WINSTONE AGGREGATES

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Part B

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Hunua Quarry Expansion Resource Report

Hunua Quarry Development

Geological and Resource Assessment

March 2026

WINSTONE AGGREGATES

Document Information

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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 over 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 both the mining and quarrying industries.

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 for the purpose of supporting an application under the Fast Track Approvals Act 2024. While not independent of Winston Aggregates, the author confirms that he has read the Expert Witness Code of Conduct contained in the Environment Court's Practice Note 2023 and (to the extent possible, given his employment) has complied with it in providing this report. 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

1.1 Purpose of Report

This report provides a technical assessment of the greywacke resource underlying the proposed Hunua Quarry Development, prepared to support the substantive application for approvals under the Fast Track Approvals Act 2024.

Its purpose is to:

- Provide an overall context for the project from the perspective of the resource, and the works required to access it;
- Describe the geological setting and material characteristics of the resource;
- Document the investigation and modelling undertaken to define resource extent and quality;
- Assess aggregate performance characteristics; and
- Evaluate the economic viability of continued extraction within the proposed expansion footprint.

The report does not address planning or environmental matters except where directly relevant to geological or economic assessment. Its focus is the continuity, quality and viability of the greywacke resource targeted by the development.

Key conclusions that can be adopted or taken from this summary are provided in **bold** below.

1.2 Project context

Auckland’s construction economy is critically dependent on secure, proximate supplies of construction aggregate, a high-volume, low-value material that underpins housing delivery, transport infrastructure, and three-waters networks. Auckland has experienced a structural aggregate shortfall for more than a decade, with demand increasingly met through longer-haul imports from outside the region, resulting in higher costs, increased emissions, and reduced supply resilience.

Hunua Quarry is one of Auckland’s three strategically important aggregate sources and plays a key role in supplying South and Central Auckland due to its scale, established infrastructure, and proximity to major growth and infrastructure areas. Without the proposed Hunua Quarry Development, existing consented rock reserves are forecast to be exhausted by 2039, removing a major source from Auckland’s supply base and materially worsening the regional shortfall. The Project secures continued access to a proven greywacke resource through staged development of an existing quarry, supporting long-term supply continuity, reducing reliance on long-distance transport, and enabling more efficient and resilient delivery of housing and infrastructure.

The Hunua Economic Assessment demonstrates that maintaining this proximate supply delivers substantial avoided transport, emissions, and social costs compared with out-of-region alternatives, confirming the Project’s importance as an enabling development with significant regional benefits.

1.3 Overview of Resource

The Hunua Quarry extracts indurated Waipapa Group greywacke, a strong, durable rock that has supplied Auckland's civil infrastructure market since the 1920s.

Within the Symonds Hill Pit and proposed expansion areas, the resource comprises variably weathered greywacke basement rock locally overlain by younger sedimentary units (predominantly Waitemata Group and minor Waikato Coal Measures), which form overburden.

The resource is characterised by:

- Laterally extensive sandstone-dominant greywacke forming the principal aggregate source;
- Localised argillaceous domains, interpreted as fault-bounded panels;
- Irregular but predictable weathering profiles; and
- Structurally controlled corridors influencing local variability but not overall continuity.

Investigations confirm a substantial volume of extractable greywacke sufficient to support long-term quarry operations, with projected supply capacity extending for 80+ years under current production rates.

1.4 Resource Continuity

Resource continuity has been established through an integrated programme of drilling (2004–2025), geological mapping, structural surveys, face mapping and ongoing reconciliation against quarry exposures.

Key findings include:

- Strong lateral continuity of sandstone-dominant greywacke beneath the main Symonds Hill area and into proposed expansion panels;
- Weathering profiles that generally decrease with depth, transitioning from overburden through moderately weathered to slightly weathered and fresh rock;
- Structural features that influence weathering penetration and local rock quality but do not truncate the overall greywacke body; and
- A geological model that explicitly represents irregular weathering surfaces and fault corridors based on drilling control rather than topographic assumptions.

Areas with dense drilling data and exposure verification are assigned high geological confidence. Peripheral and deeper zones are classified conservatively to reflect lower data density.

The dataset demonstrates that the greywacke resource is continuous at the scale relevant to the proposed quarry development.

1.5 Aggregate Quality

Aggregate quality has been assessed through:

- Production-scale aggregate testing;

- Trial product sampling;
- Petrographic analysis;
- X-ray diffraction (XRD) and X-ray fluorescence (XRF) mineralogical testing; and
- Independent alkali-reactivity testing using the concrete prism method.

Results confirm that sandstone-dominant greywacke sourced from slightly weathered to fresh domains within the existing Symonds Hill pit produces high-quality aggregates suitable for concrete and roading applications. Durability indicators are strong, deleterious clay fractions are low in representative production materials, and weak particles are rare where extraction targets competent domains.

Mineralogical assessment identifies quartz, albite, chlorite and minor accessory minerals typical of indurated greywacke. Smectite is present in small quantities but at levels that have not prevented compliant aggregate production under established quality control procedures.

Argillaceous and altered domains exhibit greater variability and reduced durability where strongly weathered or altered. These domains are spatially constrained and can be managed operationally through selective extraction and blending.

Overall, the evidence confirms that the deposit is capable of sustained production of specification aggregates consistent with its long operational history.

1.6 Life-of-Quarry Development

The Hunua Quarry Development is planned and assessed on the basis of a staged Life-of-Quarry (LoQ) development framework that demonstrates how the greywacke resource would be progressively accessed and extracted over time while maintaining operational flexibility and managing effects in a staged and controlled manner.

The proposed quarry expansion is described through eight indicative development stages, beginning with enabling works (including tributary diversion and establishment of new access infrastructure) and progressing through incremental pit expansion and deepening within a defined project footprint. Early stages focus on establishing safe and efficient access to the resource, while later stages enable continued extraction through progressive deepening and lateral expansion within the footprint.

The staging sequence and associated timing are indicative only and are provided for assessment purposes. Actual sequencing, production rates, and timing will respond to aggregate demand, operational requirements, and ongoing refinement of pit designs. A reference horizon of approximately 80 years is used to demonstrate the long-term capacity of the resource and to provide a coherent basis for assessing the scale and duration of effects and to reflect the level of sustained capital investment required to progressively access and develop the resource on a continuing basis. This timeframe represents an assessment horizon rather than a fixed operational limit, and future consenting processes for regional consents, including earthworks, would occur in accordance with statutory consent duration requirements.

Following completion of the initial stages, further extraction is anticipated to occur largely through progressive deepening within the established pit area, meaning that long-term quarrying would not materially increase the surface extent of quarrying. Progressive rehabilitation would be undertaken throughout the life of the quarry where practicable, with completed benches, batters, and overburden landforms stabilised and rehabilitated in accordance with the Quarry Management Plan.

Overall, the Life-of-Quarry Development framework demonstrates that the Hunua Quarry Development can be undertaken in a staged, adaptive, and manageable manner, enabling long-term access to a strategically important aggregate resource while ensuring that quarrying effects are appropriately planned for and managed over time.

1.7 Economic Viability

Economic viability is governed primarily by the relationship between overburden thickness, weathering distribution and recoverable resource rock.

For economic assessment, "resource rock" is defined as all moderately weathered (MW), slightly weathered (SW), and fresh (FW) greywacke excavated below overburden, consistent with operational practice.

A break-even strip ratio of [redacted] bank cubic metres (BCM) of overburden per 1 BCM of resource rock has been adopted for economic screening.

Modelled results indicate:

- Favourable strip ratios in southern and eastern panels where tertiary cover is absent or minimal;
- Increased stripping in areas where Waitemata Group or Waikato Coal Measures are preserved;
- Strong economic potential where greywacke occurs at shallow depth; and
- Manageable variability through staged sequencing and selective extraction.

Density testing (average [redacted] g/cm^3) provides a validated basis for converting modelled volumes to tonnage-based production and financial forecasts.

Taken together, the distribution of overburden and weathering profiles supports economically viable extraction within the proposed development footprint when sequenced appropriately.

1.8 Key Risks and Management Controls

The principal geological and operational risks are:

- Irregular weathering boundaries;
- Fault-controlled deep weathering corridors;
- Argillaceous panels with reduced aggregate yield;
- Localised deleterious mineral concentrations in fault-proximal zones; and

- Variability in strip ratio across panels.

These risks are managed through:

- Conservative resource classification in lower-confidence areas;
- Continuous face mapping and reconciliation;
- Selective mining and stockpile separation;
- Established QA/QC aggregate testing regimes;
- Staged development sequencing to optimise strip economics; and
- Ongoing drilling and groundwater monitoring in new development corridors.

The geological model is iterative and designed to be updated as exposure increases, reducing uncertainty over time.

1.9 Overall Conclusion

The combined evidence from drilling, mapping, laboratory testing, operational history and economic modelling demonstrates that:

- The Waipapa Group greywacke resource beneath the proposed expansion is laterally continuous at quarry scale;
- Sandstone-dominant domains are capable of producing high-quality concrete and roading aggregates consistent with long-term production history;
- Variability is structurally controlled, spatially constrained and operationally manageable; and
- Economic viability is supported by favourable strip ratios in key panels and by the ability to sequence extraction to manage overburden and weathering distribution.

The Hunua Quarry Development is therefore supported by a coherent and cross-validated geological and economic evidence base demonstrating continuity, quality and viability of the targeted greywacke resource.

2 Introduction

2.1 Background and Project 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 (Figure 1 below).

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.

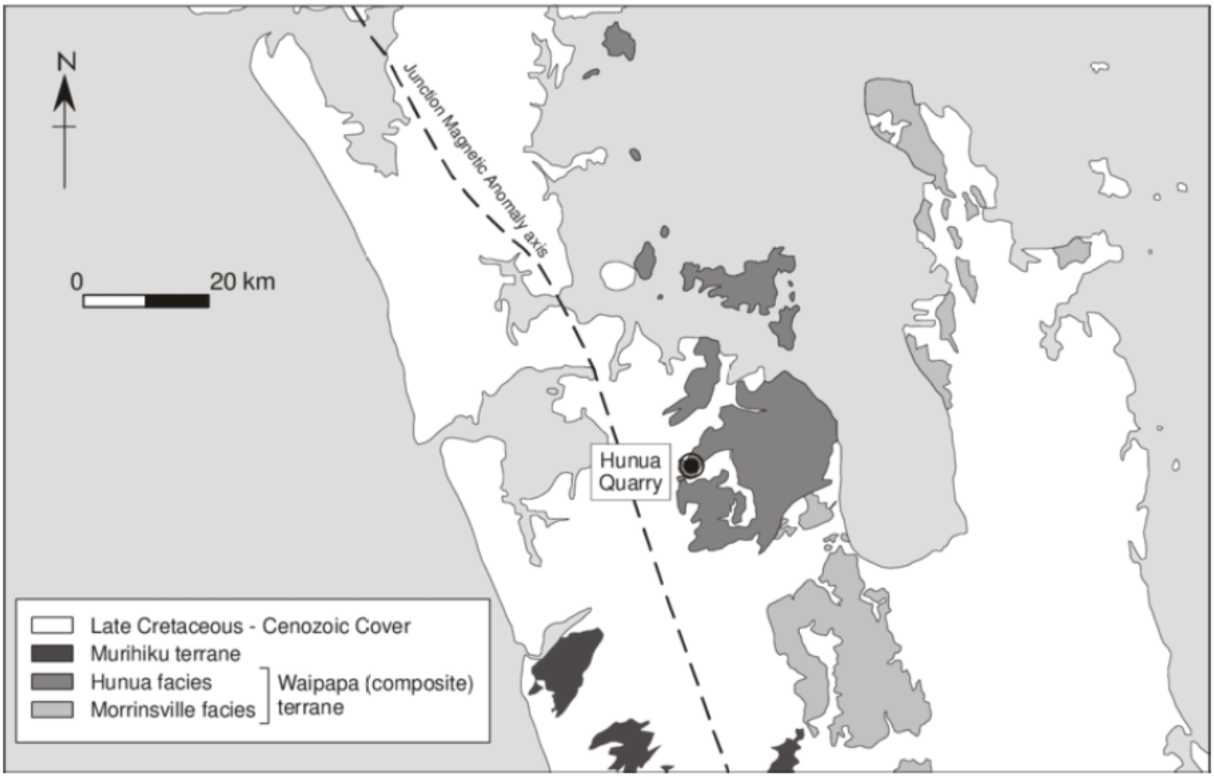

Figure 1: Exposed basement geology of the Auckland area showing tectonostratigraphic terranes and location of the Hunua Quarry

Winstone is seeking approval to the project under the Fast-Track Approvals Act 2024 (FTAA). The Hunua Quarry Development is a Listed Project in Schedule 2 of the FTAA, reflecting its regional and national significance. The proposal is to expand the existing quarry to increase annual quarry production to a peak of approximately 5.4 million tonnes of aggregate, and to enable the continued extraction of aggregate for a further 80 years (**"the Project"**) or also referred to as the "**quarry development area**". Through this approval process, Winstone propose to update the consent conditions and quarry management plans applying to the site to incorporate the changes and enable greater operational efficiency.

The Hunua Quarry development seeks to expand and deepen the existing Symonds Hill Pit, enabling sustainable extraction of additional greywacke resource, and the continuation of quarrying within Winstone's existing site for up to 50 -80 years (depending on market demand).The proposed development initially focuses on the southern and northwestern ends of the quarry complex. The new extraction footprint will initially expand the existing Symonds Hill Pit to the south and east, followed by areas to the north and west. These development works will occur entirely within Winstone-owned land and integrate with existing quarry infrastructure.

The quarry will utilise the existing access from Hunua Road, although a right turning lane is proposed to improve the safe operation of the access for turning trucks and other road users. This also reflects the increase in truck volumes accessing the Site as production on the Site increases.

The proposed Symonds Hill Pit expansion will cover an area of approximately 108 hectares, with a maximum depth of approximately – (minus) 50 metres RL and enabling quarrying beyond that in later years to access further resource. Quarry development will use benches ranging from 10m – 15m in height and 9 – 20m in width. The resource comprises Waipapa Group greywacke, with an estimated total volume exceeding 225 million tonnes. Over the life of the quarry, anticipated to be around 80 years, approximately 24 million m^3 of overburden will be removed, supporting a peak production rate of 5.4 million tonnes per annum.

