WINSTONE AGGREGATES

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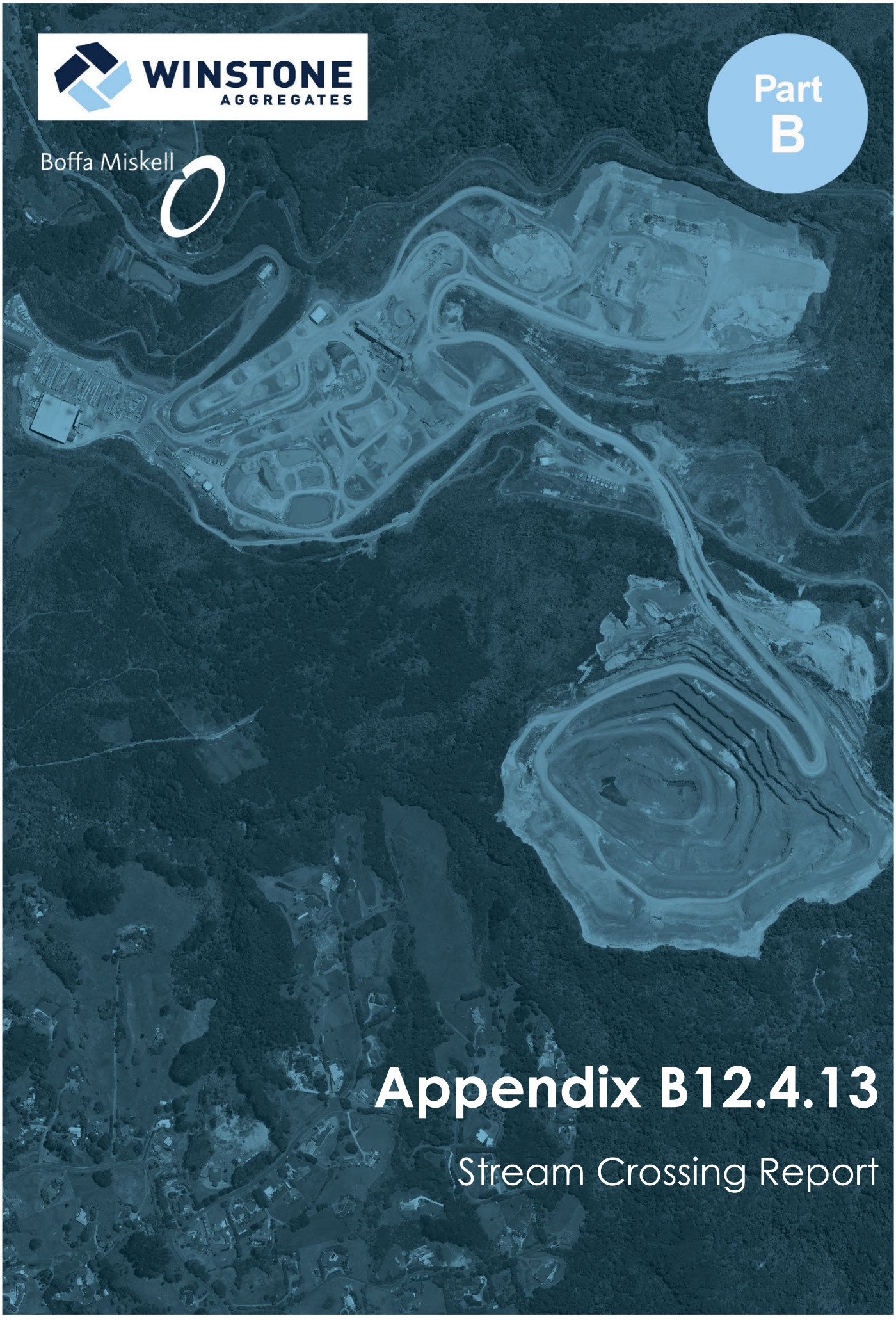
Part B



Appendix B12.4.13

Stream Crossing Report

WINSTONE AGGREGATES

Hunua Quarry Development

Stage 1 - Mangapū (Symonds) Stream Crossing Project Overview and Engineering Approach

March 2026

Document Information

Document name	Hunua Quarry Development – Stage 1 - Mangapū (Symonds) Stream Crossing: Project Overview and Engineering Approach
Version	1.0
Author	Paul Herbert
Reviewed by	Cam Russell
Approved by	Phil Heffernan

Document History

Version Number	Date	Change notes
1.**0**	26/03/2026	Final

Author

The author of this report is Paul Herbert, Senior Project Manager at Winstone Aggregates, a division of Fletcher Concrete and Infrastructure Limited. In this role, Paul is responsible for the planning, coordination, and delivery of major quarry infrastructure and staging works at Hunua Quarry.

