could be grouped into two ribbons (refer Figure 6). Ribbon A is of a similar alignment to the existing scenario and Ribbon B utilises a more direct alignment through the town.

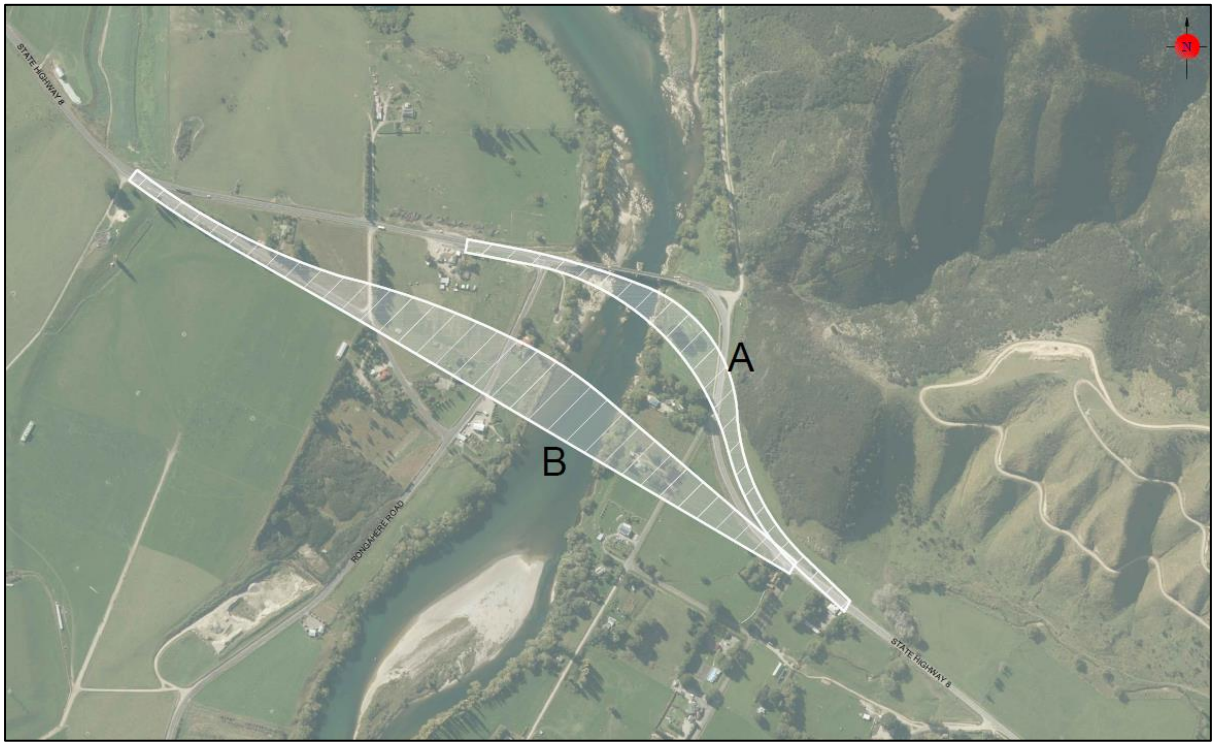


Figure 6: Ribbons A and B

It should be noted that the final alignment option would be a maximum 20m wide, in line with other state highway corridors. However these ribbons allowed for open conversations with stakeholders whilst allowing flexibility to the design.

An alignment was proposed upstream of the existing bridge, however this was omitted early in the investigation due to clear issues relating to curvature required and associated speeds. There were also clear issues at the points connecting into the existing state highway and significant land-take would be required.

A do-nothing option was considered as part of best practice. However, this option was considered unacceptable due to the rising maintenance needs, delays and uncertainties. The do-nothing option was therefore unable to achieve the improved resilience, improved safety for pedestrians and cyclists, and improve the capacity for traffic loads.

Ribbons A and B as well as the upstream option were analysed using the HNO Indicative Business Case Assessment Summary Table, included as Appendix D.

From this assessment, the preferred option was Ribbon A.

It should be restated at this stage that from consultation, the community's view was in preference of Ribbon A. This was predominantly due to less land-take than Ribbon B, and the possibility of Ribbon B alignments segregating the community. The upstream option was not discussed in detail, but did not have much community support.

Recommended package of alternatives

As noted above, Ribbon A was the preferred corridor to be progressed to Detailed Business Case. A number of alignments exist within this corridor, and the preferred alignment was determined from balancing the most practical design elements and consideration to the affected properties.

Options analysed

Alignment

In order to fully analyse and refine the package of Ribbon A alignment options, a set of sub-options were identified to test horizontal and vertical road geometry and property impact issues. This has been done to improve the eastern approach alignment, which is currently a 90 degree corner, while considering the risks of increasing speeds through the town.

Increasing speeds are expected as a result of improved alignments through improving visibility and sight lines for junctions, and segregation of more vulnerable road users (pedestrians and cyclists).

Impact on Local Community

Due to the bridge forming the central link for this small township, it is important to minimise any adverse impacts on property and businesses. This resulted in the refinement of the desired alignment to miss any building and ensure no loss of parking outside of the Beaumont Hotel.

Bridge Structure

Various superstructure options are feasible, particularly: prestressed concrete (i.e. Single Hollow Core units or Super-Tee beams), composite structural steel and cast-in-situ reinforced concrete deck. There is not a significant cost variation in the options.