This expansion will necessitate the realignment of a tributary of Mangapū Stream to allow for the pit expansion. This will include clearance of indigenous and exotic vegetation, overburden stripping and earthworks, stream realignment, followed by revegetation within the new stream corridor. Ecological offset planting will also occur within other parts of the landholding, and this will also achieve landscape mitigation and compensation for the removal of an area of the ONL. Additional ecological offset planting and compensation works will also be undertaken in locations beyond the Site.

The proposal will also utilise the current site access, along with the existing processing facilities, staff facilities and bores.

In summary, the key aspects of the proposed quarry development include:

- Diversion and reclamation of approximately 941m length of a tributary to Mangapū Stream to enable the expansion of the extraction footprint. This includes construction of a temporary 7m wide bridge to enable access for construction of the stream realignment channel.
- Draining and modification of up to 21 identified natural inland wetlands.
- Providing additional overburden capacity within the Site (from Stage 7), primarily by backfilling the Symonds Hill Pit;
- Construction of new sediment retention ponds, haul road, drainage networks, and Mangapū Stream Tributary diversion integrated with the existing quarry systems.
- Increasing average daily traffic movements during both the AM and PM peak hours when the quarry is operating at peak capacity:
  - AM peak hour – 161 truck movements corresponding to approximately 80 entry and 80 exit truck movements; and
  - PM peak hour – 135 truck movements corresponding to approximately 68 entry and 68 exit truck movements.
- Removal of 44.46 ha of indigenous vegetation, associated with the stripping of overburden including within an SEA and ONL and removal of 4.15ha of exotic scrub.
- Constructing the western haul road, including two culverts, to provide a more efficient connection between the pit and the processing yard as part Stage 2. The haul road will then be removed during Stage 7 and a new haul road constructed.
- Amending the consented groundwater takes and discharges to Mangapū Stream.

- Providing for some in-pit crushing to enable a greater volume, and more efficient, processing of aggregate.
- Providing for the placement of a greater volume of overburden within the Site.
- Implementing progressive rehabilitation (where practicable), ecological offsetting, landscape mitigation, compensation and stream enhancement measures throughout quarry development. The expansion necessitating the Mangapū Stream Tributary diversion is the first stage of the project, and the ecological offsetting needed for this will occur in the early phases.

Enable quarry development below RL-50m as part of the long-term development of the Symonds Hill Pit, recognising that this deeper resource would only be accessed once the earlier stages of the pit have been quarried. The final Life of Quarry Strategy will be confirmed prior to any excavation below RL-50m, and will detail further investigations necessary to ensure that adverse environmental effects associated with later-stage extraction and/or rehabilitation are appropriately identified, assessed, and managed (including obtaining any regional consents required).

The Hunua Quarry Development is proposed to be undertaken in 8 stages (see Figure 2 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.

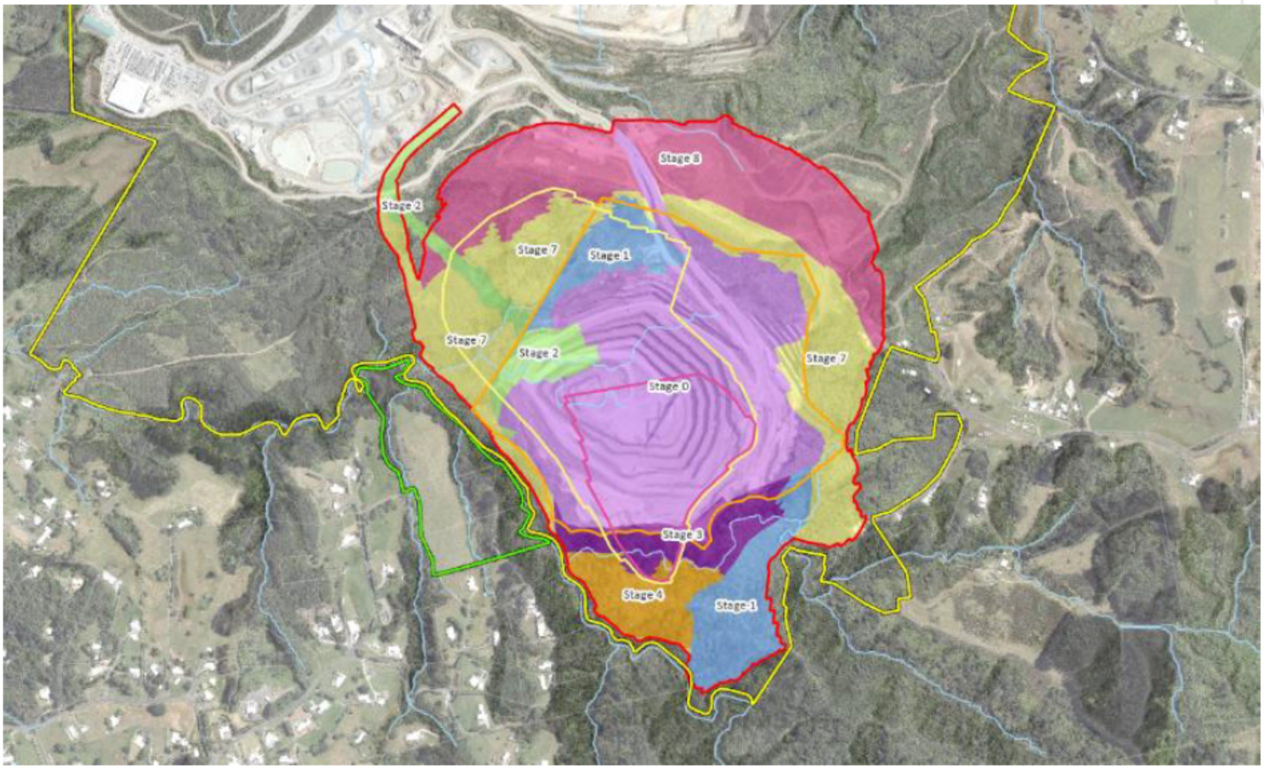

Figure 2: Hunua Quarry Development Stages 1-8 (Stages 5 & 6 are nested within Stage 7)

This report relates specifically to the economic resource targeted by proposed Stages 1-8 of the Hunua Quarry Development.

This report has been prepared to provide a clear, factual description of the geological setting, lithological characteristics, structural controls, and weathering profiles that impact on the economic viability of the greywacke resource targeted by the proposed development as well as the process of investigating and evaluating the volume and quality of the resource.

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.

2.2 Scope of this Report

This report presents the geological, materials and economic viability assessment of the greywacke resource underlying the proposed Hunua Quarry Development.

The scope of the report is to:

- Provide an overall context for the project from the perspective of the resource, and the works required to access it;
- Describe the regional and site-specific geological setting relevant to the resource;
- Characterise lithology, structure and weathering profiles that influence extractability and material performance;

- Document the investigation programme, including drilling, geological mapping, face observations, sampling and laboratory testing;
- Explain the geological modelling methodology and the basis for defining material domains;
- Outline constraints on future site development and overall design rationale
- Summarise the life-of-quarry strategy for the long-term development of the site
- Assess aggregate quality and performance characteristics relevant to concrete and roading applications;
- Evaluate factors influencing economic viability, including strip ratio, overburden distribution, density and operational considerations; and
- Identify key sources of geological and material variability and the controls used to manage them.

The report focuses specifically on the continuity, quality and economic viability of the Waipapa Group greywacke resource targeted by the proposed expansion. Matters outside the scope of this report include:

- Detailed planning, policy or statutory assessment under the Fast Track Approvals Act 2024;
- Environmental effects assessment (including ecology, landscape, noise, traffic or air quality);
- Cultural impact assessment;
- Detailed engineering design of infrastructure beyond geological feasibility considerations; and
- Financial modelling beyond geological and strip-ratio-based economic screening.

Where relevant, this report interfaces with those disciplines by providing the geological and resource framework upon which broader assessments are based. Its role is to establish, through investigation and analysis, that the targeted greywacke resource is laterally continuous at quarry scale, capable of producing specification aggregates, and economically viable when developed in sequence.

3 Project Context

A secure and reliable supply of construction aggregate is critical to Auckland's economic and social wellbeing. Aggregate is a foundational input to housing delivery, transport infrastructure, and three-waters networks, and its availability and delivered cost directly influence construction feasibility, project timelines, and affordability outcomes across the region.

This section provides context for the Hunua Quarry Development by summarising aggregate use, Auckland's aggregate market context, and the strategic role of established quarries—particularly Hunua Quarry—in maintaining supply continuity and resilience for Auckland's construction economy.

3.1 Aggregate use

Rock aggregate is a core construction material and a fundamental component of concrete and asphalt. It is used across a wide range of civil and building applications including concrete production, asphalt, road base and sub-base, rail ballast, drainage and stormwater systems, water supply and wastewater networks, building foundations and structural fills, concrete blocks and pavers, erosion protection (riprap), and landscaping.

Aggregate demand is inherently high-volume. As a commonly used industry benchmark, each new dwelling requires approximately 250 tonnes of aggregate and construction of 1 km of two-lane motorway requires approximately 14,000 tonnes of aggregate (approximately 500 truck and trailer loads) (Aggregate & Quarry Association "Fact Files"). These volumes illustrate why an appropriately located and resilient supply of aggregate is a key enabling condition for Auckland's housing delivery and infrastructure programmes.

Looking ahead, Auckland's housing growth is expected to sustain aggregate demand over the long term. The Aggregate & Quarry Association notes planning assumptions for Auckland that include approximately 310,000 additional dwellings, reinforcing the scale of aggregate volumes required to enable the region's built environment.

In the absence of sufficient, suitably located aggregate resources, construction activity would be constrained through a combination of material shortages, programme delays, and escalating costs. At a practical level, this can result in the slowing or halting of residential and infrastructure construction, reduced concrete and asphalt production, and increased reliance on long-distance transport of aggregate from more remote sources. Such outcomes increase delivered construction costs and intensify transport-related effects (including emissions and crash exposure) as heavy vehicle kilometres rise.

3.2 Aggregate demand and market context in Auckland

Auckland's aggregate market is structurally constrained. As a low-value, high-volume commodity, the delivered cost of aggregate is highly sensitive to haul distance, with transport costs and time-related logistics forming a significant component of the final cost to construction projects.

The Hunua Quarry Expansion Economic Assessment provided by Greg Akehurst of Market Economics Consulting (Economic Assessment) identifies that Auckland has experienced an aggregate shortfall for at least the last 15 years, with demand outstripping local supply and material being transported into the region from Waikato and Northland at increased delivered cost.

The assessment also identifies Auckland as New Zealand's largest growth market, adding approximately 20,000–25,000 residents per year and expected to account for around 40%–50% of national growth over coming decades, sustaining upward pressure on aggregate demand.

Importantly, in this market setting the economic risk is not limited to gate price impacts. Longer haul distances increase truck cycle times, constrain "just-in-time" delivery, and require larger fleets to maintain equivalent delivery rates. They also increase exposure to disruption risk from traffic incidents, road maintenance, congestion and weather events, and generate externalities such as emissions and crash risk as heavy vehicle kilometres rise.

The Economic Assessment's supply–demand outlook indicates that, without additional consented local supply, Auckland's deficit increases over time—from around 2 million tonnes per annum currently to approximately 6.2–9.0 million tonnes per annum by 2055 (depending on population growth assumptions), implying increased reliance on longer-haul supply and the associated cost and resilience consequences.

3.3 Role of quarries, functional need, and relevance to Hunua Quarry

Quarries play a vital role in supporting infrastructure and urban growth by supplying the raw materials required for construction. Aggregate extraction is locationally constrained: as a finite natural resource, suitable rock is not present in all locations and viable extraction can only occur where geological conditions provide deposits that can be extracted and processed economically.

This aligns with the concept of functional need in national direction, being the need for an activity to traverse, locate or operate in a particular environment because it can only occur in that environment. Aggregate extraction can only occur where sufficent geological resource exists and it is accessible (i.e. the land has not been sterilised as a result of other land uses such as urban development). There is a functional need to quarry in this location.

The sector is characterised by high entry barriers and long lead times for establishing new quarry capacity, meaning that supply resilience is heavily dependent on the continued functioning and progressive development of established quarries including Hunua

Consistent with this, the Economic Assessment cites Te Waihanga (New Zealand Infrastructure Commission) findings that no new quarries were established in Auckland between 2014 and 2021, and only three existing sites expanded, reinforcing the practical importance of optimising and extending existing quarry operations to maintain local supply resilience.

Within this setting, the Economic Assessment identifies Hunua Quarry as one of Auckland's three major quarries that account for the majority of Auckland's aggregate supply, reflecting its scale, established processing capacity and strategic role in the regional supply system.

Rock has been extracted from Hunua for over a century, and the quarry operates as an integrated extraction and processing complex supplying graded products used in concrete, asphalt and roading materials.

The Economic Assessment also notes Hunua's operational maturity, including established relationships with major construction firms, councils and infrastructure agencies, which lowers transactional friction and reduces supply risk for aggregate consumers.

A critical element of functional need is not only the presence of the resource, but the ability to access it in a practical and economically viable manner. The Economic Assessment describes the Project as securing continued access to Hunua's greywacke resource and maintaining the viability of a proven, established production system in a market already operating in deficit

The Economic Assessment and supporting geological analysis detailed in this report demonstrate that the Symonds Hill Pit contains economically accessible greywacke resource, with favourable strip ratios (generally at or below breakeven strip ratio) across substantial portions of the pit—particularly in southern and eastern areas where tertiary cover is minimal—enabling earlier access to resource rock, reduced non-productive overburden handling, and more efficient sequencing of extraction relative to alternative or deeper resources.

3.4 Importance of Local Aggregate Supply

Auckland's growth and infrastructure needs require sustained access to large volumes of aggregate. Aggregate is embedded in housing delivery through concrete, foundations, pavements and local enabling works, and in infrastructure delivery through roads, transport corridors, stormwater systems and other utilities.

Auckland Council's 10-year Budget 2021–2031 (Our Recovery Budget), Volume 2 identifies significant growth and investment pressures over the planning horizon, including expectations of approximately 250,000 additional jobs by 2048. (Auckland Council, 10-year Budget 2021–2031, Vol 2).

The same source identifies that Central, East and South Auckland account for a substantial share of future growth (reported as 64% in the supporting material cited), meaning a large portion of construction demand (and therefore aggregate demand) is concentrated in these areas. (Auckland Council, 10-year Budget 2021–2031, Vol 2).

It also identifies an infrastructure investment requirement of approximately $20–$30 billion to address both future growth and historic backlogs. (Auckland Council, 10-year Budget 2021–2031, Vol 2).