Paul has close to 20 years' experience across mining, quarrying, and civil infrastructure projects in New Zealand and Australia. He holds a Bachelor of Science and Technology (BSc(Tech)) from the University of Waikato and has multidisciplinary experience spanning geotechnical engineering, geology, engineering, and mine planning, including both major project and operational roles.

In preparing this report, Paul has led the engineering design process and coordinated specialist technical inputs from geotechnical, hydrological, and environmental consultants. This report has been prepared in good faith for the purpose of supporting an application under the Fast Track Approvals Act 2024. Except where explicit reliance is placed on advice from external specialists, the matters addressed are within the author's professional experience and responsibility. To the best of his knowledge, no material facts have been omitted that would materially alter the information presented

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1 Executive Summary

This report describes the proposed temporary single-span bridge required to support Stage 1 of the Hunua Quarry Development at 489 Hunua Road, Hunua. The bridge is an enabling work associated with the realignment of a tributary of the Mangapū Stream and will provide controlled access for heavy quarry construction vehicles during the diversion works.

1.1 Purpose of Report

Stage 1 of the quarry development involves construction of a new stream channel, associated earthworks, and progressive overburden removal to enable subsequent quarry expansion stages. Material generated from these works must be transported across the tributary to existing quarry haul roads and designated disposal areas.

A safe, reliable, and all-weather crossing is therefore required to maintain continuous haulage operations during the diversion construction period. The bridge will be used exclusively for quarry construction and operational vehicles and will not form part of the public road network.

1.2 Temporary Nature

The bridge is a temporary structure required for a maximum period of approximately five years. This duration aligns with completion of the Stage 1 diversion works and progression into later quarry stages.

Once the original stream bed is quarried out and alternative haul routes become available, the bridge will be dismantled and removed. Site reinstatement will form part of the overall staging programme.

1.3 Options Assessment

Alternative crossing options were considered, including a culvert and a ford.

A culvert was discounted due to the need for in-stream works, potential restriction of flood flows, and debris blockage risk. A ford was considered unsuitable due to heavy haul truck safety requirements and the need for reliable year-round access.

A single-span bridge was selected as the preferred solution as it:

- Fully spans the tributary with no intermediate supports in the active channel;
- Maintains natural hydraulic capacity and flood conveyance;
- Accommodates heavy vehicle loading; and
- Minimises environmental and operational risk.

1.4 Design Approach

The bridge has been conceptually designed as a single-lane, single-span structure of up to approximately 20 metres, founded on piled abutments located outside the active stream channel.

Key design principles include:

- Design flood capacity based on a 1-in-100-year event;
- Deck soffit positioned approximately 2.0 metres above the stream invert;
- Foundations embedded into weathered to moderately weathered greywacke;
- Structural capacity suitable for heavy quarry haul trucks; and
- No machinery required to operate within flowing water during construction.

The design philosophy is fit-for-purpose and proportionate to a temporary, off-road heavy vehicle structure, informed by recognised New Zealand bridge and forestry road engineering guidance.

1.5 Ground Conditions and Foundations

Geotechnical investigations confirm that greywacke bedrock underlies the site at shallow depth, with moderately to highly weathered rock present near stream level. These conditions are suitable for piled foundations embedded into competent weathered greywacke.

No adverse groundwater conditions were identified that would preclude conventional piling methods. Detailed foundation design will be confirmed prior to construction.

1.6 Construction Methodology

Construction will be staged and controlled. All foundation and abutment works will be undertaken from outside the active channel. Temporary erosion and sediment control measures will be implemented prior to earthworks and integrated with the broader Stage 1 sediment management system.