The pier substructure may consist of either single or dual columns with hammerhead or pier cap beams. The size of the pier column would be dependent upon the tributary mass of the superstructure and pier cap. The intent is to utilise the local rock outcrops in the Clutha River to locate the piers.

Single Lane vs Two Lane Bridge

The minimum option is to replace the bridge with a like-for-like single lane equivalent bridge.

The AADT in 30 years, based on a linear increase of vehicles travelling on SH8, is 2090. Based on the NZ Transport Agency's Bridge Manual, the target width for the structure is 6.8m, which is two lanes.

Detailed cost estimates and an economic evaluation have been completed on each and indicates the incremental Benefit Cost Ratio (BCR) for replacing with a two lane bridge vs a single lane bridge on the same alignment is 1.1. Therefore, a two lane bridge is essentially cost neutral compared with a single lane bridge, when comparing the costs and benefits. As such, a new two-lane bridge is the preferred option.

Walking and Cycling Facilities

As mentioned earlier in the report, one of the key deliverables is to provide pedestrian and cycling links to the township. There is an option to use the current bridge solely as a shared path. However, even under these lighter loads in a seismic event this bridge could be lost. Therefore, it is recommended that to provide reliance for all road users a shared path is provided on the new bridge.

Existing Bridge

As mentioned earlier in the report it is intended to retain the existing Beaumont Bridge which dictated the alignment to avoid clashes of abutments on the western bank.

This bridge could be used as a shared crossing for pedestrian, cyclists and riders. However the final decision will be down to the future ownership.

RECOMMENDED PROJECT OPTION

The recommended option going forward is a two-lane bridge with a shared path downstream of the existing bridge, with minimal impact on properties. The alignment is approximately 900 metres in length and will require upgrades and closures of intersections along the route.

Scope

The recommended option going forward is an alignment within Ribbon A. This alignment is outlined in Figure 7 below.

Figure 7: Preferred Alignment

The alignment is approximately 900 metres in length and will consist of two traffic lanes (one in each direction) and a shared path facility, as shown in Figure 8.

Preliminary Design Philosophy

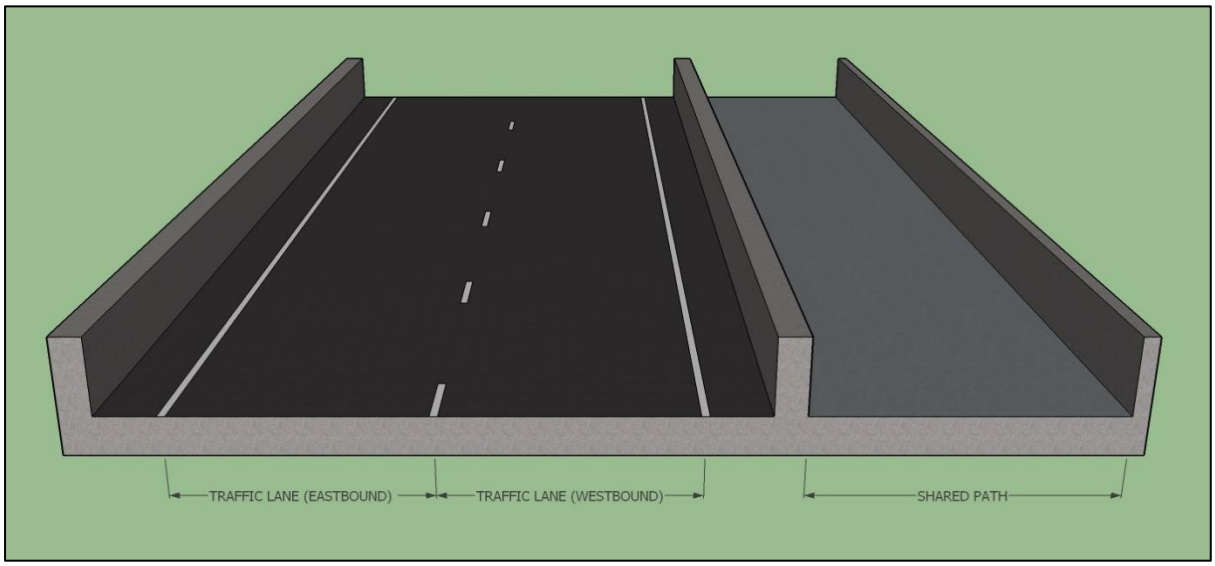


Figure 8: Proposed Cross-section

The proposed bridge lane widths are to be 3.50m wide. This complies with both Austroads Guide to Road Design Part 3: Geometric Design and the NZTA Bridge Manual: Appendix A Bridge widths and clearances (see Figure 9).

