9.5 DELATITE ROAD, SEYMOUR - BRIDGE CONSTRUCTION OPTIONS AT WHITEHEADS CREEK

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Attachments: *1. Upgrade Options Report*

SUMMARY

This report summarises the preliminary investigations undertaken into upgrade options for the existing ford located over the Whiteheads Creek on Delatite Road in Seymour.

These preliminary investigations include a hydraulic assessment of four (4) upgrade options along with preliminary costings to assist Council in deciding what design standard to adopt for a future upgrade of the existing ford.

The report also makes a recommendation on the most favourable option based on the assessment results.

RECOMMENDATION

THAT Council:

1. Adopt a 1 in 5-year flood design standard as the preferred design standard for a future upgrade of the Delatite Road crossing of the Whiteheads Creek.

2. Refers the detailed design of a new culvert structure over the Whiteheads Creek to the 2020-2021 Capital Works budget process for funding consideration.

3. Subject to the completion of a detailed design, refers the upgrade of the Delatite Road ford over the Whiteheads Creek to the 2021-2022 Capital Works budget process for funding consideration.

BACKGROUND

As part of its 2017-2018 Capital Works program, Council allocated $30,000 towards the investigation of options to improve road safety at the existing Delatite Road ford crossing of the Whiteheads Creek.

This investigation included:

- Preparation of various bridge concepts with a view of comparing Low, Medium and High ‘Level of Service’ options
- Carry out a detailed hydraulic analysis of the floodway to determine the extent to which each structural option would impact on flood flows in the waterway.
- Preparation of high-level cost estimation for each option

The above tasks were completed by Cardno Australia in consultation with Council officers and the Goulburn Broken Catchment Management Authority (GBCMA).

The investigation and its findings are intended to assist Council in making a decision regarding the future upgrade of the Delatite Road ford crossing over the Whiteheads Creek.

A report has been prepared detailing the outcomes of the assessment which is shown as Attachment 1 of this report.

ISSUES AND DISCUSSION

Bridge Upgrade Options

Four (4) concept bridge upgrade options have been developed to accommodate the 1 in 5-year, 1 in 10-year, 1 in 20-year and 1 in 100-year flood extents in the Whiteheads Creek. Table 1 below summarises the key design parameters for each bridge upgrade concept.

Table 1 – Bridge upgrade summary

	Option 1 Existing (No upgrade)	**Option 2A** 1 in 5-year design	**Option 2A** 1 in10-year design	**Option 2A** 1 in 20-year design	**Option 2A** 1 in 100-year design
Flood Level	-	140.85m AHD	141.5 AHD	141.42m AHD	142.00m AHD
Existing Road Level	139.20m AHD	139.20m AHD	139.20 AHD	139.20m AHD	139.20m AHD
Proposed Road Level	-	141.00m AHD	141.5 AHD	141.70m AHD	143.00m AHD
New road height above existing road level	-	+1.8m	+2.3m	+2.5m	+3.8m
Structure Only length (Exc. Road)	10m	9.0m	30.6m	72m	138m
Total extent of construction	-	56m	180m	200m	255m
Structure type	Ford / Pipes	Box culverts	Box Culverts	Box culverts	Short Span Bridge/ Box culverts

Hydraulic Assessment

In order to demonstrate that there will be no adverse impacts on waterway health, each of the bridge/culvert options have been modelled using flood modelling software.

In order to satisfy the above requirement, it is essential to determine the following;

- Upstream and downstream flood levels are not adversely impacted due to the presence of the structure in the waterway;
- Flow velocities at the structure (either above and/or below) and immediately upstream and downstream of the structure remain within acceptable limits.

The investigation has utilised the flood mapping prepared as part of the Whiteheads Creek Flood Mapping Study. Each individual structure has been integrated into the flood model and the above parameters are measured for 'before and after' scenarios using the 1 in 100-year flood event as the base case.

The investigation revealed that all options considered above do not significantly change the existing flood behavior in the flood plain and are considered to be within acceptable range according to the GBCMA.

Table 2 below summarises changes to 1 in 100-year flooding characteristics measured for each of the bridge/culvert structures modelled as part of this study.

Table 2 – Hydraulic Assessment Summary for a 100-year flood event

Option 2A **1 in 5-year structure**	• Structure is slightly higher than the road approaches either side of the waterway. Road approaches will inundate first, while the structure itself will remain dry up to a 1 in 5-year flood event.