The Hunua Economic Assessment links Auckland's ongoing population growth and construction activity with a widening risk of supply shortfall if local capacity does not keep pace. Under the demand projections used in that assessment, Auckland's supply shortfall increases over time in the absence of additional consented supply, with the burden otherwise met through longer-haul imports.

From an AEE perspective, maintaining proximate aggregate supply is an enabling condition for Auckland's continued housing and infrastructure delivery. Where supply becomes increasingly dependent on imports, delivery can become more costly and less resilient, and transport-related effects increase as heavy vehicle kilometres rise, including emissions and crash risk.

3.5 The Hunua Quarry Development: operational need and benefits

The Hunua Quarry Development seeks to secure continued access to a proven greywacke resource by developing the existing quarry, including enabling works such as a tributary realignment and a western haul road, and staged expansion to support longer-term extraction. The Project is advanced under the Fast-Track Approvals Act 2024 as a listed project.

The concept of 'operational need' in the National Policy is the need for a proposal to traverse, locate or operate in a particular environment because of technical, logistical or operational characteristics or constraints. The operational need for the aspects of quarry development proposed is addressed in detail later in this report.

At a high level, the operational need for the Hunua Quarry Development arises from the combination of locational constraints, market conditions, and practical supply requirements inherent in aggregate production. Aggregate extraction can only occur where suitable geological resources exist, and Hunua Quarry represents an established, large-scale source of greywacke already integrated into Auckland's construction supply chain. The Economic Assessment identifies a clear operational risk: without the Project, Hunua Quarry's currently consented rock reserves are forecast to be exhausted by approximately 2039, removing a major proximate source of aggregate from Auckland's supply base at a time when the regional market is already operating in structural deficit.

Hunua Quarry is a long-established and strategically important supplier of greywacke aggregate for Auckland, operating as an integrated extraction and processing complex with established infrastructure and customer relationships, and a demonstrated ability to supply consistent volumes over extended periods. Rather than requiring replacement capacity to be developed elsewhere—with significant lead times, consenting uncertainty, and distance-related inefficiencies—the Project focuses on securing additional resource and extending the life of an existing strategic quarry.

From an operational perspective, the Project enables the continued functioning and optimisation of Hunua Quarry. Its location—approximately 5 km east of Papakura and around 35 km southeast of Auckland's CBD—provides efficient access to major demand nodes in South and Central Auckland and to key freight routes. Given the low value-to-weight nature of aggregate and the need to reliably deliver large daily volumes to time-critical construction programmes, this proximity is a material operational characteristic, materially reducing haul distances relative to out-of-region alternatives and underpinning avoided transport, emissions and social cost effects.

In contrast to the counterfactual, the Project supports continued extraction over a longer horizon (subject to future regional consenting processes over time) and enables annual production up to a peak capacity of approximately 5.4 million tonnes, depending on market conditions. In doing so, the Project functions as an enabling development: it prevents the loss of existing strategic capacity and maintains Auckland's ability to deliver housing and infrastructure efficiently and resiliently, rather than becoming increasingly reliant on longer-distance aggregate supply.

The Project's operational benefits include:

- **Supply continuity and resilience**: Preserving a major source of aggregate supply within a market that is already supply constrained, reducing exposure to supply disruptions, delivery uncertainty, and price escalation risks associated with the loss of established local capacity.

- **Reduced reliance on longer-haul imports**: avoiding or reducing the need to source material from more distant quarries in Waikato or Northland, increasing heavy vehicle kilometres and associated transport effects.
- **Reduced transport-related externalities**: the Hunua Economic Assessment quantifies substantial avoided costs associated with transport distance (including social and emissions costs), demonstrating the significance of proximity in Auckland's aggregate market.
- **Operational efficiency improvements**: the western haul road materially reduces pit-to-crusher cycle distance and time, enabling improved productivity and reduced fuel use, with flow-on benefits to efficiency and emissions.

Overall, in the context of Auckland's aggregate shortfall, limited opportunities to establish new quarry capacity within the region, and the distance-sensitive economics of aggregate supply, the Project functions as an enabling development. It is intended to prevent the loss of existing strategic capacity and to maintain Auckland's ability to deliver housing and infrastructure with greater efficiency, resilience and lower transport-related effects than would occur under a counterfactual increasingly reliant on longer-distance aggregate supply.

3.6 Existing Quarry Context and Site Evolution

Hunua Quarry is a long established quarry that has operated continuously, in various forms, for almost 100 years. Over this period, the site has evolved through successive phases of extraction, overburden stripping, internal placement of waste material, rehabilitation, and infrastructure development.

As a result, the current quarry site does not comprise a single undisturbed landform, but instead includes:

- actively quarried areas;
- previously quarried and rehabilitated areas;
- internal overburden disposal areas;
- operational infrastructure such as stockpiles, haul roads, ponds, and plant; and
- areas of unquarried greywacke resource.

The proposed development therefore represents a continuation and reconfiguration of an existing quarry system, rather than the establishment of a new quarry in a greenfield setting.

- **3.3 Development Footprint and Land Tenure**

The Hunua Quarry Development is assessed within a defined development footprint that reflects land ownership and operational control relevant to the fast-track application. Quarry development is proposed to be contained within land owned or controlled by Winstone Aggregates a division of Fletcher Concrete and Infrastructure limited (FCIL) for the purposes of the Schedule 2 listed project.

This land tenure context is a fundamental framing constraint: while greywacke resource may extend beyond the assessed footprint, only those areas that can be practically accessed, developed, and managed within the application envelope are considered in this report. The pit geometry, staging, and sequencing assessed later in this document have been developed within this constraint.

The anticipated sequencing and long-term development of the Hunua Quarry Development is further described in the Life-of-Quarry Strategy section below, which sets out the indicative staging framework used for assessment purposes.

4 Geological Setting

Figure 3 presents a simplified geological context for the Auckland Region and illustrates that high-quality hard-rock aggregate resources are spatially limited and confined to discrete geological units. As demonstrated by GNS Science's aggregate opportunity modelling for the southern Auckland area reported in 2024, hard-rock aggregate supply in the region is primarily derived from indurated Mesozoic sandstone (commonly referred to as greywacke) and, in more limited areas, volcanic rocks such as basalt and andesite. The opportunity to develop additional hard-rock quarry capacity is therefore strongly influenced by the distribution, quality and accessibility of these rock types, together with land-use, feasibility and sensitivity constraints.

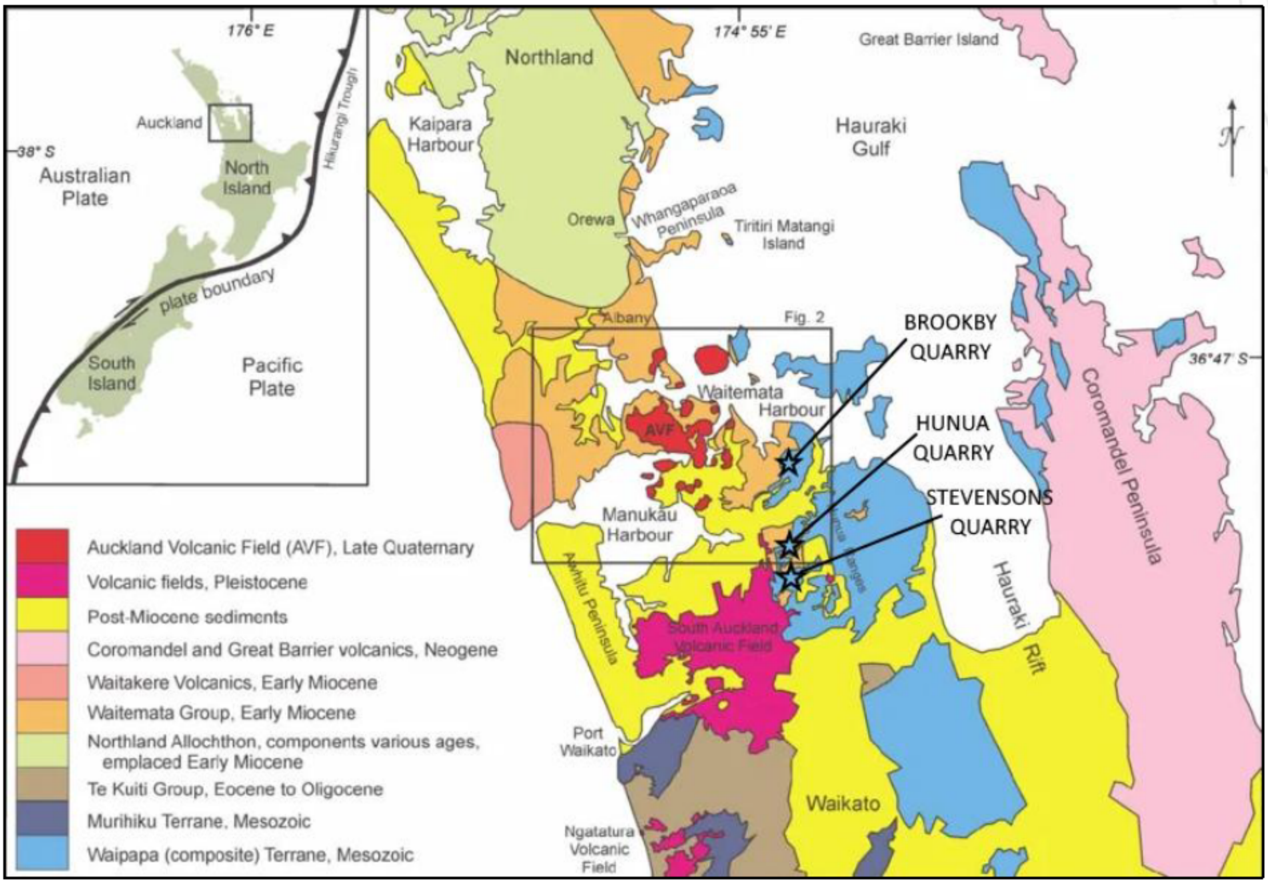

Figure 3: Auckland region geological setting.

At a regional scale, much of the Auckland Region is underlain by geological units that are not preferred sources of high-quality hard-rock aggregate. Younger sedimentary formations (Paleogene–Neogene age) are generally weaker and less durable than basement greywacke and are typically less suitable for high-specification aggregate uses. While such materials may have limited local applications, they do not provide the consistent strength and durability required for large-scale construction aggregate supply.

Volcanic rocks can provide suitable hard-rock aggregate in parts of the region; however, the opportunity modelling highlights that rock quality and extractability are often constrained by weathering, alteration and variability. In particular, the depth of weathering and the local presence of alteration minerals can materially affect the quality and recoverability of aggregate. The GNS Science study notes that weathering depth is not consistently mapped at the regional scale and therefore cannot be comprehensively incorporated into regional modelling, reinforcing the uncertainty and practical constraint associated with developing new volcanic hard-rock quarry sources outside well-proven extraction areas.

Importantly, the modelling demonstrates that areas with the highest opportunity for hard-rock aggregate extraction comprise only a small proportion of the study area. The best hard-rock aggregate opportunity areas (excluding ignimbrite) represent approximately 6.5% of the southern

Auckland study area, reflecting the combined influence of favourable source rock, proximity to infrastructure and markets, suitable terrain, and lower land-use and cultural sensitivity constraints. This substantially limits the realistic options for establishing new greenfield hard-rock quarries within the region.

Within this constrained geological and spatial context, the GNS Science modelling identifies the Hunua, Hapuakohe and Pakaroa ranges as hosting the most favourable opportunities for indurated Mesozoic sandstone (greywacke) aggregate. In these areas, structural uplift and exposure have brought strong, competent basement rock closer to the surface, improving accessibility and quarry feasibility relative to other parts of the region. Volcanic hard-rock opportunities (particularly basalt) are also identified in discrete and spatially limited areas, including parts of southern Auckland, but remain constrained by weathering, land-use pressures and proximity to sensitive environments.

Overall, the regional geological context demonstrates that, while hard-rock aggregate resources are present within the Auckland Region, the combination of geological limitations, weathering effects, land-use patterns and sensitivity constraints results in a very limited number of locations where hard-rock quarrying can be feasibly undertaken at scale. The opportunity modelling reinforces that Auckland's future hard-rock aggregate supply is therefore heavily reliant on the continued access to, and progressive development of, a small number of established quarry areas located within the region's most favourable greywacke and volcanic rock provinces.

4.1 Hunua Quarry Geological Context

Hunua Quarry is situated within the Hunua Ranges, which form part of a prominent basement uplift southeast of Auckland. The geological framework of the area is dominated by Mesozoic basement rocks of the Waipapa Group, which constitute the principal aggregate resource. Younger Cenozoic sedimentary units occur locally as erosional remnants and form overburden where preserved as shown in Figure 4 taken from GNS Science Geological Map of New Zealand 1:250,000 (2023).

The regional stratigraphy relevant to the site, from youngest to oldest, comprises:

Waitemata Group (Early Miocene) – Marine siliciclastic sediments including interbedded sandstone and mudstone. These rocks are generally weak to moderately indurated and weather rapidly. Where present at Hunua, they form part of the overburden above greywacke.

Te Kuiti Group (Late Eocene–Early Miocene) – Terrestrial to shallow marine sediments representing a regional marine transgression. In the Hunua area, this group is primarily represented by the Waikato Coal Measures, consisting of weak carbonaceous mudstones and siltstones. These units occur locally beneath the Waitemata Group and contribute to overburden thickness.

Waipapa Group (Late Triassic–Early Jurassic) – Deep marine turbiditic sedimentary rocks that were later deformed within an accretionary prism setting. These rocks are dominated by indurated greywacke sandstone with subordinate siltstone and argillite. The Waipapa Group forms the structural and topographic core of the Hunua Ranges and constitutes the quarry's economic resource.

From a quarrying perspective, the regional geological framework is defined by strong greywacke basement rock variably overlain by weaker tertiary sediments that form overburden material.

A more detailed geological description is set out at Appendix B.