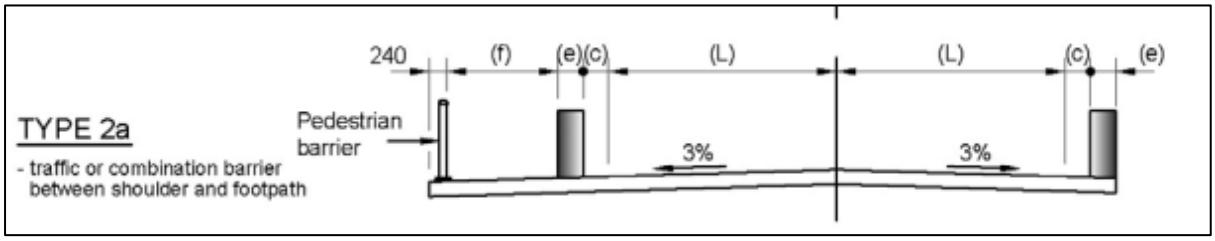


Figure 9: Typical Bridge Deck Details (Type 2a)

The shared path has also been preliminarily designed to meet both standards mentioned above, and is 3.00m wide. This width has been specified due to the heavy vehicles on the state highway and vehicle speeds, high volumes of cyclists and the frequency of school children. It will also reduce risk of cyclists going onto the road to avoid pedestrians.

The shared path has been designed on the southern side of the proposed bridge. Connections have been proposed from both directions at either end. As the existing bridge is north of the proposed bridge, the southern location of the shared path on the proposed bridge will ensure an easily accessible and continuous path for users from each direction. As the local community sites are on the southern side it will eliminate the requirement for users to cross the state highway.

Based on Figure 9 and the associated tables in the manual, the shoulder will have a width (c) of 1.00m as the AADT of the road is approximately 2000, and the barrier will have a width (e) of 0.45m for a rigid traffic barrier. The total width of the proposed bridge is therefore 13.14m.

Speed management will require careful consideration as the bridge passes through Beaumont and will no longer have the 'throttle', it is expected that the operating speed will increase. At this stage the speed has not been restricted so the alignment has been designed to allow for up to the current 100km/h speed in line with the NZ Transport Agency draft State Highway Geometric Design Manual.

Following consultation with the Clutha District Council board, the NZ Transport Agency may wish to put in place a speed restriction through the township and use landscaping features incorporated into the detailed design to assist with speed management.

For simplicity of construction and seismic performance, the bridge is proposed to have a straight vertical alignment. A 3% crossfall will be provided on the bridge surface for drainage purposes. Minor variations in vertical curvature could be considered as part of the detailed design (pre-implementation) phase to optimise constraints such as sight distance, design speed, stormwater drainage, property constraints, and tie-in with existing roadway alignments.

Spans may be either simply supported or continuous. Span lengths are likely to be in the order of 35m depending on the selected superstructure type. The advantage of keeping these larger spans is that the piers can align with those of the existing Beaumont Bridge, reducing the hydraulic impact downstream and also making it easier for boats navigating along the Clutha River.

The preliminary drawings have shown the preferred structural option as being a six span simply supported structure, with Super-Tee beams spanning 35 m clear spans. However as discussed, various prestressed concrete structural steel superstructure options exists, and there is not a significant cost variation in these option.

A number of intersections will be impacted by the implementation of a new bridge, due to a new alignment being necessary. As shown in Figure 10, five intersections will be upgraded/altered and three will be closed.

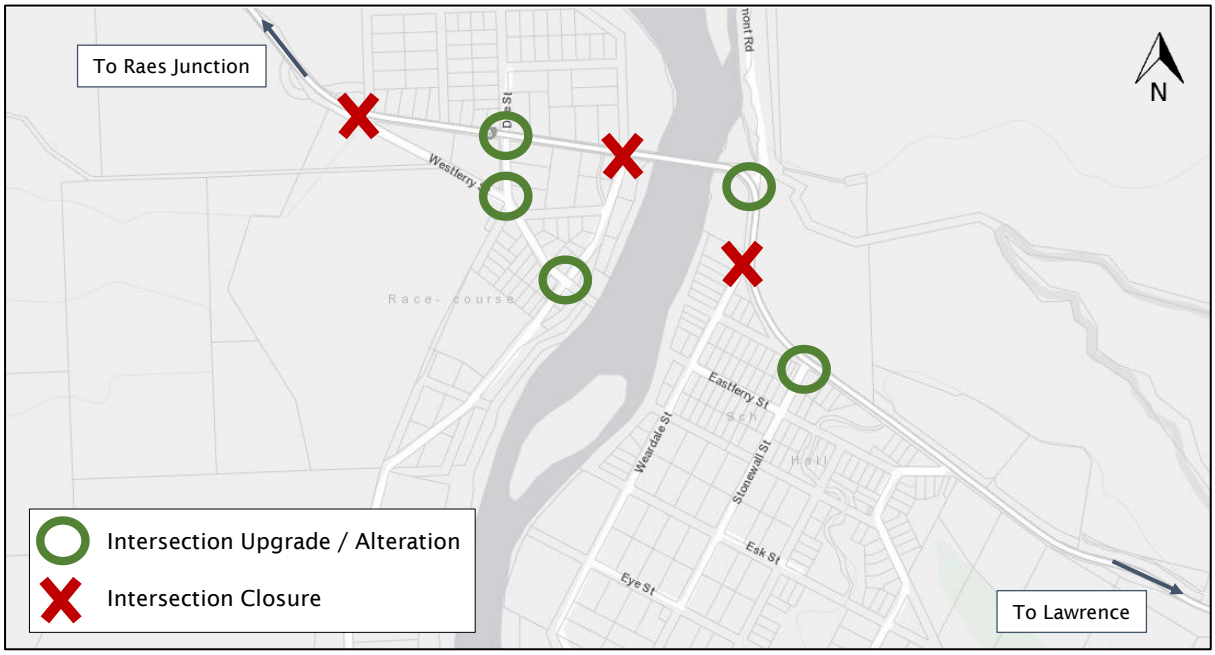


Figure 10: Impacts on Intersections

The intersections to be upgraded or altered are:

i) Stonewall Street – the intersection with the highway would remain and receive minor upgrading.