(9.0m structure)	• Northern road approach road surface overtopped by 1.8m during a 100-year flood event. • Road surface at structure overtopped by 1.0m during a 1 in 100-year flood event. • No discernable alterations to flood levels or flow velocity characteristics during 1 in 100-year flood event
Option 2B **1 in 10-year structure** (30.6 m structure)	• The road will remain dry for 1:10 ARI event. • Road surface overtopped by 0.5m during 100-year flood event • No discernable alterations to flood levels or flow velocity characteristics during 1 in 100-year flood event
Option 2C **1 in 20-year structure** (72.0m structure)	• Road surface overtopped by 370mm during 100-year flood event • Increase to upstream flood levels by up to 50mm up to a distance of 280m from the structure; • Upstream flood levels near the structure can increase above 100 mm, however, the extent of increase is relatively small. • Downstream flood levels remain relatively the same • Flow velocities has not been significantly changed
Option 2D **1 in 100-year structure** (138.0m structure)	• No discernable alterations to flood flow characteristics

Comparative Analysis

Part 4 of the options assessment report contains a high-level comparative assessment of each of the three bridge/culvert upgrade options. Four key criteria have been assessed including;

- Improvements to Road Safety - 40%
- Lifecycle Costs - 25%
- Levels of Service - 20%
- Environmental Impacts - 15%

Table 5 of the options assessment report summarises the results of the comparative assessment. These results are replicated in Table 3 below.

Table 3 – Comparison of bridge/culvert upgrade options.

Option	Health and Safety	Lifecycle Cost	Level of service	Environmental	Combined Weighted Score (High to Low)	Estimated Cost*
	40%	**25%**	**20%**	**15%**		
Option 1 No action, retain existing	6	10	3	7	**6.55**	**-**
	2.4	2.5	0.6	1.05		
Option 2A 1:5-year structure	7	9	6	5	**7.00**	$914k
	2.8	2.25	1.2	0.75		
Option 2B 1:10-year structure	8	5	7	5	**6.6**	$2.1m
	3.2	1.25	1.4	0.75		
Option 2C 1:20-year structure	9	2	8	5	**6.45**	$3.9m
	3.6	0.5	1.6	0.75		
Option 2D 1:100-year structure	10	1	10	4	**6.85**	$7.5m
	4	0.25	2	0.6		

*Inclusive of Project Management and Contingency

Implementation of a 1 in 100-year structure

By contemporary standards, bridge designs that accommodate the 1 in 100-year flooding extents are typically considered to be the most desirable outcome.

The implementation of a bridge structure above the 1 in 100-year flood level will significantly reduce road safety risks at this location and reduce delays to traffic during road closures in times of flood.

While the 1 in 100-year structure provides highest level of service, the size of the infrastructure and the capital investment required to achieve this level of service appears disproportionate to the benefits of the project for the foreseeable future.

In consideration that any residual road safety risks associated with a low set structure are considered to be appropriately managed through the ongoing operation of the existing flood warning system, the additional net benefits to road safety associated with a 1 in 100-year high-set structure are considered to be somewhat diminished when compared to the road safety improvements achieved through the implementation of a low-set structure and the ongoing operation of the existing flood warning system.

Further, the current and forecast traffic volumes using Delatite Road are not considered to be high enough to warrant investment of this scale to mitigate any delays to traffic experienced during larger less frequent flooding events.

This location is a significant natural flood plain where flood nuisance is expected under high rainfall events. The duration of flood is not excessive under normal circumstance and there are a multiple detour options which are available to road users when the flood water has reached the road level.

The implementation of a 1 in 100-year structure at this location will also require a substantial footprint (over 255m in length) resulting in the loss of a large amount of

roadside vegetation. As Delatite Road is identified as a Significant Roadside Area, this is considered to further diminish the net benefits of a 1 in 100-year bridge structure.

The assessment has ranked this option as the second preferred option and this result appears reasonable due to above reasons.

Implementation of a Low-Set Structure (below the 1 in 100-year flood level)

1 in 5-year structure has been ranked highest of all the upgrade options investigated. Its benefits appear relatively high when compared with its low capital investment. It also proposes a significant improvement to the current level of service.

Any decision to proceed with a bridge/culvert upgrade at this location that is placed below the 1 in 100-year flood limits should be made with a complete appreciation for both the (a) residual risks to public safety and (b) the physical risks to the structure that are present during any flood that exceeds the design level of the structure.

a) Public Safety

Structures designed to satisfy either a 1:5-year, 1:10-year or 1:20-year flood level will inevitably result in a net improvement to public safety compared to the existing conditions.

With the existing flood warning system and electronic warning signage to remain in place for either of these low-set structure options, the increased level of the roadway will increase the available time for emergency response agencies to attend to the site and deploy appropriate exclusion measures (road closure) to prevent public access to the inundated section of the roadway.