The superstructure will be installed using cranes positioned clear of the stream channel. The bridge will fully span the tributary with no in-channel supports. Upon completion, approach roads will tie into the quarry haul network and runoff will be directed to existing sediment retention infrastructure.

1.7 Environmental and Hydraulic Safeguards

The bridge is designed to avoid permanent modification of the active stream channel. There will be:

- No intermediate piers within the watercourse;
- No reduction in channel width;
- Adequate clearance for flood flows;
- Scour protection at abutments where required; and
- Full removal at the end of its operational life.

1.8 Overall Conclusion

The proposed temporary single-span bridge is a necessary and proportionate enabling work for Stage 1 of the Hunua Quarry Development. It has been conceptually designed to provide safe and reliable heavy vehicle access while maintaining hydraulic capacity, avoiding in-channel obstruction, and minimising environmental disturbance.

Subject to approval, detailed design will be completed in accordance with relevant New Zealand engineering standards prior to construction.

2 Hunua Quarry Development Overview

Winstone Aggregates (Winstone), a division of Fletcher Concrete and Infrastructure Limited, operates the Hunua Quarry located at 489 Hunua Road, Hunua, South Auckland. Hunua Quarry is located in the Hunua Ranges in South Auckland, North Island, New Zealand.

The quarry has been operating since the 1920s and produces greywacke aggregate that supplies a significant proportion of the Auckland region's demand for civil infrastructure, including roading and concrete production. Hunua Quarry is recognised as one of Auckland's three most strategically important aggregate sources.

Winstone is seeking approval for the development of Hunua Quarry under the Fast Track Approvals Act 2024 (FTAA). The project is a Listed Project in Schedule 2 of the FTAA, reflecting its regional and national significance. The overall proposal seeks to expand and deepen the existing Symonds Hill Pit to access additional high quality greywacke resource, enabling quarry operations for up to 80 years (the Hunua Quarry Development).

The Hunua Quarry Development is proposed to be undertaken in 8 stages (see Figure 1 below), with Stage 1 comprising the diversion and realignment of a tributary of the Mangapū Stream to enable subsequent expansion of the extraction footprint. The Stage 1 works include vegetation clearance, overburden stripping, earthworks, construction of a new stream alignment, and associated sediment and drainage infrastructure.

This report relates specifically to the proposed temporary bridge required as part of Stage 1 of the Hunua Quarry Development. The bridge is an enabling component of the Stage 1 stream diversion works and is required to provide access for construction activities and haulage associated with the diversion channel. The bridge does not form part of the public road network and will be used exclusively for quarry construction and operational vehicles.

This report has been prepared to provide a clear, factual description of the proposed bridge works, including the functional requirements, assessment of crossing options, engineering design criteria, conceptual bridge form, and construction methodology. The information contained in this report will inform the planning assessment under the FTAA; however, the planning assessment itself is not the subject of this report and is addressed separately within the broader application documentation.