ii) Weardale Street – the intersection with the highway would be closed. This is because the visibility for motorists at this intersection, looking back across the new bridge, would be compromised by the new bridge (barrier systems). Traffic using this intersection would need to detour to Stonewall Street, via Eastferry Street.

iii) Millennium Track – junction is moved and sealed. It was noted during the public consultation that the Clutha Gold Trail community group would like to retain a parking and picnic area at the current location. Although this is outside of our project brief, this is something that could be worked through with Council and the Clutha Gold Trail group.

iv) Rongahere Road – the intersection with the highway would similarly need to be closed due to visibility constraints when looking back across the new bridge. Traffic using this intersection would need to be re-routed via Westferry Street, in the first instance.

v) Westferry Street / Rongahere Road intersection. Notwithstanding the need to re-route Rongahere Road traffic at this intersection, it is proposed to retain the present simple 'Tee' layout, with some nominal seal widening/surfacing improvement. The intersection priority and signage would also likely require modification. But it is not thought a more comprehensive realignment/reconfiguration of the intersection would be necessary – trucks are presently capably using the junction of Westferry Street and Rongahere Road.

vi) Dee Street – it is proposed to upgrade both Dee Street and the intersections of Dee Street with the highway and Westferry Street, and to re-direct Clydevale/Balclutha traffic via this route. It is envisaged that Dee Street is both widened and sealed, and the intersection with the highway is similarly widened to accommodate a right turn bay. This improvement is regarded as an alternative to the continued use of the Westferry Street / State Highway 8 intersection.

vii) Westferry Street – the intersection with the highway would be closed. This is proposed as the acute angle at which Westferry Street connects to the highway is very poor and not suited to long term planning for safe highway intersections. The current layout allows, and is perhaps encouraging of motorists, to enter/leave the highway at high speeds and potentially compromising the requirement to give-way to opposing traffic.

During the DBC, future options for the existing Beaumont Bridge have been considered as it has significant historic value. The majority of the maintenance and operation costs to date pertain to the current live loads. With the removal of these loads it is anticipated with another round of maintenance work that the ongoing costs will significantly drop.

There are a number of services including electricity, water and telecoms which are currently under the existing bridge. Whilst there is no immediate need to relocate them to the new bridge it will be important that all companies are consulted about their requirements for ducting under the new bridge to allow for future transfer of services.

RECOMMENDED OPTION – ASSESSMENT

The recommended option will contribute to the specified project outcomes. A number of impacts have been assessed with the most significant being statutory requirements and property impacts.

The assessment of the recommended option forms part of the Economic Case for the project in conjunction with the Economic Analysis. The assessment identifies all the impacts of the proposal, and the resulting value for money, to fulfil the NZ Transport Agency's requirements for appraisal and demonstrating value for money in the use of public money.

In line with the NZ Transport Agency's appraisal requirements, the impacts considered are not limited to those directly impacting on the measured economy, nor to those which can be monetised. The economic, environmental, social and distributional impacts of a proposal are all examined, using qualitative, quantitative and monetised information. In assessing value for money, all of these are consolidated to determine the extent to which a proposal's benefits outweigh its costs.

Outcomes

Following the DBC assessment a new two lane bridge approximately 40m downstream of the Beaumont Bridge will achieve the project outcomes:

- Provide resilience through a crossing which has improved seismic.
- Improves safety and connectivity for pedestrians and cyclists.
- Improves capacity both for traffic flows and heavy loads (HPMV).

The recommended option will achieve the desired outcomes and allow for additional improvements to the road geometrics.

The recommended option will allow for the retention of the historically important existing bridge and remove the loads currently causing the fatigue deterioration.

Finally, the recommended option will result in significantly reduced maintenance, resulting in a more resilient connection and overall network.

Implementability

Constructability

The recommended option is expected to be either a conventional precast, reinforced concrete design or a composite steel and reinforced concrete design, with common and widely-used detailing. Therefore the construction of the structure is likely to be unremarkable.

As the existing bridge will remain, it is intended that the final selection should, where possible, be aesthetically complementary whilst remaining simple, so as to not take away from the heritage structure.

Staging of construction activity and access provisions are likely to be critical to programming the works, and off-site staging areas and working platforms in the river margin are also likely to be required. The parcel of land requiring purchase for the eastern embankment could serve as this.

The flows in the Clutha River at Beaumont are primary dictated by the Roxburgh Dam and timing of works to take place within the riverbed should be arranged in discussion with them.

Due to the close proximity of residential properties, control measures for dust and noise should be considered at the detailed design and implemented during construction to assist in this project being supported by the community.

Following the opening of the new bridge, work can be undertaken on the existing bridge in preparation for any handover of this historic feature. The costs involved in this are set out in the ongoing maintenance regime for the bridge and depending on the programme commencement and duration are provided for in the 2018-2021 budgets.

Operability

The new bridge will operate as a typical two-lane with shared path highway bridge and no extraordinary operations activity is expected.

The issue of the operating speeds may need to be addressed in discussions with Clutha District Council.