Further, the existing flood warning system also has additional capability to be linked to other physical measures which can prevent public access to inundated sections of roadway such as automatic gates. Such systems would be useful in the event emergency agencies cannot attend the site during a flood emergency.

Notwithstanding the above, should a low-set structure be implemented at this site, it will be critical to ensure the wider public have a full appreciation for the residual risks that will continue to exist at the site. Delatite Road will still be prone to flood inundation and as such an appropriate community education campaign should complement any planning, design, implementation and promotion of a new low-set bridge or culvert structure on Delatite Road over the Whiteheads Creek.

b) Physical risks to low set structures

The construction of a new bridge or culvert structure below the 1 in 100-year flood level will expose the structure to potential damage during any flood that overtops the design road surface level of the structure.

Some typical examples of damage include;

- Debris build up;
- Damage to barrier rails and guard rail;
- Scour of the road surface and downstream faces of road embankments;

- Dislodgement of bridge decking;
- Dislodgement of culvert sections;
- Catastrophic loss of the entire structure.

A 1 in 5-year bridge or culvert structure has a 20% chance of being overtopped in any given year. Similarly, a 1 in 10-year and 1 in 20-year culvert structures have 10% and 5% chances respectively, of being overtopped by flood flows in any given year.

Whilst appropriate design and build quality can serve to mitigate these physical risks, full mitigation of the risks is not possible. These risks will need to be accepted and managed appropriately should a low-set structure be implemented at this location.

CONSULTATION

The Goulburn Broken Catchment Management Authority (GBCMA) have been consulted during the preparation of this report. The GBCMA have given their endorsement to the hydraulic analysis methodology used in the assessment of the bridge/culvert upgrade options.

GBCMA have indicated 'in principle' support to the bridge/culvert upgrade options featured in this study subject to the final design form of the structure.

In order to implement any bridge/culvert upgrade over the Whiteheads Creek, a 'Works on Waterway' permit is required to be issued by the GBCMA. Granting of this permit will be subject to a detailed hydraulic analysis on the final design form of the preferred upgrade option and the preparation of a Site Environmental Management Plan.

With this in mind, the GBCMA's primary assessment criteria for any permitted works on the waterway will focus on;

- The impacts on waterway health associated with the new structure;
- The impacts on upstream and downstream flood levels and flow velocities; and,
- An assessment of the safety of the public using any structure set below the 1 in 100-year flood level.

With specific regard to the latter, the GBCMA have indicated that they would likely request physical barriers (manually operated boom gates) be implemented as part of any future upgrade of the existing ford should Council pursue a low-set bridge/culvert structure below the 100-year flood level. This additional requirement is estimated to add a further $50,000 to any upgrade costs and would be assessed as part of the detailed design phase of this project to satisfy the GBCMA 'Works over the Waterway' permit process.

FINANCIAL, RESOURCE AND ASSET MANAGEMENT IMPLICATIONS

Preliminary costs estimates have been prepared in order to inform discussion on the feasibility of each bridge culvert upgrade. These costings are based on preliminary estimates of quantities. No detailed design or detailed quantity survey has been undertaken. In order to inform a future budget bid to the capital works program, a more detailed investigation of the desired bridge/culvert upgrade is recommended.

These costings have been summarised in Table 3 below and have also been represented graphically in Figure 1 below. Note that contingency has been added to all cost estimates due to the preliminary nature of the estimates.

Table 3 – Summary of preliminary cost estimates.

1 in 100-year structure	$7,472,648 (Inc. 20% CT)
1 in 20-year structure	$3,890,863 (Inc. 20% CT)
1 in 10-year structure	$2,150,598 (Inc. 30% CT) *
1 in 5-year structure	$914,000 (Inc. 30% CT) * *Note: due to relatively low project costs, a higher contingency amount has been allocated.