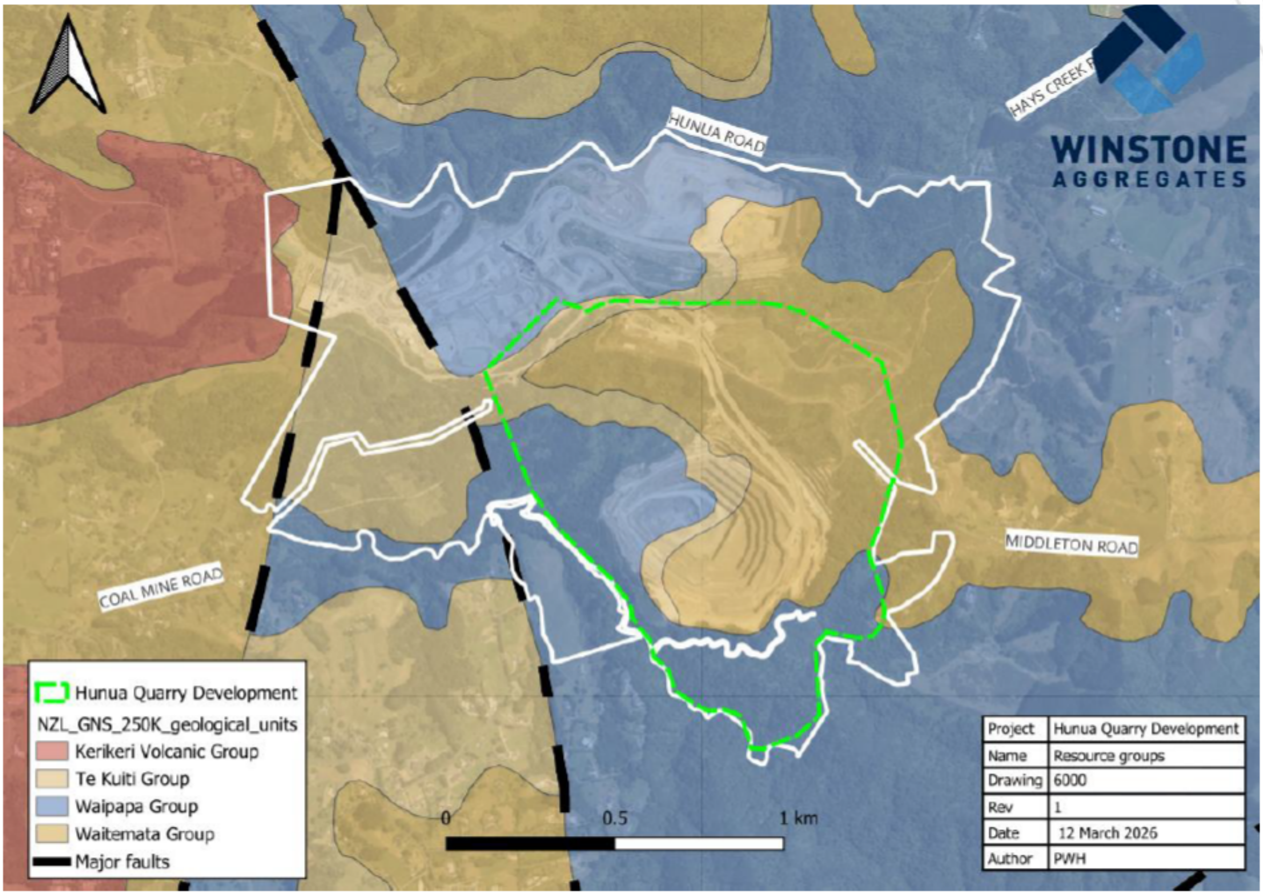

Figure 4: Hunua Quarry geological setting.

4.2 Local Geology – Symonds Hill

Within the Symonds Hill Pit and proposed development areas, the geology is characterised by variably weathered Waipapa Group greywacke forming the primary resource, locally overlain by Waitemata Group sediments and remnants of Waikato Coal Measures.

The basal contact between tertiary sediments and greywacke is irregular and locally relief-forming, reflecting an ancient erosional surface developed on greywacke basement and subsequently modified by structural processes. As a result, overburden thickness varies across the site and cannot be inferred from surface topography alone.

Lithologically, the central and eastern portions of Symonds Hill are dominated by sandstone-rich greywacke capable of producing high-quality aggregates where slightly weathered to fresh. Toward the western margin, more argillaceous greywacke (siltstone and argillite-rich intervals) are more prevalent. These argillaceous domains are interpreted as structurally controlled panels rather than gradual depositional transitions.

Overall, the greywacke resource beneath Symonds Hill is laterally continuous at quarry scale, with local variability in lithology and weathering influenced by structure.

4.3 Geological Structure

The geological structure of the area reflects regional compressional tectonics associated with accretionary prism development, followed by uplift and erosion.

At a regional scale, major fault systems occur west and east of the quarry area. Within the Symonds Hill Pit, faulting and pervasive jointing are present and influence rock mass characteristics, weathering penetration and local variability in aggregate quality.

Two principal fault zones have been mapped within the pit and form boundaries between structural domains. In addition, steep to near-vertical fault corridors and closely spaced joint sets are observed in both drilling and pit exposures. These structures locally:

- Increase fracture density;
- Promote deeper weathering;
- Influence veining intensity; and
- Affect rock mass behaviour during extraction.

While structurally complex zones occur, they do not disrupt the overall continuity of the sandstone-dominant greywacke body within the proposed extraction envelope. Instead, they create predictable corridors of variability that can be identified and managed through selective mining and sequencing.

4.4 Geological Cross-Section

A cross-section through Symonds Hill geological model presented in Figure 5 illustrates the fundamental geological relationships controlling the resource:

- An irregular upper surface comprising residual soils, highly weathered greywacke and locally preserved Waitemata Group (Waitemata) and Waikato Coal Measures (TK);
- A downward progression through highly (HW) & moderately (MW) weathered greywacke into slightly weathered (SWG/SWB) and fresh rock (FW);
- Laterally continuous sandstone-dominant greywacke forming the principal aggregate resource;
- Localised argillaceous or altered panels interpreted as fault-bounded domains; and
- Steep fault corridors associated with deeper weathering and increased veining.

Weathering boundaries are non-conformal with surface topography and are controlled by both the erosional paleosurface and structural discontinuities. As a result, geological modelling relies on drilling and exposure data rather than simple geometric assumptions.

This geological framework provides the basis for defining operational material domains, estimating strip ratios, and assessing economic viability within the proposed development footprint.

Figure 5 is a north-south cross-section through the Symonds Hill geological model showing current consented pit and geological domains described in Table 1 - Section 6.3.1

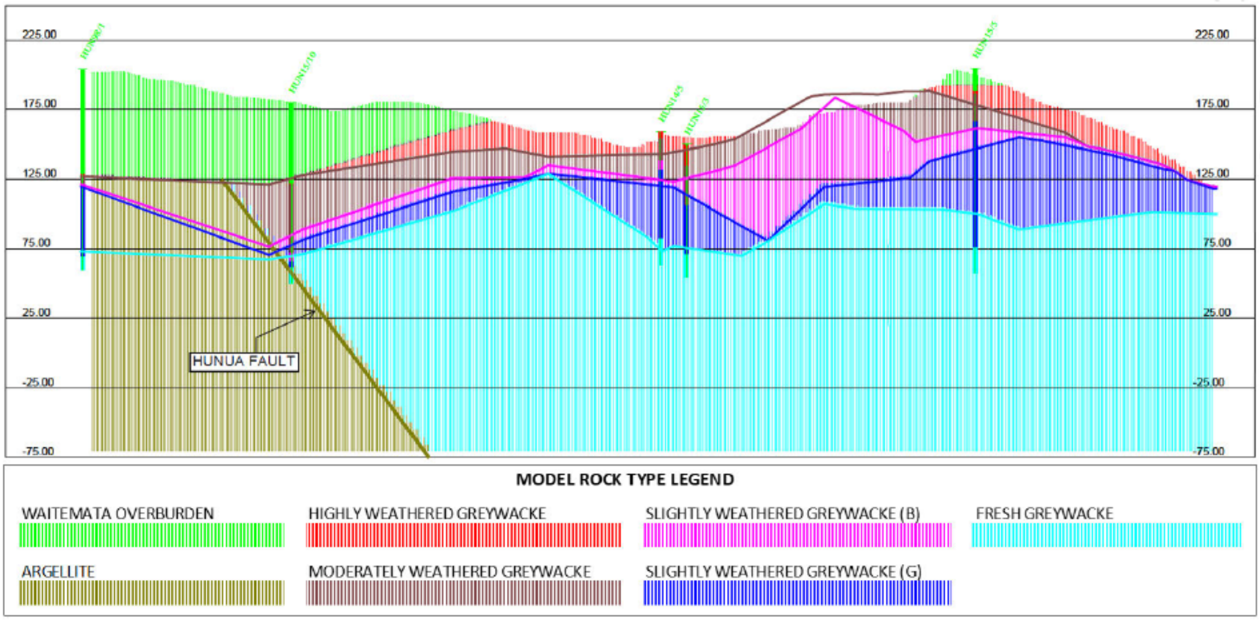

Figure 5: North-South cross-section of the Symonds Hill geological model.

5 Resource Investigation and Evaluation

5.1 Geological Mapping

In addition to regional scale mapping shown in Figure 6, geological mapping at Hunua Quarry, with particular emphasis on the Symonds Hill Pit (the active extractive pit), has been undertaken using a combination of surface/outcrop mapping, observations of active and newly exposed quarry faces, and targeted structural documentation to support geological interpretation, resource evaluation, and quarry design.

Surface mapping in the Symonds Hill area confirms that natural exposures of in-situ greywacke are generally limited and commonly concentrated within incised watercourses (including Symonds Stream and tributaries). Where exposed, the rock in-stream settings are frequently more weathered and/or altered than the rock encountered beneath the main hill, which is consistent with enhanced weathering along valley corridors and structural zones. The mapped lithologies comprise predominantly greywacke sandstone in the main hill area and locally to the east, with greywacke siltstone/argillite more common along the western valley and locally along the eastern margin where argillaceous domains are present.

Figure 6 shows surface mapping undertaken since 2004 and last updated in 2025 including significant greywacke outcrop mapped in exposures in Mangapū (Symonds) Stream and tributaries.

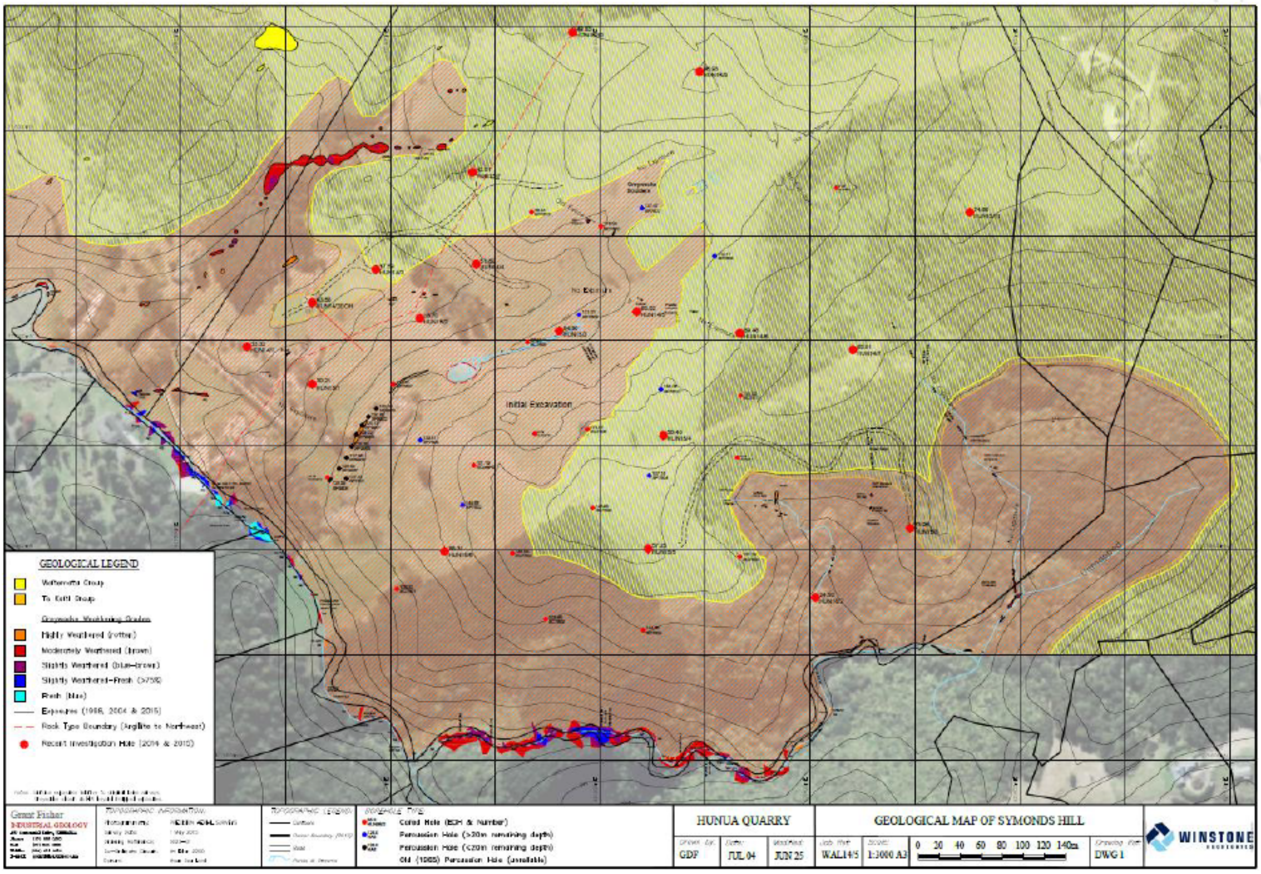

Figure 6: Symonds Hill detailed geological mapping.

5.2 Face mapping

Face-based geological observation is a core component of ongoing resource verification at Hunua Quarry and has been used to confirm lithological interpretations derived from drilling, refine weathering boundaries, and identify structural features that become visible only during excavation (Figure 7). Prior to and during development of the Symonds Hill Pit, face mapping at Hunua Quarry has been explicitly used as a model control for updating resource surfaces alongside drilling information.

Within the Symonds Hill Pit, quarry development has created extensive exposure of slightly weathered to fresh greywacke in the southwest sector (approximately RL130–175 m), allowing systematic inspection of the upper faces and broader inspection of lower faces to verify the inground distribution of weathering and lithology. These exposures have shown the fresh rock to be grey, very strong, medium to coarse grained greywacke sandstone with occasional indistinct argillaceous intervals, and with joints that are locally limonite stained or lightly surface weathered, consistent with drilling indications for the main hill resource. Face observations also demonstrate that the contact between tertiary cover sediments and underlying greywacke is irregular and locally exhibits relief, reflecting ancient erosional topography and/or structural modification rather than a uniform stratigraphic thickness.