The existing bridge will require ongoing maintenance, however with the removal of the live loads, it is anticipated this will be at a significantly lower cost.

Statutory requirements

An existing designation exists along the highway, however to implement the project this will need to be altered. This requirement is however not as extensive as alterations associated with the other corridor options, as the recommended corridor option aims to utilise the existing highway, and therefore the existing designation, as much as possible.

The consents required and other statutory requirements for the project going forward are detailed further in the Consenting Strategy in Appendix I.

Heritage New Zealand

There are six NZAA registered sites within a 1,000km radius of the Beaumont Bridge. Four lie north on the Millennium Track and are associated with dredging the river and mining for gold. The other two, located to the south east of the bridge within the township, are associated with pre-European occupation of the area.

As there will be an element of earthworks for the east approach and within the river bed on either side of the river, there is a high risk of archaeological discovery.

It is recommended that an archaeological assessment report is prepared for the project during the implementation phase. It is likely that this report will recommend that an Archaeological Authority is sought from Heritage New Zealand.

Property impacts

Figure 11: Land Parcel Plan

A number of properties in Beaumont will be impacted with the implementation of a new bridge, despite which option was recommended. In saying this, the recommended option results in the least number of properties to be affected, which was a main reason behind the communities' preference.

As mentioned throughout the business case the alternative corridor options, particularly the Ribbon B option, result in a significantly higher number of affected properties.

Details regarding the Land Requirement Plans can be found in Appendix J.

The preferred alignment of the SH requires purchase of six properties (full or partial). All but one of the properties are privately owned by three landowners. From early consultation with the landowners at the Open Day, additional consultation about land purchase will need to be undertaken at the start of the next stage.

The junction improvements proposed as part of the project is believed to be undertaken within the road corridor. However a detailed survey is required at the detailed design to identify partial land areas required.

Asset management

The recommended new bridge options are of a conventional design, which typically have low maintenance costs for the majority of the life of the asset. There are no asset management issues which influences the choice of the recommended option.

The existing bridge will require ongoing management but, as mentioned above, at a significantly lower rate than currently undertaken. The responsibility of this currently lies

with the NZ Transport Agency, however there are possibilities it may be transferred to Clutha District Council or another party.

Wider project impacts

Environmental impact

The impact on the natural environment has not been a focal point for determination of the recommended option. As outlined in the Consenting Strategy (Appendix I) the Clutha River is the sole significant environmental feature in the area, and any proposed option will have an impact on this.

An environmental and social responsibility screen has been completed and can be found in Appendix K.

Social impact

The social impacts associated with the project have significantly influenced the recommended option. These impacts were focussed around reducing impacts to existing property; severance of the community; and access to the Beaumont Hotel.

The recommended option has therefore emerged as it presents an option similar to the existing situation. This results in a lower social impact in terms of community severance, as an alternative option proposed the route to exist through the middle of the community.

This option also resulted in the least property impact and allows the entrance to the Beaumont Hotel to remain as is.

Access to the existing boat ramp immediately south of the existing bridge, will however be impacted in order to provide the shared path. However, it is envisaged during the detailed design this access can be provided at or close to the current unofficial ramp off Rongahere Road.

An environmental and social responsibility screen has been completed and can be found in Appendix K.

Joint working

An opportunity for joint working arises from retaining the existing bridge. The owner of the existing bridge may be altered in the future from the NZ Transport Agency to a local authority, which may give rise to a joint working opportunity.

Additionally there is an opportunity to work with Clutha Gold Trail Incorporated to ensure the proposed shared paths meet the minimum trail requirements.

Do-minimum option

The do-minimum option for this project is to retain and continue maintaining the existing bridge. Due to the age and condition of this bridge this is not deemed to be feasible for the long term resilience.

This option therefore does not involve a new bridge, nor does it involve improvements to the existing bridge.

The current level of maintenance is detailed in the *"SH8 Beaumont Bridge Report for Point of Entry, March 2016"* report, attached as Appendix A for reference.

For the economic assessment and incremental BCR the do-minimum benchmark is a like for like replacement with a single new lane bridge.

The relative merits of single lane vs two lane bridges are also discussed in the Alternative Options Assessment section.

RECOMMENDED OPTION - ECONOMIC ANALYSIS

This analysis was carried out to assess the economic difference between replacing the Beaumont Bridge with a single lane structure (Do-Minimum) or a two lane structure (Preferred Option).

The net cost difference between the Do-Minimum and Preferred Option is $1.7M

The net difference in benefits (travel time, vehicle operating costs, crash costs and cycling benefits) is $1.8M.

The incremental BCR is 1.1.

An economic analysis has been undertaken for the recommended option outlined in the previous sections.

Basis of Economics

Benefit Cost Ratio (BCR) calculations are based on the NZTA's Economic Evaluation Manual (EEM). The standard time period for calculating costs and benefits is 40 years, with a 6% discount rate.

Time Zero is the date to which all future costs and benefits are discounted to, and is 1 July of the financial year in which the project is submitted for a commitment to funding. For this project Time Zero is assumed to be 1 July 2017.

Construction is assumed to occur between Years 1 and 2.5 (July 2018 to December 2019), with benefits accruing from Year 2.5 onwards.

Copies of the economic spreadsheets are included in Appendix F.