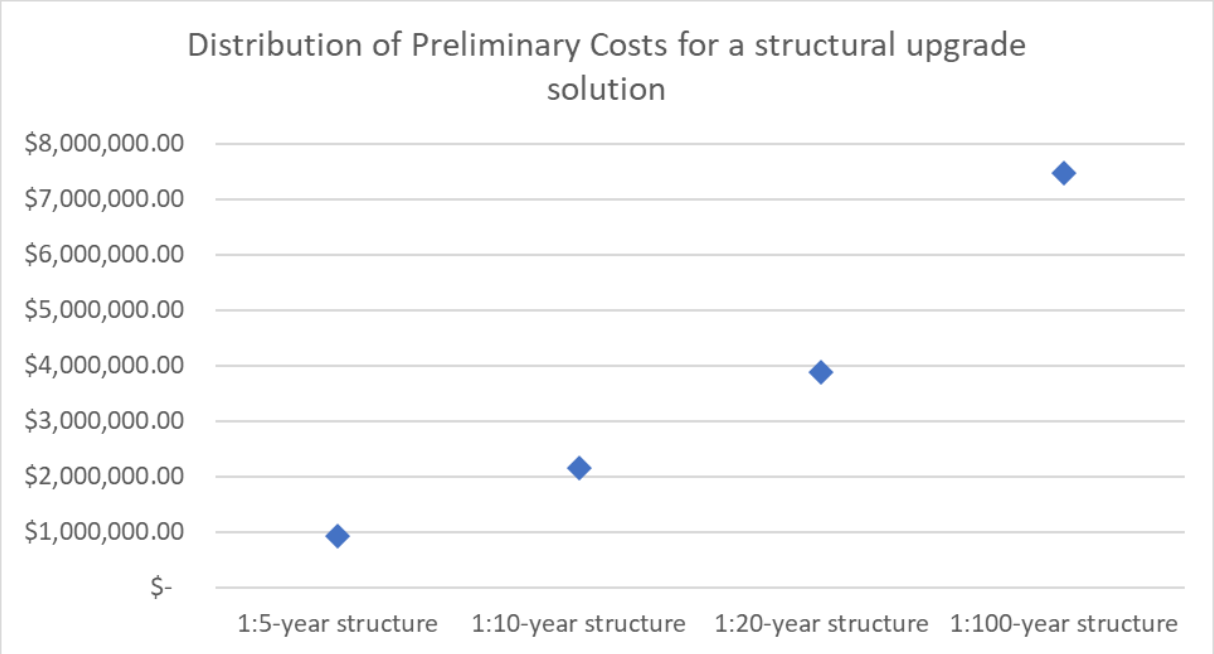

Figure 1 – Distribution of preliminary cost estimates.

POLICY AND LEGISLATIVE IMPLICATIONS

Future works will be completed based on a detailed design which is developed on appropriate codes and standards.

RISK IMPLICATIONS

Risk Ranking is determined using ROHS201-G1- Corporate Risk Matrix. Risk is identified as Low, Medium, High or Very High.

Risk	Risk Ranking	Proposed Treatments	Within Existing Resources?
Reputational Risks due to unexpected flood behavior due to the structure	Low	Proper flood modeling has been completed, GBCMA has been consulted	Yes
Financial Risks due to approval of the recommendations	Medium	Proposed bridge project to be prioritised as part of the annual capital program	Yes

SUSTAINABILITY IMPLICATIONS (SOCIAL AND ENVIRONMENTAL)

If construction works were to be undertaken in the future, necessary environmental impact studies will be completed before commencement of the project.

CHARTER OF HUMAN RIGHTS IMPLICATIONS

The rights protected in the *Charter of Human Rights and Responsibilities Act 2006* were considered in preparing this report and it's determined that the subject matter does not raise any human rights issues.

CHILDREN AND YOUNG PEOPLE IMPLICATIONS

Not applicable.

OFFICER DECLARATION OF CONFLICT OF INTEREST

No officers involved in the preparation of this report have any direct or indirect interest in this matter.

CONCLUSION

Council engaged Cardno Australia to assess multiple upgrade options for the Delatite Road crossing of the Whiteheads Creek. The assessment included the preparation of four (4) bridge concepts for a range of design flood events including the 1 in 5-year, 1 in 10-year, 1 in 20-year and 1 in 100-year flood events of the Whiteheads Creek, along with detailed hydraulic analysis of these options and the preparation of preliminary cost estimates.

The above four (4) options, as well as a "do nothing" approach was compared using a range of criteria to determine a ranking for the most favorable upgrade option.

The 1 in 5-year flood event structure has been ranked as the most favorable option to improve road safety at this location. Any upgrade at this location will also provide improved facilities for pedestrians, cyclists and horse riders.

MITCHELL SHIRE COUNCIL

Council Meeting Attachment

DEVELOPMENT AND INFRASTRUCTURE

24 JUNE 2019

9.5

DELATITE ROAD, SEYMOUR - BRIDGE CONSTRUCTION OPTIONS AT WHITEHEADS CREEK

Attachment No: 1

Upgrade Options Report

Upgrade Options Assessment

Delatite Road at Whiteheads Creek

V180361

Prepared for
Mitchell Shire Council

18 June 2019

Cardno
Shaping the Future

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