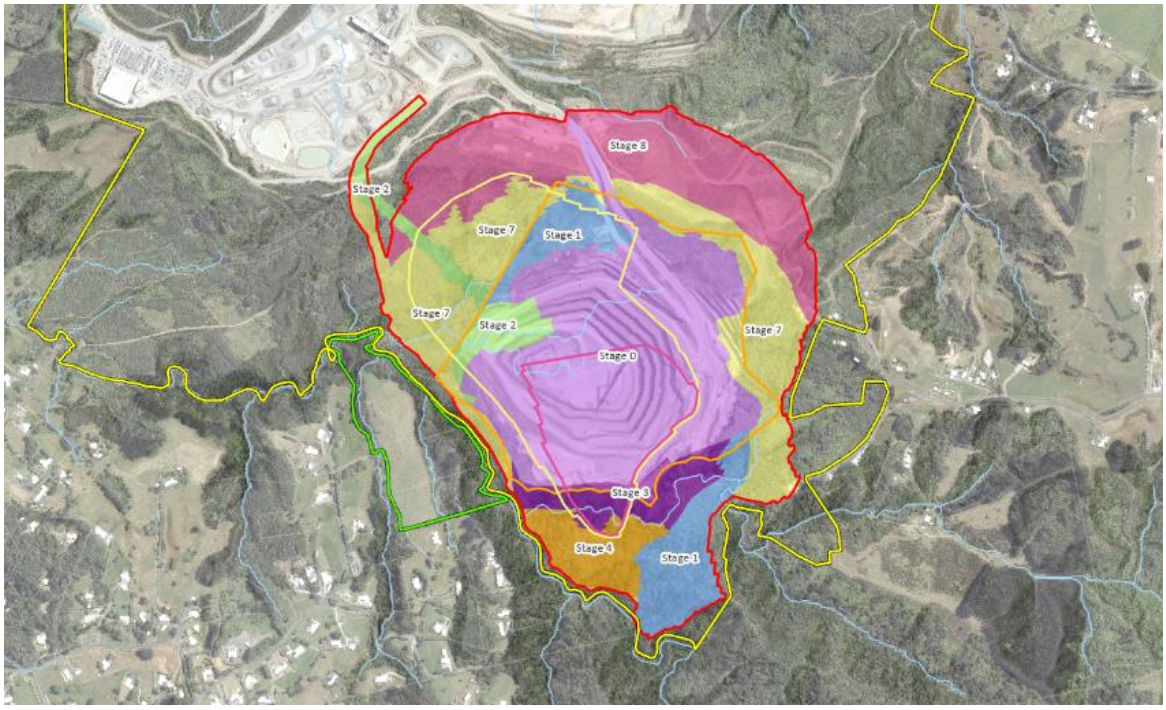

Figure 1: Hunua Quarry Development Stages 1-8 (Stages 5 & 6 are nested within Stage 7)

3 Purpose and Functional Requirement

The proposed bridge is required to enable access to the Stage 1 Mangapū Tributary stream realignment area at Hunua Quarry. Stage 1 works include overburden removal, construction of batter faces, and the excavation and engineering of the realigned (new) channel.

All material generated from these works must be hauled from the Stage 1 area, across the tributary, and transported to designated disposal areas within the operational quarry footprint. The location of the bridge within the broader quarry development and its relationship to the Stage 1 diversion works are shown on Figure 2 below.

Figure 2: Stage 1 Diversion – Bridge Location and Operational Context

The bridge is therefore a critical enabling component of the Stage 1 works, providing a safe and reliable crossing for loaded haul trucks of up to approximately 170 tonnes. The bridge is required to support continuous overburden stripping and quarrying operations during the construction and livening of the diversion channel and to maintain an uninterrupted haulage route between the realignment works and the quarry and overburden disposal areas.

The proposed location and local site context of the stream crossing is illustrated in Figure 3 and cross-section of the bridge relative to the stream channel is shown on Figure 4.