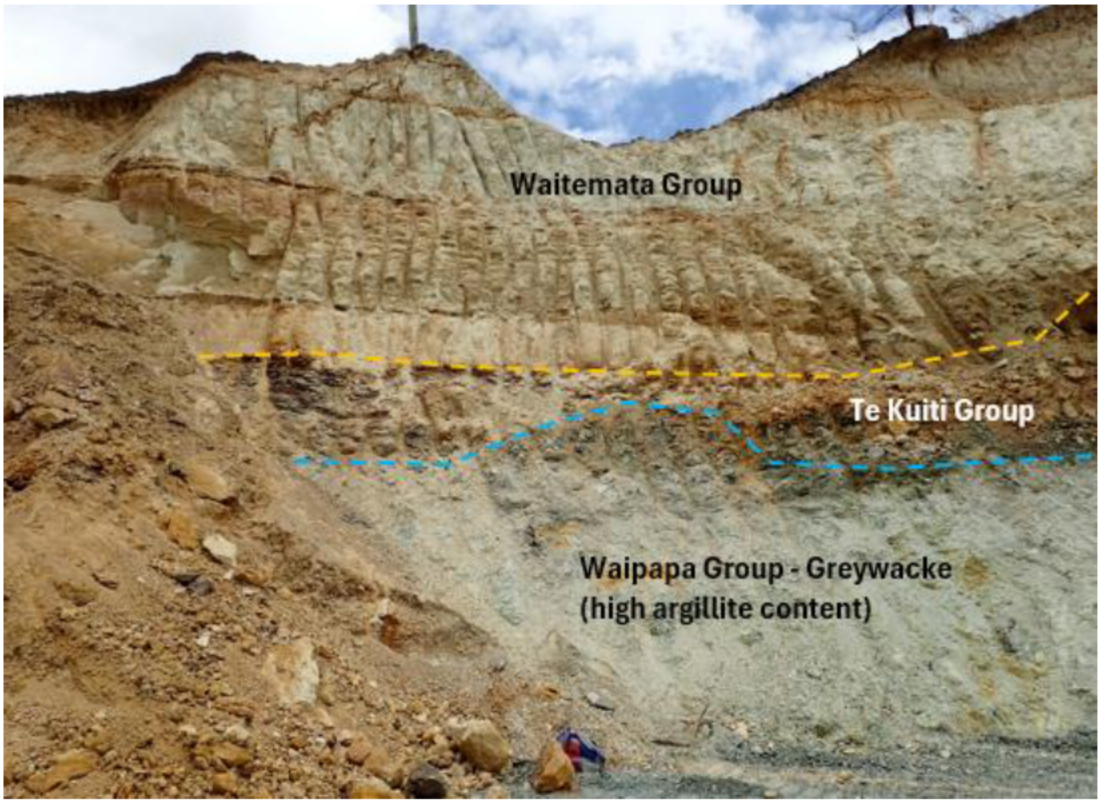

Figure 7: Face mapping in Symonds Pit highlighting contact between differing geological domains.

5.3 Structural measurements

Structural characterisation has been informed by outcrop mapping, quarry face observations, and targeted fault survey work where exposures permit. Major faults exposed in the quarry have been surveyed and documented for incorporation into mine design, and the complexity of faulting—particularly in the vicinity of the Hunua Fault—has been explicitly recognised in the geological modelling approach, where surfaces near the fault were treated as approximate and intended primarily for volume estimation.

In the Symonds Hill area, structural control is evident in both drilling and exposure observations. Mapping along Mangapū (Symonds) Stream identified the change from argillite to sandstone dominant greywacke coincident with a narrow slot feature dipping steeply to the east-southeast, with argillite exposures typically showing much closer fracture spacing than sandstone. Within the Symonds Hill Pit, steep to near-vertical fault zones have been exposed through the pit, and deeper weathering is observed down these structures, consistent with drilling which encountered structurally influenced weathering profiles and zones of intense veining near faults.

5.4 Pre-2025 Drilling Investigations

Subsurface investigation at Hunua Quarry has been undertaken through an extensive programme of cored and percussion drilling distributed across the Symonds Hill area and adjacent ground, including older historic datasets and modern cored boreholes used to constrain lithology, weathering surfaces, and structural controls.

Modern cored boreholes at Symonds Hill were drilled to depths generally in the order of ~80–150 m, with hole spacing designed to constrain key surfaces (base of tertiary sediments, roof of moderately weathered rock, roof of slightly weathered rock, and the deeper fresh rock surface where intersected). Drilling included both vertical and angled holes, with the angled bore providing information beneath valley floor and lower hill flanks where access and geometry warranted. These investigations were explicitly commissioned to confirm rock resource continuity in areas that (previously) had been sparsely drilled, particularly to the west, north, and northeast of the main hill, and to provide data for updating computer models used in pit design and resource volume estimation.

There have been several stages of investigations that have occurred within Hunua Quarry since the opening of the Symonds Hill Pit, including:

- Four machine boreholes in 2004 throughout Symonds Hill pit (HUN04/9 –12)
- Seven machine boreholes in 2014 throughout Symonds Hill pit (HUN14/1 –7)
- Eleven machine boreholes in 2015 throughout Symonds Hill pit (HUN15/1 –11)
- One machine borehole in 2018 to the southeast of the Symonds Hill pit (HUN18/2)
- One machine borehole in March 2025 to the southwest of the Symonds Hill pit (HUN25/1)

The locations of the previous borehole investigations are shown on the plan in Appendix C.

The drilling investigation undertaken between 2004 and 2025, in association with mapping undertaken by Grant Fisher, provide a robust geological model of the site.

5.4.1 Logging methodology

Core samples have been geologically logged in accordance with established Hunua Quarry procedures and standard geological practice, with enhancements tailored to quarrying applications. Logging records lithology (including differentiation of sandstone dominant greywacke and argillaceous rock), weathering/alteration grade, defects and faults, veining, and the presence of structurally disturbed or argillaceous intervals with reduced aggregate potential. Rock Quality Designation (RQD) has been recorded as an indicator of fracture intensity, and boxed core has been photographed to support review and verification.

Weathering classification applied during logging follows the standard greywacke weathering framework summarised in Table 1 (Standard Greywacke Weathering Grades). This framework provides the consistent basis for translating geological weathering observations into quarry terminology and operational categories (overburden, hardfill, and aggregate-suitable rock). Resource domains used for planning and estimation are therefore derived from weathering grade boundaries and the associated quarry use expectations set out in Table 1, rather than from a separate domain table, ensuring consistent application across drilling, face observations, and modelling.

Table 1: Standard Greywacke Weathering Grades

STANDARD GREYWACKE WEATHERING GRADES (28/2/2015)			
Geological Term	**Quarry Term**	**Definition**	**Potential Quarry Use**
Residual Soil to Highly Weathered	Rotten	More than half changed to geotechnical soils [RS, CW & HW]	Overburden (Clay & Clean Fill)
		Weak discoloured rock [HW-MW]	Hard Overburden (Fill & Race Rock)
Moderately Weathered [MW]	Brown	More than 50% rock discoloured but retains significant strength	Hard Fill and High PSV Aggregates (Strong Sandstone Only)
Slightly Weathered [SW]	Blue-brown	50-25% discoloured or weakened [MW-SW]	Low-Grade Aggregates: GAP & Asphalt Aggregates
(Two subdivisions)		25-5% discoloured or weakened [SW-FW]	Moderate-Grade Aggregates: Basecourses & Concrete Aggregates
Fresh [FW or UW]	Blue	Less than 5% rock discoloured or weakened	High-Grade Aggregates: Standard Sealing Chips

5.5 November 2025 Site Investigations

Geotechnical investigations were undertaken in December 2025 to the south of the Symonds Hill pit, within the vicinity of the proposed Mangapū Tributary diversion. The purpose of these investigations was to investigate subsurface geology in the proposed diversion area, to confirm geotechnical feasibility design for the diversion cut and alignment, weathering profiles and resource quality.

This comprised two cored machine boreholes and four test pits, which are described in the following sections. The locations of the investigations are shown on the drillhole location plan in Appendix B.

5.5.1 Borehole Investigations

The two machine borehole investigations were undertaken by Drillforce Ltd, under the supervision of Tonkin+Taylor (T+T). The boreholes were strategically located at the high and mid-slope elevations where the Mangapū Tributary diversion is proposed, and where access for the tracked drill rig was achievable.

HUN25/2 was completed near the crest of the Mangapū Tributary diversion cut (191 m RL) to a depth of 80 m below ground level (bgl). HUN25/3 is located midway up the slope (150 m RL) to a depth of 35 m bgl.

The core samples were photographed and geologically logged in accordance with previous studies at Hunua Quarry and standard guidelines. Standpipe piezometers were installed in both boreholes for groundwater monitoring.

5.5.2 Test Pits

Four test pits (HUN25/TP1-4) were carried out using an excavator. The test pits were located at the northern (upstream) end of the proposed Mangapū Tributary diversion, adjacent to the existing tributary stream, between RL 141 m and RL 145 m.

The excavated material from the test pits was photographed and geologically logged in accordance with previous studies at Hunua Quarry and standard guidelines..

5.5.3 Core recovery and quality

Drilling conditions in greywacke were commonly challenging, reflecting fractured rock conditions in structurally influenced zones and locally collapsing ground in near-surface materials; however, core recovery within greywacke was generally high and sufficient to support reliable interpretation of lithological transitions, weathering boundaries, and structural disturbance. Short core runs and occasional circulation losses were encountered in several holes, but these intervals provide meaningful geological signals (e.g., faults, intensely fractured zones, and altered/veined domains) relevant to resource evaluation and quarry design.

Core quality trends support domain differentiation: argillite dominant zones in the western area show poorer to fairer RQD and closer defect spacing at shallow to mid depths, whereas sandstone dominant greywacke generally exhibits good to excellent RQD below relatively shallow depths, supporting the continuity and quality of the principal aggregate resource.

5.6 Sampling and Testing

5.6.1 Sampling Methodology

Sampling for aggregate evaluation has been designed to reflect both geological variability and operational relevance at the Symonds Hill Pit, combining production scale aggregate samples, trial product samples, representative core derived materials, and targeted samples of vein/joint materials where these may influence performance. Samples include aggregates collected from stockpiles, laboratory crushed core prepared to representative aggregate sizes, spot core samples from within the initial development area, and joint/vein materials collected from both core and exposed faces. Where core derived samples were used, the preparation process (washing and laboratory crushing) and the representativeness limitations of certain materials (notably joint fillings) were explicitly recorded to ensure transparency regarding sample representativity.

Visual examinations were undertaken on representative particle counts across defined size fractions, enabling quantification of lithology proportions, weathering state distribution, defect occurrence, and qualitative strength categories (e.g., strong/very strong versus weaker chippings).

5.6.2 Laboratory testing undertaken

Laboratory investigations included detailed visual examinations, thin section petrography under a petrographic microscope, Xray diffraction (XRD) analyses of both bulk mineralogy and clay fractions, and Xray fluorescence (XRF) analyses of major oxides and multielement screening. These mineralogical and geochemical investigations were complemented by standard aggregate engineering tests undertaken through the quarry laboratory system for production aggregates and crushed core materials.

In addition, independent testing for alkaline activity in concrete (concrete prism method) has been undertaken for Symonds Hill greywacke aggregate, providing relevant performance information for concrete applications.

5.6.3 Aggregate quality parameters

Testing demonstrates that greywacke sandstone from the Symonds Hill Pit is capable of producing high quality aggregates suitable for concrete and roading applications, with excellent durability and strength indicators and low deleterious fines/clay measures in representative trial production materials. Visual examinations of Symonds Hill trial concrete aggregate indicate a dominance of greywacke sandstone with minor argillaceous content and low proportions of weathered particles, with weak chippings described as rare in examined samples. Mineralogical work confirms that these sandstones are indurated quartzofeldspathic greywacke with low-grade metamorphic assemblages and only minor smectite detected in most samples, generally below levels expected to cause deleterious performance effects in typical aggregate use.

Argillite dominant material shows materially different performance depending on weathering/alteration state, with fresh argillite being generally stronger than altered argillite and altered argillite demonstrating poorer durability and strength indicators, supporting operational differentiation between sandstone dominant resource rock and argillite dominant marginal domains. Mineralogical testing also indicates that veins and joint fillings may contain calcite, quartz, zeolite species, and clay minerals in varying proportions, reinforcing the need to manage intensely veined and fault-proximal rock during extraction and processing, particularly where zeolite bearing or clay rich infill is present.

Aggregate test results and production outcomes are interpreted in the context of the weathering use relationship defined in Table 1 (Standard Greywacke Weathering Grades), which provides the expected linkage between weathering state and typical quarry use. This ensures that laboratory performance data and trial production outcomes can be confidently tied back to the weathering-based domains present in the deposit and used to support scheduling, blending, and selective extraction strategies targeted at maintaining consistent product compliance.

5.7 Data Quality and Verification

Geological and analytical data have been subject to systematic validation through crosschecking between drilling, mapping, and face observations, and through iterative reconciliation within the resource modelling workflow. The modelling process integrates a digital terrain model (DTM), assigns elevations to mapped outcrop lines, consolidates datasets within a multilayer CAD environment, inspects and resolves conflicting points (generally giving precedence to the most recent data), and iteratively refines triangulated surfaces using break lines and multiple builds. Surfaces are then intersected with topography and compared against predicted and observed outcrop patterns and modified to correspond with end-of-hole geology and to minimise crossovers between surfaces, before export in formats suitable for mine design software.

Earlier assumptions regarding uniform thicknesses or simple correlations between weathering surfaces and topography/cover have been explicitly recognised as unreliable, with subsequent updates placing greater reliance on triangulation constrained by drilling and verified exposures. Data limitations are primarily associated with structural complexity, irregular weathering profiles (including local reversals and fault controlled deep weathering), and areas where bore spacing is wider or control on the depth to fresh rock is limited.

Resource certainty is therefore treated as a function of investigation density and geological complexity.

6 Geological Model and Resource Interpretation

The geological model for Hunua Quarry represents an integrated interpretation of drilling, mapping, face observations, and laboratory testing, with particular focus on the Symonds Hill Pit as the active extractive resource. The model conceptualises the deposit as variably weathered greywacke basement rocks forming the primary aggregate resource, locally overlain by younger sedimentary units (predominantly Waitemata Group) and local remnants of Te Kuiti Group in fault modified palaeo valleys and depressions. The contact between tertiary sediments and greywacke is irregular and locally exhibits substantial relief, consistent with ancient erosional topography and structural modification.