Traffic

An NZTA telemetry site SH*: 401/10.94 is the closest to the site. The 2015 AADT is 1,558 vehicles per day. The traffic count has increased an average of 18 vehicles per day since 2011, so a growth rate of 1% has been used.

Vehicle Speeds

The posted speed limit along SH8 through Beaumont (including the bridge) is 100 km/h, the approach bends and traffic lights at the bridge form traffic calming, limiting vehicle speeds. The current speed environment through the site has been assumed to be 30 km/h.

Options Considered

An assessment of ongoing maintenance costs was carried out for the SH8 Beaumont Bridge. The Net Present Value (NPV) of repairs was calculated to be $4,600,000 over the next 20

years, on top of the estimated $450,000 - $550,000 annual costs. Due to the age of the structure it is uncertain the costs beyond this date. If these costs were projected for the 40 years the maintenance costs are similar to the cost of replacing the bridge. However based on the current vehicle loads it is unlikely that the existing bridge would be operational.

The purpose of the economic analysis in this DBC is to assess the difference between replacing the bridge with a single lane structure or a two lane structure. Both the Do-Minimum and Preferred Options are assumed to be constructed on the new alignment. Vehicle speeds will almost certainly increase due to the removal of the traffic lights and improved road surface. A new bridge on the same alignment would therefore increase the risk of crashes at the low speed horizontal curve at the northern end of the bridge.

Do-Minimum

The 'Do-minimum' consists of replacing the existing single lane bridge with a new single lane bridge on the preferred alignment.

Preferred Option

The preferred option consists of replacing the single-lane bridge with a new two-lane structure on the preferred alignment.

Costs

Capital costs are based on the expected construction cost estimate for the Do-Minimum and Preferred Option. Copies of the estimates are included in Appendix F.

Ongoing maintenance costs for the Do-Minimum and Preferred Option have been assessed. The maintenance costs for the Do-Minimum are higher overall; while the periodic resurfacing costs are higher for the two lane bridge (due to the surface area), the annual inspection costs are higher for the single lane structure due to the additional traffic management required to inspect the bridge.

Benefits

One Lane Bridge Delays

One lane bridge delays have been assessed as per National Road Boards, Road Research Unit, paper "Delays & Conflicts at One Lane Bridges" (L.R. Saunders, 1988). This gives travel time benefits due to bottleneck delays from the bridge, as well as vehicle operating benefits due to cars having to stop and speed up again.

Crash Benefits

There has been no reported injury crash on the Beaumont Bridge in the 10 years to 2017.

Realigning the bridge approaches is considered to be a fundamental change to the layout of the site, so both Do-Minimum and Preferred Option were assessed using Method B: Crash rate analysis.

The Do-Minimum used the Single Lane Rural Bridges, > 80 km/h crash prediction model. The Preferred Option used the Two Lane Rural Bridges, > 80 km/h crash prediction model.

Cycling Benefits

It has been assumed that a new single lane bridge would not have sufficient width for a cycle path. Due to the length of the bridge, it is likely that only confident cyclists would travel in the live traffic lane.

The Preferred Option includes a shared path on the southern (downstream) side that could also be used by cyclists. It has been assumed that there will be an average additional 20 cycle trips per day due to the new facilities as it is located on the Clutha Gold Trail (based on 97,000 trail users per month during the summer peak).[3]

Economic summary of recommended project option

Costs and Benefits are summarised in Table 3 below.

Table 3: Economic summary table

	Present Value Costs
Do Minimum Capital Costs	$12,742,667
Option Capital Costs	$14,457,667
Net Maintenance Costs	-$68,510
TOTAL NET COSTS	$1,646,500
Travel Time Benefits	$358,000
Vehicle Operating Cost Benefits	$56,000
Cycling Benefits	$116,000
Crash Savings	$1,397,000
TOTAL BENEFITS	$1,811,000
Incremental BCR	**1.1**

The indicative incremental BCR is 1.1.

It should be noted that this analysis considers only the economic benefits for installing a single lane versus a two lane bridge, and does not include other factors such as route resilience or public perception.

[3] http://www.nzcycletrail.com

FINANCIAL CASE

The base estimate for the project (pre-implementation and implementation phases) is $13.5M (excluding property costs), with an expected estimate of $14.5M (including property costs but excluding a contingency) and a 95th percentile estimate of $21.0M. Given the increasing costs of maintaining the existing structure, it is recommended construction of the new bridge be programmed for completion by the end of the 2020/21 financial year.

Given the obvious need for a replacement structure, this Financial Case section concentrates on the costs associated with project delivery and ongoing operation and maintenance.

Project delivery costs

Capital Cost Estimate for the pre-implementation and implementation phases including property costs has been produced in accordance with the Cost Estimation Manual (SM014).

The expected estimate for the project is $14.5M (including property costs, excluding a contingency) and the 95th percentile estimate is $21.0M. The breakdown of this estimate is attached as Appendix F.

This section will outline the key cost assumptions, including:

- Timing assumptions
  Construction commencing in 12 months and a construction duration of around 18 months. Property purchase and notified statutory approvals completed within the 12 month pre-implementation period.

- Property purchase, management and disposal costs
  Property purchase completed within the 12 month pre-implementation period. Extended period beyond this catered for by escalation generally. Rationalisation of property for eventual disposal to be finalised following detailed design.