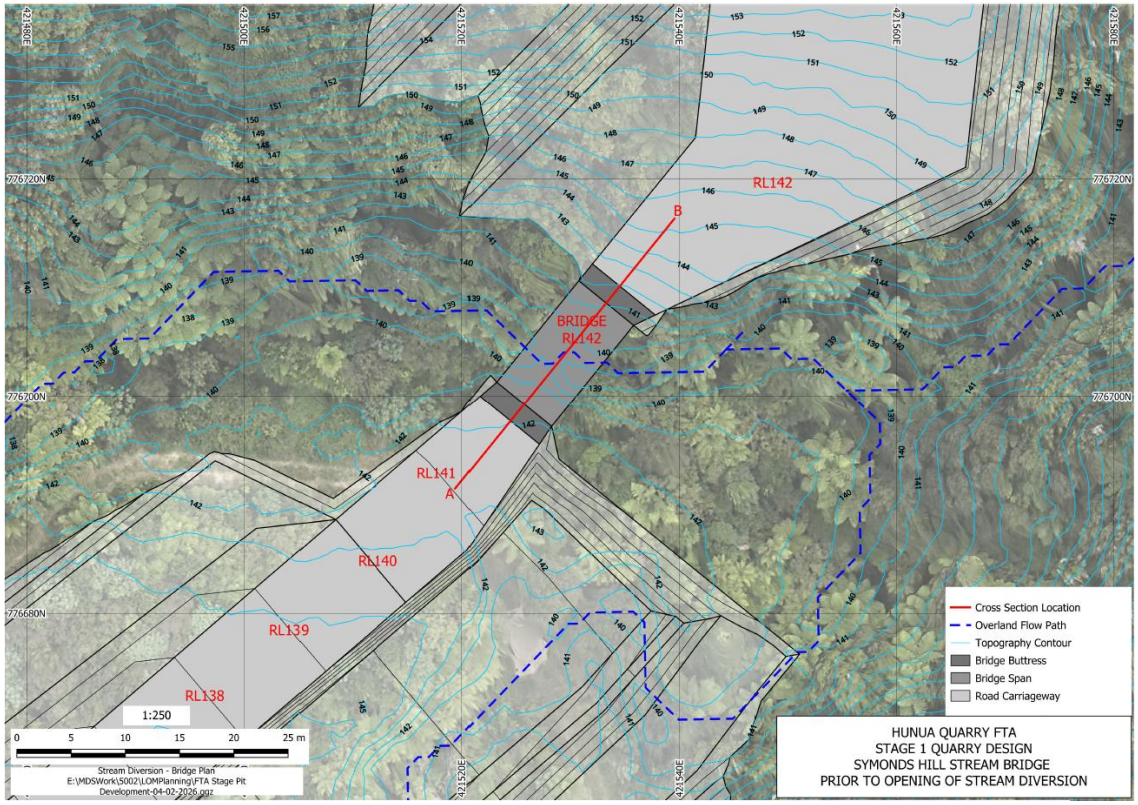

Figure 3: Stage 1 Quarry – Bridge Location and Site Context Plan

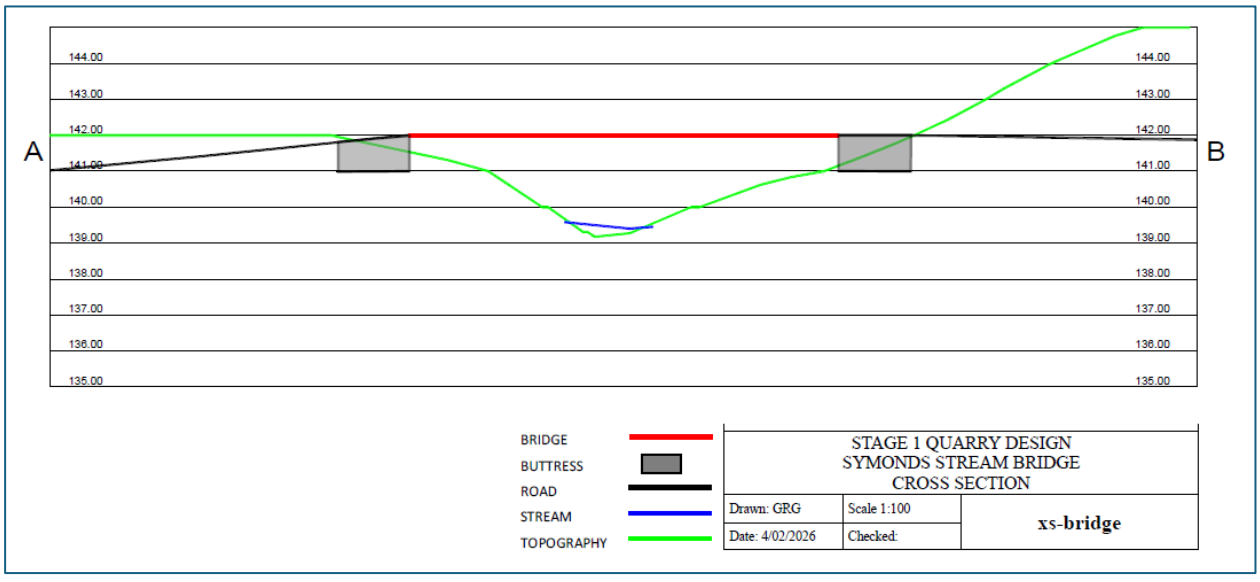

Figure 4: Bridge Cross Section A–B Showing Deck Level, Abutments, and Stream Profile

4 Duration and Staging Context

The bridge is required for a maximum duration of up to five years. This period aligns with the time required to complete construction and livening of the Stage 1 diversion channel and to allow progression to Stages 3 and 4 of the quarry development.