Resource interpretation for the Symonds Hill Pit is underpinned by a weathering-based material domain framework, where domains are derived from the standard greywacke weathering grades and associated quarry use categories set out in Table 1 (Standard Greywacke Weathering Grades). The model therefore places emphasis on representing the spatial distribution of key weathering boundaries (residual soil/highly weathered, moderately weathered, slightly weathered, and fresh rock), because these boundaries define the practical separation between overburden, hardfill, and aggregate suitable resource. In this report, “resource domains” refer to these weathering-controlled material classes rather than a separately enumerated domain scheme.

The resource is dominated by sandstone rich greywacke beneath the main Symonds Hill area and ridge, with an abrupt transition to argillite along the western side of the hill and locally along the eastern margin of the planned long-term pit. These argillaceous domains are interpreted as fault bounded panels rather than gradual facies transitions, and they are associated with closer defect spacing and lower aggregate yield potential, particularly where alteration is present.

Lateral continuity of sandstone dominant greywacke within the Symonds Hill Pit is strong at the scale relevant to quarry development, supported by drilling and corroborated by exposures in the developing pit. Vertically, the deposit exhibits a typical progression from soil and highly weathered material through moderately weathered and slightly weathered rock into less weathered and fresh rock at depth, but local reversals and thickened weathering zones occur where structure exerts strong control on alteration and weathering penetration.

Weathering boundaries are irregular and nonconformal with topography and cover thickness, requiring explicit interpretation from drilling and exposure data rather than simple extrapolation. As a result, weathering surfaces are treated in the model both as geological horizons and as operational domain boundaries consistent with Table 1, ensuring that model outputs directly support stripping estimates, sequencing, blending, and the availability of aggregate suitable rock.

Structural domains are recognised where faulting influences rock type distribution, weathering depth, and veining intensity, including steep to near vertical fault zones exposed in the Symonds Hill Pit and additional faults inferred from drilling and stream mapping. These structures may locally reduce rock quality through deeper weathering and intense veining near fault corridors, but they do not disrupt overall continuity of the sandstone dominant resource within the planned extraction envelope.

Resource classification is based on geological confidence derived from data density and quality. Areas with closely spaced drilling and corroborating exposure verification are assigned higher confidence in the model, while peripheral areas and deeper surfaces—particularly where depth to fresh rock is less well controlled—are assigned lower confidence in the model, consistent with acknowledged limitations of modelling in structurally complex and irregularly weathered greywacke terrain.

The geological model defines the spatial distribution, continuity, and variability of the greywacke resource, together with the depth and geometry of overburden and weathering boundaries that directly influence extractability. These characteristics provide the technical basis for pit design, geometry, development direction, and sequencing. The following section explains how this geological framework, together with site specific operational, environmental, and land use constraints, has informed the proposed pit design and the indicative Life of Quarry staging.

7 Life of Quarry Strategy

Quarry development is proposed to proceed in its current form and sequence, and how the indicative staging described in the Life of Quarry Development has been derived. It should be read alongside the Geological Model and Resource Interpretation (Section 6), which defines the distribution of greywacke resource, overburden, and key geological constraints relevant to extraction planning.

7.1 Design Considerations

7.1.1 Consideration of Alternative Development Options

A range of alternative quarry development options were considered during high-level planning and resource evaluation, including:

- further expansion to the north beyond the current Symonds Hill Pit;
- expansion to the east and west into adjacent blocks;
- development toward the south-east south of Symonds Stream; and
- progressive deepening of the existing pit footprint.

These options were assessed at a conceptual level against resource extent, quality and accessibility, overburden stripping implications, environmental and cultural constraints, proximity to sensitive receivers, and operational practicality. The pit development logic adopted for assessment reflects the outcome of this high-level option screening and the site-specific constraints described below.

7.1.2 Key Constraints

From an operational and site-specific perspective, several key constraints influence why pit development is proposed in its current form and sequence.

Northeastern (Hay Paddock) and Western (Friedmann Block) Areas
Land to the northeast and west of the existing pit contains areas of established offset planting and ecological mitigation associated with previous consents and the requirement to covenant that vegetation in perpetuity. In addition, these areas are characterised by higher overburden-to-rock ratios, which materially affect development efficiency unless sufficient overburden placement capacity is available in advance. Development into these areas would therefore require early stripping without a practical location to place overburden prior to rock extraction.

The northeastern area also contains a recorded pou, introducing an additional cultural constraint that limits practicable quarry development in that direction.

Northern Area
Land to the north of the Symonds Hill Pit has been progressively quarried over the last 100 years and subsequently used for overburden placement and operational infrastructure (including stockyards and the Hunua Pit overburden disposal area). As a result, there is limited accessible insitu greywacke resource remaining in this direction, and further pit expansion to the north is not considered a practicable development option within the assessed framework.

South East Area
Initial exploration considered the potential to extend quarrying toward the southeast into the Judge Richardson Drive area. However, this land is protected by conservation covenants and its development would bring quarry activity significantly closer to residential receivers and requires diversion or crossing of Mangapū (Symonds) Stream. This option was therefore discounted at an early stage due to a combination of land use constraints, planning risk, and increased potential for adverse effects.

Southern Area
The southern extent of the pit contains high quality greywacke resource and represents a logical continuation of the existing Symonds Hill extraction sequence identified in the geological model. While the presence of the Mangapū (Symonds) Stream and its tributaries introduces engineering and environmental considerations, these constraints can be managed through staged enabling works (such as stream diversion) and integrated quarry infrastructure planning. Development to the south enables efficient access to resource while maintaining separation from sensitive land uses.

7.1.3 Overall Pit Design Rationale

The resulting pit design reflects a balance between resource recovery, operational efficiency, environmental management, and long-term land stewardship. Development initially proceeds generally southward and downward from the existing Symonds Hill Pit because this direction:

- accesses proven, high quality greywacke resource identified in the geological model, with comparatively favourable stripping characteristics;
- allows overburden to be managed within existing and planned internal disposal areas;
- avoids land subject to conservation covenants, offset planting, or cultural constraints;
- maintains appropriate separation from residential areas; and
- builds on established quarry infrastructure and historical development patterns.

This rationale establishes the basis for the staged Life-of-Quarry Development described below.

7.2 Life of Quarry Strategy

This section describes the staged development of the Symonds Hill Pit and provides an overview of the anticipated Life of Quarry (LoQ) sequence for the proposed quarry expansion.

The staged approach demonstrates how the greywacke resource will be accessed and extracted over time while ensuring that environmental effects are appropriately managed through progressive staging, operational planning, and rehabilitation. The Life of Quarry framework consolidates the staged pit development (Stages 1–8) and extends the operational planning horizon to approximately 80 years, based on the assumed production rate and the currently indicated resource.

The Life of Quarry staging is based on:

- the geological and weathering domain model described in this report;
- staged pit designs developed for the Symonds Hill Pit; and
- overburden stripping volumes and overburden placement and rehabilitation concepts described in management planning documentation.

This staged development approach enables efficient recovery of the greywacke resource while maintaining operational flexibility and ensuring environmental effects are appropriately managed through time.

7.2.1 Indicative Nature of Staging

The staging years and sequencing described below are indicative and provide a coherent basis for environmental assessment and operational planning. Actual sequencing and timing may vary over the operational life of the quarry in response to aggregate demand, operational and market conditions, refinement of pit designs, and geotechnical or geological conditions encountered during quarrying.

The stage footprints define the spatial and operational extent of quarry development assessed in this report. Staging of the pit has been designed to prioritise areas with favourable strip ratios to support economic production during early phases.

7.2.2 Strategy Stage Descriptions

Stage 1 – Stream Works and Northwest Establishment

Stage 1 comprises enabling works required to facilitate safe expansion of the extraction footprint.

These works include the realignment or diversion of a tributary of the Mangapū Stream and associated temporary works required to implement the diversion.

The diversion and realignment of the Mangapū (Symonds) Tributary is a necessary enabling component of Stage 1 of the Hunua Quarry Development, as the existing stream alignment traverses the area required to access additional greywacke resource and would otherwise constrain pit expansion and quarry staging. It would not be possible to access and extract the greywacke resource in this area without diverting and realigning the tributary, because the tributary is on top of the greywacke resource. Undertaking the diversion early establishes a stable, permanent stream alignment outside the future extraction footprint, avoiding repeated disturbance, reducing long-term environmental and operational risk, and enabling subsequent quarry stages to proceed efficiently. The diversion supports safe and continuous haulage of overburden and construction materials during Stage 1 works, integrates with the quarry's sediment and stormwater management systems, and ensures the watercourse remains functional and protected throughout the life of the quarry.

As part of this stage, it will be necessary to remove vegetation to enable access to the overburden and greywacke resource beneath. The earthworks associated with overburden stripping and quarrying will also cause the loss of wetlands in these areas. The removal of vegetation and loss of wetlands in these areas is necessary for the purposes of the proposed quarrying activities because the aggregate extraction can only occur where the resource is located. Concurrent with these enabling works, stripping and initial extraction activities occur within the northwest panel to establish access to greywacke resource and maintain continuity of supply.

These activities establish the initial pit expansion area and provide the operational platform for subsequent stages of quarry development.

Stage 2 – Completion of Diversion and Western Haul Road

Stage 2 completes the diversion works and removes temporary enabling structures associated with the stream realignment.

Extraction continues in the northwest portion of the pit, with the quarry floor progressively lowered to approximately RL105.

During this stage the western haul road is constructed and commissioned.

The proposed western haul road is a critical enabling component of the Hunua Quarry expansion, delivering substantial operational, economic, environmental, and safety benefits through materially improved internal haul efficiency. The selected alignment reduces the average pit-to-crusher circuit distance from approximately 2.3 km to 1.2 km and lowers elevation gain from around 142 m to 80 m, reducing truck cycle times by approximately 33% (from ~16.6 minutes to ~11.2 minutes). This delivers an estimated ~32% increase in tonnes delivered to the crusher per truck per operating hour, allowing equivalent production to be achieved with a reduced haul fleet (from approximately six trucks to four) and materially lowering operating costs, including fuel consumption, tyre wear, maintenance, and mechanical stress on vehicles and infrastructure.

The western haul road will need to include constructed culverts that convey water underneath it where the road crosses through permanent and intermittent streams in the location. The requirement for these culverts is a consequence of the operational requirement for the haul road in the proposed alignment.

Alternative haul road alignments were assessed as part of the Project's development. The proposed alignment was selected as the most efficient and robust option, as it follows the southern extent of the quarry adjacent to the Symonds (Mangapū) Stream, which represents a hard physical boundary to future extraction. Locating the haul road along this boundary avoids sterilisation of recoverable resource and provides direct, efficient access to the eastern and south-eastern extraction areas associated with Stages 1–4, while maintaining unencumbered future access to the northern extraction areas (Stages 6–8).

Other potential haul road locations were assessed and found to be impracticable due to a combination of operational and resource constraints, including:

- the location of the existing processing plant to the northwest,
- the presence of lower-quality, high-argillite material west of the Hunua Fault, together with committed offset planting in that area, and
- the need to prioritise extraction of higher-quality greywacke resources to the east.

The selected alignment results in shorter haul distances, reduced gradients, and fewer truck movements. These efficiencies deliver enduring environmental benefits through lower fuel consumption per tonne and correspondingly reduced greenhouse gas and exhaust emissions over the life of the quarry. Safety outcomes are also improved through reduced driver exposure hours, lower fatigue risk, and fewer heavy vehicle interactions, supported by a purpose-designed haul route with consistent geometry and gradients.

As a long-life strategic asset supporting quarry operations over the full development horizon, the western haul road underpins the economic viability of accessing the extended resource by reducing unit operating costs and supporting the long-term supply of competitively priced aggregate to the Auckland market. The haul road is therefore a necessary and economically justified component of the Project, rather than a discretionary upgrade, and is required to enable the efficient transfer of excavated material from the pit to the processing plant.

Stages 3–6 – Progressive Pit Expansion and Deepening

Stages 3 to 6 comprise a series of incremental stripping and mining campaigns that progressively expand the pit southwards and to the northwest while deepening the excavation.

These stages:

- establish the longer-term pit geometry;

- manage transitions between weathered and fresh greywacke domains;
- maintain operational flexibility; and
- allow staged development of benches consistent with geotechnical design parameters.

Overburden stripping occurs in discrete campaigns as required to expose rock resource while maintaining appropriate strip ratios and operational efficiency.

As part of these stages, it will be necessary to remove vegetation to enable access to the overburden and greywacke resource beneath. The earthworks associated with overburden stripping and quarrying will also cause the loss of wetlands in these areas. The removal of vegetation and loss of wetlands in these areas is necessary for the purposes of the proposed quarrying activities because the aggregate extraction can only occur where the resource is located.

Stage 7 – Main Production Phase to RL-50

Stage 7 represents a significant production phase within the Life-of-Quarry sequence.

During this stage the pit continues to expand and deepen to approximately RL-50, with extraction occurring across multiple benches.

Where required, this stage includes realignment of the western haul road and associated infrastructure modifications to maintain efficient access to the northwest extent of the pit.

Overburden is stripped in targeted campaigns and placed within approved overburden disposal or rehabilitation areas in accordance with the Quarry Management Plan.

Stage 8 – RL-50 Stage Completion and Northern/Northwest Expansion

Stage 8 continues the anticlockwise development sequence, extending the pit to the northwest and north and completing the RL-50 stage footprint.

This stage includes significant overburden stripping campaigns earlier in the stage to secure long-term access to slightly weathered and fresh greywacke resource.

Completion of Stage 8 establishes the primary spatial footprint of the proposed quarry development in this application.

7.3 Long-Term Resource Development

Following completion of the RL-50 stage footprint, quarry operations are expected to continue within the established pit area through progressive deepening of the excavation to access additional greywacke resource located beneath the RL-50 level.

This deeper extraction would occur largely within the established pit footprint, meaning that the deepening phase would not materially increase the surface disturbance area or significantly alter the spatial extent of quarrying proposed as part of this application.

The deeper greywacke resource forms part of the same geological system described earlier in this report and represents a continuation of the existing resource body currently being extracted at Hunua Quarry.

Based on the currently available geological information, the greywacke resource beneath the proposed pit footprint is substantial and capable of supporting quarry operations beyond the 80-year Life-of-Quarry schedule horizon presented in this report.

Accordingly, while the indicative production schedule presented in this report extends to approximately 80 years, this timeframe represents a practical assessment horizon (from the perspective of geological availability) rather than a defined limit on the available resource.

The potential to access deeper portions of the resource would enable quarry operations to continue beyond the 80-year timeframe, should demand for aggregate and operational conditions support continued extraction, and subject to any future regulatory requirements.