- Investigations
  An allowance for on-site geotechnical investigations has been included in the consultation fees for the pre-implementation phase works. Adverse ground conditions carry considerable financial risk, as outlined in the risk register. However, we have assumed the NZ Transport Agency is likely to accept ground movements exceeding the requirements of the Bridge Manual in a design seismic event given the very high seismicity of the area, lower priority of the route and significant potential incremental cost for ground improvement to meet the full code requirements.

- Construction costs
  The cost estimate has not been independently reviewed at this time. The implementation estimate (Form I) includes a 3% allowance within Base Estimate for extraordinary construction costs in addition to 11% contingency to Expected Estimate and a further 33% to the 95th percentile estimate.

- Other costs (insurances etc.)
  Provision made in estimate for P&G and insurances.

Ongoing maintenance and operations costs

The recommended option is a standard bridge design using typical and widely used structural detailing.

There will be some maintenance costs against the NLTP for the maintenance of the new structure although these will be minimal for the first 50 years.

For the new bridge structure, no extraordinary ongoing maintenance or component replacement activity is anticipated. The annual cost to maintain the new bridge is expected to be significantly less than the existing structure (estimated at $30,000 p.a. compared to an estimated $450,000 - $550,000 p.a. to continue to maintain the existing structure moving forward). The present value of all annual maintenance and renewals to a new two lane structure over the next 40 years is estimated in the region of $500,000. This amount includes:

- Operating Costs:
  - Nil (no street lighting included)
- Maintenance Costs:
  - Graffiti removal
  - Debris removal from pier and abutments (if necessary)
  - Landscaping
  - Street cleaning
  - Routine (6 monthly), General (2 yearly) and Principal (6 yearly) Inspection Costs
  - Renewals Costs:
  - Surfacing
  - Deck Joints

Detailed maintenance cost estimates are included in Appendix G.

The maintenance costs for the existing bridge have not been incorporated in the costs for this project to avoid double up of funding applications. Also whilst the recommendation is to retain the historic structure, the level of work required depends on the future use which has yet to be determined and the decision on this does not affect the primary works and need of this project.

Existing bridge maintenance requirements if the bridge is restricted to pedestrian, cyclists and horse riders:

i) Bridge Deck (All Spans)

The timber bridge deck is made up of heavy hardwood beams/girders (running longitudinally). These are in good condition and may require packing from time to time, however packing is unlikely if the bridge is restricted to pedestrian/cycle use. Deck boards are heavy sleeper sized timber located transversely and fixed by bolts to the hardwood beams. Deck boards are a treated pine, generally in good condition and should provide good service for at least 50 years. Running boards (200mm by 50mm) are placed at 45 degrees to the deck boards and held down with bolts. These are kept in good condition with

annual maintenance including bitumen seal coat and under light load and should need only very minor maintenance over 50 years.

ii) Wrought Iron Truss and Transoms

The truss has recently been strengthened. Where work has been done, the areas affected have been painted to protect against corrosion. Additional heavy corrosion protection costing has been applied to the inner plates of the 2 bottom chords, full length.

Debris clearing from the lower chord is a continuing cyclic maintenance activity, the lower chord has drainage holes that need to be kept clear.

The bridge is in a very low risk corrosion environment. Prior to any transfer of bridge ownership, it is recommended a qualified Engineer assess and report on the condition of the paintwork. It is estimated the paintwork, as it stands now, will require minor spot painting (corrosion prevention) over the next 25 years.

There are cracks in the wrought iron and on-going fatigue. The rate of this deterioration will reduce significantly once the heavy vehicles cease using the bridge. No repair or strengthening will be required 50-60 years.

iii) Abutments

The abutment on the Beaumont Hotel end of the bridge is moving downwards and towards the bridge and has been for many years. Removing heavy traffic loading will reduce the rate of movement. The bridge joint may need some repairs within 15 years, more likely 25 years.

iv) Bearings

Nothing needed for 50 years. The bearings at the Beaumont Hotel will need to be adjusted to accommodate ongoing movement of the abutment. This will likely be required within the next 25 years.

v) Handrails

Will require upgrading for both pedestrian and cyclist safety before handover.

Funding options

It is recommended that funding for the Implementation phase of the Beaumont Bridge Replacement be requested to be included within the 2018-21 NLTP. Any additional funds required for the pre-implementation phase (including property purchase) should be requested within the 2015-18 NLTP, with some provision for extension into the 2018-21 NLTP.

Financial risk

Project Base Estimate: $13.5M (excluding property costs)

Project Expected Estimate: $14.5M (including property costs, excluding contingency)

95th Percentile Estimate: $21.0M

See Appendix F for details.

It is not anticipated that any additional funding will be required over and above the funding estimates. However, changes in overall bridge deck design, adverse ground conditions or incorporating the maintenance works required to prepare the existing historic bridge for handover could result in the costs approaching the 95th percentile estimate.