At the point that Stages 3 and 4 are undertaken, the original stream bed will be quarried out, and the bridge will no longer be required. The bridge has therefore been intentionally designed as a temporary structure, with removal and site reinstatement forming part of the overall project scope.

5 Assessment of Crossing Options

A range of stream crossing options were considered, including a culvert, ford, and bridge.

A culvert was discounted due to the requirement to construct works within the stream bed, potential flow constriction during high flow events, and the need for ongoing maintenance and debris management. A ford was not considered suitable due to safety constraints associated with heavy haul truck movements and the requirement for regular access during all weather conditions.

A single span bridge was selected as the preferred option as it allows the tributary to be fully spanned without intermediate supports, provides adequate clearance for flood flows, and accommodates heavy vehicle loading requirements. The bridge option also aligns with quarry operational needs by providing a reliable and unrestricted crossing during the Stage 1 works period.

6 Design Standards and Reference Documents

The design criteria and construction methodology for the Hunua Quarry Stage 1 Bridge have been informed by recognised New Zealand guidance, applied on a fit-for-purpose basis appropriate to a temporary, off-road structure carrying heavy quarry vehicles. Reference has been made to the Waka Kotahi NZ Transport Agency Bridge Manual (SP/M/022) to guide structural performance, foundation design, hydraulic capacity, scour management, and construction sequencing principles, acknowledging the bridge is not on the state highway network.

The Ministry for the Environment's Culvert and Bridge Construction – Guidelines for Farmers informed the assessment of alternative crossing options and supported selection of a single-span bridge over culvert or ford options in a high-load, debris-prone environment. Primary reliance has been placed on the New Zealand Forest Road Engineering Manual, which provides industry-accepted guidance for temporary and semi-permanent heavy vehicle bridge structures, including span selection, piled foundations, constructability, and integration with erosion and sediment control.

Collectively, these documents underpin a conservative, practical, and proportionate design approach consistent with quarry operational requirements and environmental risk management objectives.

7 Engineering Design Criteria

The bridge has been conceptually designed in accordance with recognised bridge and forestry road engineering principles and will be subject to detailed design prior to construction.

Key design parameters include:

- Single lane configuration suitable for controlled haul truck movements
- Maximum span of up to approximately 20 metres
- Design flood standard of 1 in 100-year event
- Bridge deck soffit approximately 2.0 metres above the stream invert
- Stream channel width at crossing of approximately 2 metres
- Design vehicle loading of up to approximately 170 tonnes

These criteria ensure the bridge provides sufficient hydraulic capacity, structural performance, and operational safety for the intended quarry use.

8 Ground Conditions and Foundation Concept

Geotechnical investigations undertaken by Tonkin + Taylor in late 2025 for the Mangapū Tributary works provide a robust characterisation of subsurface conditions in the vicinity of the proposed bridge abutments. Drillhole HUN25/3 and four test pits (HUN25/TP1–TP4) were completed in ground that is proximal to, and representative of, the site.

8.1 Geological Profile

The investigations confirm that ground conditions are dominated by greywacke bedrock, with a weathering profile that varies with elevation and proximity to the tributary.

Residual and completely weathered soils were encountered near surface, extending to depths of up to approximately 12 m below ground level in mid-slope locations (HUN25/3).

Beneath this, highly weathered greywacke was encountered to approximately 20 m bgl, transitioning to moderately weathered greywacke at greater depth.

At lower elevations adjacent to the Mangapū Tributary (test pits at RL approximately 141–145m), completely to highly weathered greywacke was encountered at shallow depths of approximately 4–5 m bgl.

Moderately to highly weathered greywacke is exposed within the existing stream bed and banks of the Mangapū Tributary, based on site walkovers and field mapping, confirming that bedrock is present at or near channel level in the vicinity of the proposed bridge crossing.

Slightly weathered greywacke is present at deeper levels and at downstream locations, consistent with observations elsewhere in the quarry.

The greywacke comprises predominantly sandstone sequences with lesser siltstone beds, consistent with previous geological mapping at Hunua Quarry.