7.4 Progressive Rehabilitation and Closure Concept

Progressive rehabilitation will be implemented throughout the operational life of the quarry where practicable.

Rehabilitation measures are expected to include:

- shaping and stabilisation of overburden landforms;
- treatment of completed batters and benches;
- revegetation of completed non-operational slopes; and
- integration of rehabilitated areas into the surrounding landscape and ecological framework.

These activities will be undertaken in accordance with the Quarry Management Plan (QMP) and associated environmental management plans.

While the quarry is expected to continue operating for many decades, the long-term closure and rehabilitation of the site will be progressively considered through future management planning processes.

If quarry extraction were to cease at any stage in the future, the quarry void could be progressively backfilled where practicable using suitable cleanfill or managed fill material. This process would be accompanied by landform shaping, slope stabilisation, and ecological restoration to create a stable and integrated post-quarry landform.

The final rehabilitation approach and end-use outcomes would be determined closer to the time of closure through preparation of a detailed closure or rehabilitation plan prepared in consultation with the relevant authorities and in accordance with consent requirements.

7.5 Monitoring and Reporting Through the Life-of-Quarry

Environmental monitoring and reporting requirements will be implemented through the Quarry Management Plan and associated management plans.

An Annual Management Plan (AMP) cycle will provide forward planning and reporting for quarry operations, including:

- annual forecasts of overburden removal and placement;
- identification of areas of expected quarry operations over the following 12 months;
- updates on rehabilitation activities; and
- summaries of environmental monitoring results and effectiveness reviews.

Transition between major quarry stages will trigger updates to stage development plans, monitoring locations where required, and stage-specific environmental management measures.

This staged approach ensures quarry operations and environmental management remain aligned throughout the operational life of the quarry.

8 Factors Affecting Economic Viability

Economic viability at Hunua Quarry (site-wide), and in particular the Symonds Hill Pit (active extractive pit), is controlled by the interaction between:

- geological controls on the quality and accessibility of greywacke;
- extraction performance and stability constraints that influence achievable cut geometry and productivity; and
- the variability and compliance risk associated with aggregate material properties.

The economic objective is to maintain sustained access to aggregate suitable greywacke—predominantly slightly weathered and fresh sandstone dominant domains—while efficiently managing overburden, moderately weathered material and local argillaceous/altered zones as lower-value streams.

8.1 Geological Controls

8.1.1 Weathering depth

Weathering depth is a primary economic control because it determines the thickness and volume of material that is generally unsuitable for higher value aggregate production and therefore must be stripped, rehandled, or directed to hardfill. Across the Symonds Hill resource, weathering transitions are locally irregular and can vary significantly over short distances. This variability influences short to medium term product yield because early or poorly sequenced extraction may encounter higher proportions of moderately weathered (“brown”) material prior to sustained access to consistently fresh (“blue”) rock.

The standard greywacke weathering framework used at Hunua Quarry links weathering grade to typical quarry use: residual soil to highly weathered material is treated as overburden; moderately weathered rock is typically directed to hardfill (and selectively to aggregate where strong sandstone is present); slightly weathered rock generally supports lower to moderate grade aggregate streams; and fresh rock supports higher grade aggregate products. Consequently, the geometry of the weathering boundaries directly controls stripping requirements, the timing of high-grade feed availability, and the blending required to maintain specification compliance.

8.1.2 Lithological variability

Lithological variability affects economic viability through its influence on aggregate yield, product compliance, and processing efficiency. The principal resource lithology at Symonds Hill is sandstone dominant greywacke, which is capable of producing high-quality aggregates where extracted from slightly weathered to fresh domains. However, discrete argillaceous domains (argillite and greywacke siltstone) occur along the western margin and locally along the eastern margin of the long-term pit area. These argillaceous domains are generally more closely fractured and can be materially more variable in strength and durability, particularly where alteration is present, increasing the likelihood that a greater proportion of mined rock is directed to hardfill rather than higher value aggregate streams.

Lithological patterns are structurally controlled, occurring as fault bounded panels and corridors rather than gradual facies changes. Economic outcomes therefore depend on maintaining operational separation between sandstone dominant production domains and argillaceous/altered domains through selective mining, stockpile management, and blending controls, especially near boundary zones where variability is greatest.

8.1.3 Mineralogy

Mineralogy influences economic viability because it controls durability, moisture sensitivity, fines generation, and the occurrence of deleterious clay and vein minerals that can affect product compliance and market acceptance. X-ray diffraction (XRD) analyses across the quarry indicate the greywacke contains quartz, albite, illite and chlorite, together with common hornblende, minor clinopyroxene, and less common prehnite, calcite and potassium feldspar. Clay separate XRD further indicates that many samples contain smectite irrespective of intensity of weathering and including unweathered greywacke. Albite and quartz comprise on average approximately 50% and 27% of the greywacke respectively, with chlorite averaging around 13%, and illite, hornblende and prehnite typically occurring between 2% and 4%.

Mineral proportions vary systematically on a broad scale, with quartz increasing toward the northeast by approximately 10%, while albite is more abundant in the southwest. Chlorite, hornblende and pyroxene combined also increase toward the southwest and correlate with increasing rock density toward the southwest, which is relevant to tonnage forecasting and may modestly influence crushing behaviour and wear.

From an aggregate performance perspective, smectite and prehnite have the greatest potential to have a negative impact on aggregate quality. Prehnite predominantly occurs in veins and is a soft mineral, and is preferentially broken down and lost during processing. In contrast, smectite occurs throughout the rock mass and cannot be readily removed by standard crushing and screening, and therefore represents the principal deleterious mineral within this source. However, because smectite occurs in small amounts, its effect on the overall quality of hard greywacke aggregates is generally minimal when extraction is focused on slightly weathered to fresh sandstone dominant domains and standard QA controls are maintained.

Overall, the Hunua mineral assemblage demonstrates that while individual mineral abundances vary systematically across the resource, the core mineral framework remains conducive to high-quality concrete and roading aggregate production, with only a small proportion of unfavourable soft minerals and clay minerals.

8.1.4 Structural influences

Structural controls affect economic viability through their influence on weathering depth, rock mass quality, veining intensity, groundwater pathways, and local bench stability. Steep to near vertical fault zones occur within and adjacent to the Symonds Hill Pit and are associated with deeper weathering corridors and increased veining in fault proximal rock. These structural corridors can reduce the yield of higher-grade aggregate feed by increasing the proportion of moderately weathered or altered material and can necessitate more conservative benching in poorer ground.

At the quarry scale, structurally complex zones are associated with greater uncertainty in the geometry of weathering surfaces and rock type boundaries. As extraction advances, these areas require enhanced exposure mapping and reconciliation to maintain confidence in short-term scheduling, product forecasting, and stability assumptions. The renewal dates for regional earthworks consents for the Symonds Hill Pit every 35 years will provide important milestones for the continued ground-truthing of the assumptions inherent in the model for lower depths. See also the Life of Quarry Plan provided with the substantive application in this regard.

8.2 Extraction Considerations

8.2.1 Geotechnical stability

Bench stability is a key control on economic viability as it influences achievable batter angles and bench widths, dilution, scaling and clean-up effort, and the likelihood of operational interruptions. The Tonkin & Taylor (T+T) Geotechnical Assessment for the Hunua Quarry Development confirms that performance in the Symonds Hill Pit has been dominated by minor, localised bench-scale instability rather than large-scale slope failure, with bench behaviour primarily governed by rock mass condition, defect persistence, and proximity to faulted or deeply weathered zones.

In competent Waipapa Group greywacke—particularly slightly weathered to unweathered, sandstone-dominant domains—bench behaviour is generally predictable and supports steeper batters and efficient extraction. In contrast, more weathered, argillaceous, or structurally disturbed domains exhibit increased ravelling and local bench degradation, requiring more conservative batter management and higher clean-up effort.

The T+T assessment identifies fault corridors and associated damage zones as key features that locally reduce bench competence and increase variability in extraction performance, with kinematic analysis demonstrating that bench-scale instability is strongly controlled by face orientation and defect persistence rather than global slope geometry. Accordingly, economic sequencing prioritises sustained access to aggregate-suitable greywacke while deliberately managing faulted, argillaceous, and more weathered zones as lower-value streams requiring tighter operational controls and adaptive bench design.

8.2.2 Fragmentation behaviour

Fragmentation behaviour affects drill and blast efficiency, loading productivity, crusher throughput, product grading stability, and plant wear, and therefore directly influences operating cost and product yield. At Hunua Quarry, fragmentation response is primarily controlled by the orientation, spacing, and persistence of internal joint sets and veining within the greywacke, with secondary influences from lithological composition, weathering state, and the degree of alteration.

Sandstone-dominant greywacke, particularly in slightly weathered to fresh domains, is very strong but well jointed and typically fragments in a predictable manner. This supports stable plant feed and efficient production of high-specification aggregate. In contrast, argillite-dominant, altered, or intensely veined rock is more variable and closely fractured, generating higher fines and poorer particle shape, increasing processing effort and reducing premium product yield.

Fragmentation control is informed by production drilling data. Drill cuttings are logged to assess changes in rock strength and material type, including cuttings colour, texture, and penetration depth. These observations are used to adjust drill-and-blast patterns and powder factor, which are engineered to suit the anticipated material and optimise fragmentation for consistent plant feed.

Accordingly, economic performance improves where high-specification products are preferentially sourced from slightly weathered to fresh sandstone-dominant domains, while fault-proximal, altered, or argillaceous material is managed through selective stockpiling, blending, and blast design adjustment.

8.3 Strip Ratio and Economic Implications

Strip ratio is a primary economic driver for the Symonds Hill Pit because it governs the volume of non-productive overburden (OB) that must be removed to access resource rock, directly influencing unit costs, extraction sequencing, and the timing of value realisation.

For quarry planning and economic screening, resource rock is defined as greywacke excavated beneath overburden within the moderately weathered (MW), slightly weathered (SWG/SWB), and fresh (FW) weathering spectrum. This reflects operational practice, where MW material is typically directed to hardfill (and selectively to aggregate), SW material supports lower to moderate grade aggregate production, and FW material supports higher-grade aggregate products. All MW–SW–FW material must be drilled, blasted, loaded, and hauled regardless of final product recovery and is therefore appropriately included in strip ratio assessment.

On this basis, a breakeven strip ratio (OB:Resource rock) has been adopted. Areas where predicted stripping exceeds the breakeven strip ratio are more likely to be marginal unless offset by sequencing (deferral), improved operational efficiency, or product/value uplift, and may require refinement of pit limits or cut geometry to avoid uneconomic overburden removal.

Accordingly, favourable strip economics are expected in the southern and eastern extraction panels, where tertiary cover is minimal and greywacke is encountered near surface. These areas benefit from reduced overburden volumes, earlier access to resource rock, improved early cashflow due to lower upfront stripping, and a higher proportion of total material movement contributing to usable rock streams rather than overburden.

Figure 8 illustrates the spatial variability in overburden thickness across the Symonds Hill Pit, showing a general increase in stripping requirements from south to north. This variability is explicitly reflected in the staged Life of Quarry Development, which prioritises lower strip ratio panels in earlier stages to reduce early demand on overburden placement capacity, minimise overburden handling volumes, and improve cashflow. Higher strip ratio panels, typically associated with thicker tertiary cover, are deliberately deferred to later stages, when internal placement capacity and pit geometry can support more efficient overburden management and when advancement can be justified by production needs, operational efficiencies, or product value uplift.

Figure 8 shows that overburden depth varies across the Symonds Hill Pit, with a clear north–south increase in stripping requirements. Within the operational pit, where stripping has already been completed, OB is absent (brown). Low OB thickness occurs along the pit margins where stripping has commenced and in southern areas (red/pink). OB thickness progressively increases toward the north (orange–green).

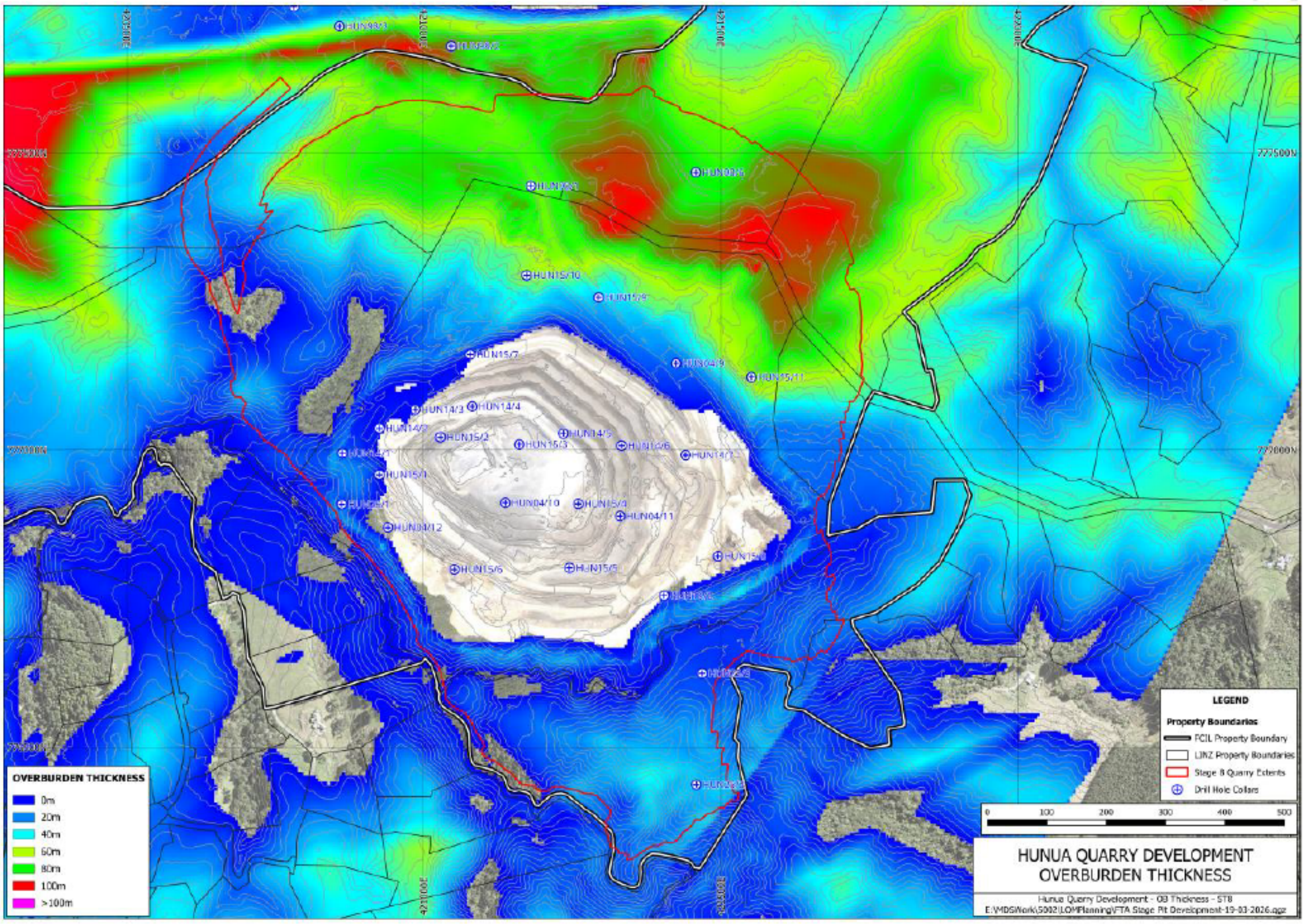

Figure 8: Overburden thickness at Symonds Hill.