PART B – READINESS AND ASSURANCE

COMMERCIAL ANALYSIS AND MANAGEMENT CASE

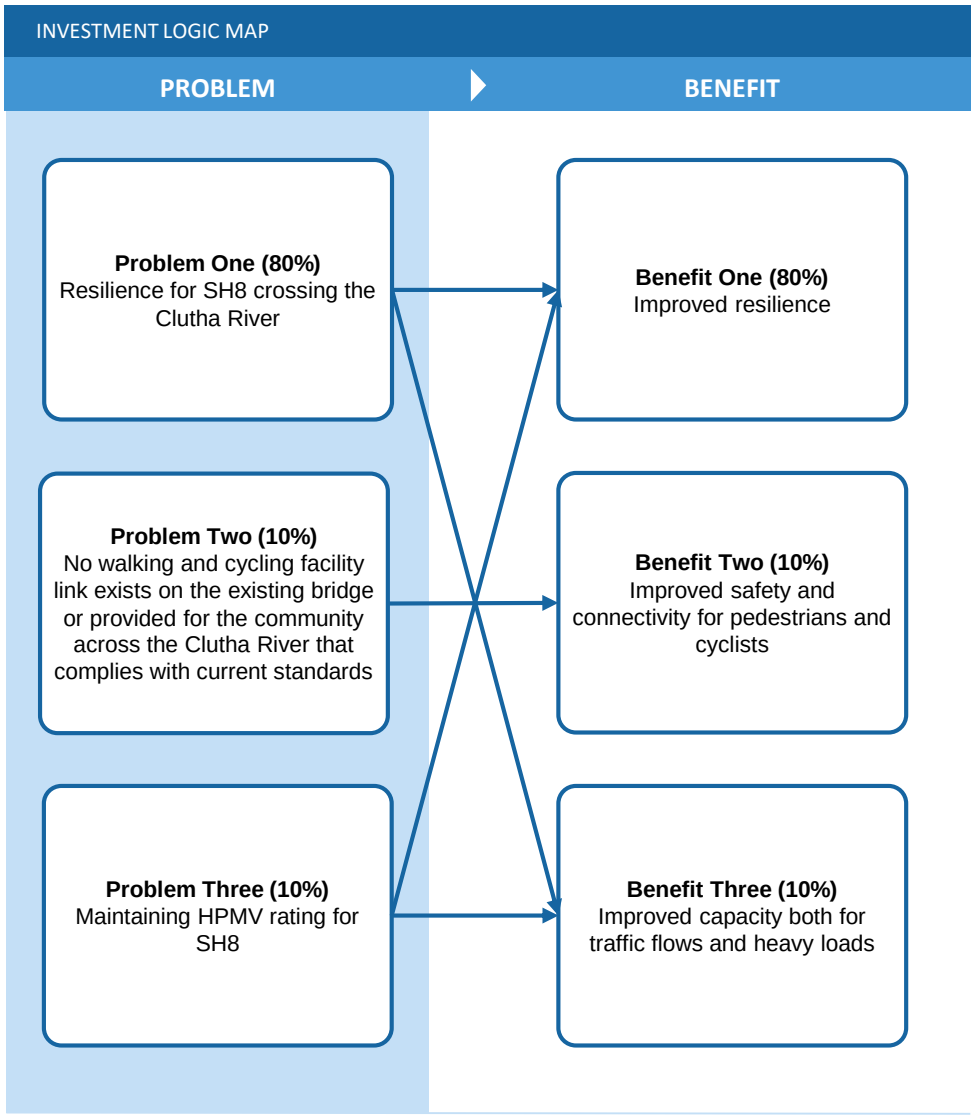
Given the condition of the bridge, construction is recommended to be completed within the next 3 years (i.e. by the end of 2021). To progress beyond pre-implementation, a request to P&I for inclusion in the current NLTP will be required.

Detailed commercial analysis and a management case have been excluded from the Detailed Business Case at present, as inputs are predominantly required from the client (NZ Transport Agency). In particular, the NZ Transport Agency are currently preparing a separate Stage 1 Procurement Strategy.

APPENDICES

APPENDIX A – POINT OF ENTRY REPORT

APPENDIX B - INVESTMENT LOGIC MAP



APPENDIX C – LONG LIST OPTIONS

APPENDIX D – OPTIONS ASSESSMENT SUMMARY TABLES

The summary tables for the three broad options – Ribbon A, Ribbon B and the upstream Option C are attached.

APPENDIX E – RECOMMENDED OPTION DRAWINGS

APPENDIX F – CAPITAL COST ESTIMATES

APPENDIX G – MAINTENANCE COST ESTIMATES

APPENDIX H – PRELIMINARY GEOTECHNICAL REPORT

APPENDIX I – CONSENTING STRATEGY

Summary

We have undertaken a preliminary scoping of the SH8 Beaumont Bridge Replacement project and identified the following Resource Management Act approvals are required:

- Alteration of Designation;
- Outline Plan;
- Resource Consents from the Otago Regional Council for works associated with the construction of a new bridge.

Other Approvals potentially required:

- Resource consent for any drilling associated with geotechnical investigations;
- Resource Consent under the NES National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health;
- Resource Consent from the ORC to disturb a contaminated site;
- Archaeological Authority.

APPENDIX J – LAND REQUIREMENTS PLANS

APPENDIX K – ENVIRONMENTAL & SOCIAL RESPONSIBILITY SCREEN

APPENDIX L – HERITIAGE SIGNIFICANCE ASSESSMENT

APPENDIX M – PROJECT RISK REGISTER

APPENDIX N – SAFETY IN DESIGN REGISTER

Safety audits

A safety audit has not been undertaken at this stage. The project has focussed on the alignment options of the proposed bridge and has used relevant standards only.

As the design develops, safety audits will be of importance to ensure the proposed bridge will not cause harm. These may be included as mitigation measures in Safety in Design reviews, or at appropriate phases of design development.