8.2 Engineering Implications for Bridge Foundations

The investigations indicate that competent greywacke is present at shallow depth across the proposed diversion and at elevations relevant to the bridge abutments. Exposed HW–MW greywacke within the existing stream bed, together with weathered to moderately weathered greywacke encountered in borehole HUN25/3 and the test pits, confirms the suitability of founding bridge piles within weathered to moderately weathered greywacke at this location.

No adverse groundwater conditions were identified that would preclude the use of conventional piling methods.

The bridge will be supported on piled foundations embedded into greywacke rock. Both bored and driven pile options are considered feasible and will be confirmed during detailed design. Where bored piles are adopted, temporary or permanent casing will be used to maintain shaft stability through the alluvial soils, with piles embedded a minimum of three pile diameters into competent rock.

Bridge abutments will be designed to accommodate hydraulic loading and incorporate scour protection where required.

Additional targeted ground investigation is recommended prior to construction at the proposed bridge location, including at each abutment, to confirm rock levels and pile founding conditions.

9 Conceptual Bridge Form

The conceptual bridge form, illustrated in Figure 5, comprises abutments located outside the stream channel supporting a prefabricated superstructure (such as precast concrete beams or modular steel components). The structure will fully span the tributary, with no intermediate supports within the active channel.

The deck will incorporate traffic barriers and edge protection appropriate for heavy haul truck operations. Bridge geometry will be integrated with the quarry haul roads to provide safe and efficient entry and exit for construction traffic, as reflected in the stylised section shown in Figure 5.

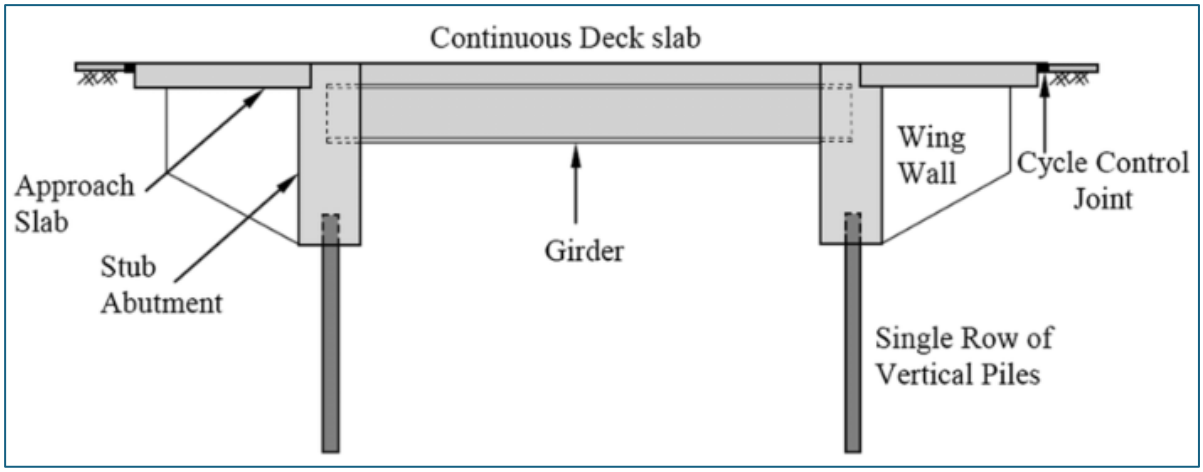

Figure 5: Conceptual Stylised Section of Temporary Single Span Bridge

10 Proposed Construction Methodology

The following construction methodology has been designed in accordance with the proposed Erosion and Sediment Control Plan and Auckland Council GD05 and TP108.

Prior to the commencement of any earthworks or construction activities, the site will be established and temporary erosion and sediment control measures installed. These measures will be implemented to manage runoff during construction and to integrate with the sediment control system established for the Stage 1 earthworks.

Temporary erosion and sediment controls will include stabilised construction entrances, diversion drains to separate clean and dirty water, appropriate to the scale and duration of the works. Controls will be installed upslope of disturbed areas where required and maintained for the duration of construction.

Temporary construction access will be established from existing quarry infrastructure, including access from the RL150 m Pond area, with access to the opposite side of the tributary via the existing Middleton Road track. Construction laydown areas, crane pads, and working platforms will be formed outside the stream channel and positioned to avoid encroachment into the active watercourse.

Once established, runoff from the completed bridge deck and approach roads will be directed to the Sediment Retention Ponds (SRPs) servicing the Stage 1 realigment cut earthworks, ensuring that operational runoff from the bridge integrates with the wider quarry stormwater and sediment management system.

10.1 Ground Investigation

Localised geotechnical investigations will be undertaken at each abutment and pile location, where required, to confirm ground conditions prior to foundation construction. These investigations will be

carried out using small plant and will be undertaken from the stream banks, with no works within the active channel.

Foundation preparation will involve excavation to the design depth at each abutment location. Excavations will be supported as required to maintain stability through alluvial soils. Where bored piles are adopted, temporary or permanent casing will be installed to maintain pile shaft stability during construction.

10.2 Piling and Foundation Construction

Piled foundations will be installed in accordance with the detailed design, using driven, screw, or bored piling methods as confirmed during final design. Piles will be embedded into competent greywacke rock to achieve the required load capacity. Where required, pile integrity testing or load testing will be undertaken to verify performance.

Concrete footings and pile caps will then be constructed, followed by the installation of any required scour protection at the abutments, such as rock armouring. All foundation and abutment works will be undertaken from outside the stream channel, and construction sequencing will ensure that no machinery is required to operate within flowing water.

10.3 Abutment Construction

Abutments will be constructed on both sides of the tributary and will typically comprise reinforced concrete walls, wingwalls, and associated drainage elements. Abutment construction will be coordinated with approach earthworks to ensure continuity of the haul road alignment.

Engineered fill will be placed behind the abutments and compacted in layers to form the approach embankments. Batters will be shaped to the design profile and stabilised progressively as construction advances.

10.4 Superstructure Installation

The bridge superstructure will be delivered to site as prefabricated components, such as precast concrete beams or modular steel bridge units. Installation will be undertaken using cranes positioned clear of the stream channel and outside the active floodway.

Beams will be placed onto the abutments, followed by installation of the bridge deck, edge protection, and traffic barriers suitable for heavy haul truck operations. The bridge will fully span the tributary with no intermediate supports.

10.5 Approach Road Construction and Integration with Diversion Works

Following installation of the bridge superstructure, the approach roads on both sides of the bridge will be constructed and tied into the existing quarry haul road network and the Stage 1 stream work cut earthworks.

Approach road construction will be undertaken to provide smooth transitions onto and off the bridge, suitable for heavy haul truck movements. Pavement construction will be coordinated with the tributary realignment earthworks to ensure that runoff from the bridge and approach roads is directed to the SRPs established for the diversion cut, rather than directly to the stream.

Permanent drainage features associated with the approach road will be completed as part of this stage, replacing or supplementing temporary erosion and sediment controls as appropriate.

10.6 Completion, Inspection, and Operation

Upon completion of construction, the bridge will be inspected and certified for operational use. Safety barriers, signage, and delineation will be installed to manage single lane traffic movements by haul trucks.

Temporary erosion and sediment controls will remain in place until disturbed areas are stabilised, and the permanent stormwater and sediment management system associated with the stream works is fully operational.

10.7 Decommissioning

At the end of the required operational period (up to five years), or once the bridge is no longer required to support quarry staging, the bridge will be dismantled and removed. Abutments and associated structures will be removed where practicable, and the site will be reinstated in accordance with the quarry staging and stream realignment progression.

11 Conclusion

This report has been prepared to provide a clear and factual description of the proposed bridge works, including the functional requirements, assessment of alternative crossing options, applicable engineering criteria, conceptual design parameters, and proposed construction methodology. It is intended to support and inform the associated planning and environmental assessments by transparently setting out the technical basis for the proposed temporary single-span bridge at Hunua Quarry.

The design presented in this report is conceptual in nature. Subject to approval, detailed engineering design will be completed prior to construction and will be undertaken in accordance with relevant New Zealand industry standards and recognised best practice applicable at the time of design. Detailed design will confirm structural sizing, foundation requirements, hydraulic capacity, constructability, and associated environmental controls.