8.4 Material Quality Considerations

8.4.1 Suitability for aggregate use

Material suitability is a primary economic driver because it determines achievable product mix, compliance rates, and market acceptance. Testing and trial production outcomes demonstrate that sandstone dominant greywacke from Symonds Hill can produce high-quality aggregates suitable for concrete and roading applications when sourced from slightly weathered to fresh domains. In contrast, argillite dominant material is more variable, with performance strongly dependent on alteration/weathering state, and therefore requires selective extraction, blending controls, and/or restriction to lower value products where altered material dominates.

Concrete performance considerations include alkali reactivity management. Prism testing indicates performance within the one-year limit but suggests a longer-term expansion trend and cracking observations, implying that some concrete applications may require specification controls depending on cement alkali content and project requirements. This does not preclude use but can influence product allocation strategy and customer specification conditions.

8.4.2 Variability risks

Variability risk arises from irregular weathering boundaries, fault-controlled alteration corridors, and lithological changes near argillite boundaries, all of which can affect product compliance and processing behaviour over short mining intervals. This risk is managed through continuous face observation, reconciliation against the geological model, and operational controls that limit dilution of high-quality feed with more weathered or altered material. Deleterious minerals (particularly smectite and clay/zeolite-bearing joint/vein materials) may be concentrated in fault-proximal domains; inclusion of such material can elevate clay-related indices, affect moisture behaviour, and increase fines generation if not controlled through selective mining, stockpile separation, and QA monitoring.

8.4.3 Density

Density is economically relevant because geological models and pit designs are typically generated in volumes (e.g., BCM), whereas production, plant throughput, haulage, sales and financial assessments are managed in tonnes. A validated density basis is therefore required to convert modelled volumes into tonnage for quarry planning (annual production forecasts, plant feed scheduling and stockpile management) and for economics (unit costs and revenues are typically tonne-based).

Density of Hunua greywacke was determined from cuttings taken from RL135 m bench blast holes. Particle density values range from [redacted] g/cm^3 and average [redacted] g/cm^3 (Figure 9). Within individual blast holes, the density difference between samples ranges from [redacted] g/cm^3. Overall, density increases toward the southwest, with a maximum northeast to southwest difference of approximately [redacted] g/cm^3. This increase broadly correlates with increasing combined abundance of chlorite + hornblende + pyroxene, minerals that are denser than quartz and albite, and is consistent with the observed systematic mineralogical trends across the quarry.

For planning purposes, adopting an average density provides a defensible basis for converting volume-based resource estimates to tonnage-based schedules. Spatial density variability can introduce differences in tonnage forecasts between pit sectors and should be managed through reconciliation to measured production tonnages and periodic verification sampling as extraction advances.

[redacted]

9 Integrated Assessment

The planned expansion and development at Hunua Quarry is supported by a substantial body of geological, geotechnical and materials data that collectively demonstrates (i) continuity of resource volume, (ii) consistency of aggregate suitable rock quality, and (iii) favourable economic viability driven by weathering and overburden distribution, with uncertainty managed through ongoing exposure verification and targeted investigations.

Importantly, Hunua Quarry has continuously produced greywacke aggregate since the 1920s, supplying a significant proportion of Auckland's roading and concrete demand. This long operational record provides a strong line of evidence that the underlying greywacke resource has remained a reliable source of specification aggregates over multiple decades, and that there has been no fundamental change in the geological nature of the resource being extracted (Waipapa Group greywacke) that would suggest a step-change in product capability.

9.1 Continuity of resource and geological confidence

A key strength of the dataset is the density and duration of subsurface control across the Symonds Hill Pit footprint and adjacent expansion areas, supported by multiple drilling & mapping campaigns and ongoing reconciliation against pit exposures.

The geological model is built from an integrated interpretation of drilling, mapping, and face observations, and explicitly recognises the greywacke resource as laterally continuous at the scale relevant to quarry development, with localised argillaceous panels and fault influenced corridors treated as discrete domains rather than as discontinuities in the overall resource.

The geological model used for quarry planning and pit design accounts for the irregular basal surface of overburden units (Waitemata Group and Waikato Coal Measures where present), which is locally relief-forming and is treated as a controlling surface for volume estimation and sequencing rather than assumed uniform cover, particularly to the north. This interface significantly impacts the economics and efficiency of operations and is a key driver for initial development to the southeast.

Field mapping and pit exposure observations provide ongoing validation of interpreted surfaces and support refinement of weathering boundaries and structural corridors as extraction advances.

In addition to site-scale datasets, the supporting evidence base incorporates regional-scale geological mapping and broader drilling context used to define the quarry block geology and expansion setting. This wider context demonstrates that the Waipapa Group greywacke basement extends beyond the current extraction footprint and provides continuity into the proposed expansion areas, with younger sedimentary units preserved only locally as overburden on the margins of the uplifted basement.

9.2 Continuity of resource quality

Aggregate suitability is supported by direct evidence from trial production and laboratory testing of Symonds Hill greywacke, which demonstrates that sandstone dominant greywacke sourced from slightly weathered to fresh domains is capable of producing high-quality aggregates suitable for concrete and roading applications.

Petrographic and mineralogical testing confirms the greywacke is an indurated quartzofeldspathic rock with a core mineral assemblage conducive to durable aggregate performance, with deleterious minerals present only in small proportions in most tested samples.

The dataset also characterises known sources of variability, including argillite dominant and altered domains, and shows that these domains are spatially constrained and can be managed through selective extraction and stockpile control to maintain consistent product outcomes. Independent alkali reactivity testing (concrete prism method) provides additional evidence for concrete performance considerations and supports the development of appropriate specification controls where required for sensitive concrete applications.

9.3 Economic viability

Economic viability is strongly governed by the distribution of overburden and weathering profiles, which directly influence stripping requirements, product yield and achievable production sequencing.

The report applies a weathering-based material domain framework (overburden → MW → SW → FW) that links geological observations to quarry use categories and provides a consistent basis for estimating recoverable resource rock, managing product streams and planning stripping and haulage requirements.

Strip ratio is treated as a key project driver, with a breakeven threshold of 1.5 BCM OB : 1 BCM resource rock, and favourable economics expected where tertiary overburden is absent or minimal and greywacke occurs at shallow depth within the expansion footprint.

Density data provides the basis for converting volume-based resource estimates into tonnage-based schedules and economic forecasts, supporting consistent planning conversions and reconciliation.

9.4 Operational and geotechnical validation

Geotechnical assessment work consolidates historic and recent investigation and observation and confirms that the proposed quarry development is feasible, with slope behaviour calibrated against observed performance of existing Symonds Hill Pit faces and supported by defect mapping and stability assessment.

Recent targeted investigations in the Mangapū Tributary diversion area extend subsurface control into the southern development corridor and confirm the representative weathering profile variability used in design and planning, with groundwater monitoring instrumentation installed to support ongoing verification. This ongoing verification will continue as the pit extends below RL-50m, and at each of the milestone dates for renewal of regional groundwater and earthworks consents.

10 Conclusion

The assessment presented in this report demonstrates that the proposed Hunua Quarry Development is underlain by a laterally continuous Waipapa Group greywacke resource that is geologically robust, technically proven and economically viable when developed in staged sequence.

The geological framework is well understood. Drilling, mapping and face observations confirm that sandstone-dominant greywacke extends across the Symonds Hill Pit and into the proposed expansion areas, with predictable vertical weathering progression from overburden through moderately weathered rock into slightly weathered and fresh resource domains. Structural features influence local variability but do not disrupt overall resource continuity at quarry scale.

Aggregate testing and mineralogical assessment confirm that slightly weathered to fresh sandstone-dominant greywacke is capable of producing high-quality aggregates suitable for concrete and roading applications. Known sources of variability, including argillaceous panels and fault-proximal zones, are spatially constrained and can be effectively managed through selective extraction, blending and established quality assurance procedures.

Economic assessment indicates that strip ratios within key development panels are favourable, particularly where tertiary overburden is minimal and greywacke occurs at shallow depth. The adopted break-even strip ratio provides a conservative screening benchmark, and staging enables optimisation of early access to resource rock. Validated density data supports reliable conversion from volume-based resource estimates to tonnage-based production forecasting.

Importantly, the proposed expansion builds on nearly a century of continuous greywacke extraction from the same geological unit. The underlying resource has demonstrated sustained capability to meet regional infrastructure demand, and there is no geological evidence of a fundamental change in resource character within the expansion footprint.

On the basis of integrated geological investigation, materials testing, operational experience and economic evaluation, the greywacke resource targeted by the Hunua Quarry Development is continuous in volume, capable of producing specification aggregates, and economically viable when sequenced appropriately.

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Appendix A: Detailed Regional Stratigraphy

The Hunua Ranges form a prominent basement uplift southeast of Auckland and expose predominantly Mesozoic greywacke of the Waipapa Terrane. Younger Cenozoic sedimentary units are preserved only locally as erosional remnants on the flanks and margins of the uplift. From a quarry resource perspective, regional geology is dominated by the distribution, structure, and weathering profile of indurated greywacke, with younger sedimentary units contributing primarily to overburden.

The regional stratigraphy relevant to Hunua Quarry is summarised below from youngest to oldest.

Waitemata Group (Early Miocene)

The Waitemata Group comprises marine siliciclastic sediments preserved as erosional remnants and basin margin facies across the Auckland region. In the Hunua district, these rocks typically rest unconformably on older basement or on Te Kuiti Group units where preserved. Structurally, the Waitemata Group generally dips gently westward to north westward, although local tilting and faulting reflect later Neogene deformation.

Lithologically, the Waitemata Group is dominated by weak to moderately indurated interbedded sandstone and mudstone, including turbiditic and mass transport facies. From a quarrying perspective, these units are significantly less competent than underlying greywacke and weather rapidly to friable, clayrich materials with low strength, forming a substantial component of overburden where present.

Te Kuiti Group (Late Eocene–Early Miocene)

The Te Kuiti Group unconformably overlies Waipapa Group greywacke and represents a regional marine transgression following prolonged erosion of basement rocks. Regionally, the group records a transition from terrestrial to shallow marine conditions, progressing from basal clastic and carbonaceous sediments into calcareous shelf deposits.

In northern New Zealand, the Te Kuiti Group includes basal transgressive conglomerates and sandstones, carbonaceous mudstones (Waikato Coal Measures), calcareous sandstones and siltstones, and locally developed limestone units. In the Hunua area, the full carbonate succession is not typically developed; instead, the Te Kuiti Group is represented primarily by its basal terrestrial unit, the Waikato Coal Measures, which is addressed in the site-specific geology section. Where preserved, Te Kuiti Group units contribute to overburden thickness and may locally influence stability due to weak, sheared or carbonaceous horizons.

Waipapa Group (Late Triassic–Early Jurassic)

The Waipapa Group forms the structural and topographic core of the Hunua Ranges and constitutes the principal greywacke quarry resource. These rocks were deposited in deep marine environments and subsequently incorporated into an accretionary prism along the Gondwana margin. Regional tectonic compression resulted in intense deformation, including folding, faulting, cleavage development and veining, followed by Cenozoic uplift and erosion that exhumed the basement block.

The Waipapa Group is dominated by greywacke sandstone with subordinate siltstone and mudstone (argillite). Greywacke sandstone is typically dark grey to bluegrey, fine to medium grained, poorly sorted and strongly indurated, and exhibits high strength and durability when slightly weathered to fresh. Argillite occurs as interbedded layers within the sequence and is weaker and less durable, exerting an important control on aggregate quality and yield where proportions increase.

Fault zones, shear zones, and quartz–calcite veining are widespread at a regional scale and significantly influence rock mass behaviour by controlling fracture density, weathering penetration, and local variability in strength and durability. These structural features are a fundamental control on quarry performance and are described in more detail in the site-specific geology section.

Symonds Hill Pit – Local Geology

The Symonds Hill area comprises variably weathered Waipapa Group greywacke, which forms the quarry resource, locally overlain by weaker overburden units including the Waitemata Group and local remnants of the Te Kuiti Group. At Hunua Quarry, the Te Kuiti Group is represented by its basal terrestrial unit, the Waikato Coal Measures (WCM). The basal contact between overburden and greywacke is irregular and locally relief forming, consistent with an ancient erosional surface developed on greywacke and subsequently modified by local structural processes.

Lithologically, there is a marked transition from sandstone dominant greywacke beneath the main Symonds Hill ridge to more argillaceous greywacke toward the western margin of the pit and beyond the current pit shell. This transition includes increasing proportions of siltstone and mudstone beds and zones of altered argillite, which locally influence rock mass characteristics and aggregate yield.

Regional geological mapping identifies the major Drury Fault system west of the site (approximately 1.5–2 km from the Symonds Hill Pit) and the Hunua Fault as an east–west regional structure separating the Hunua Pit and Symonds Hill Pit excavations. Site investigations and pit exposures confirm the presence of local faulting and pervasive jointing within the greywacke block. These structures influence weathering depth, veining intensity and lithological variability but do not disrupt the overall continuity of the greywacke resource within the Symonds Hill Pit footprint.

Three geological units are relevant within the Symonds Hill Pit footprint and adjacent expansion areas. The Waitemata Group forms a significant component of overburden in the upper northwest to northeast highwall and comprises extremely weak to weak interbedded sandstone and siltstone overlain by residually weathered soils. The base of the Waitemata Group is irregular and locally rests non-conformably on greywacke where WCM is absent. The Waikato Coal Measures (WCM) comprise dark brown, highly weathered, weak carbonaceous mudstones and siltstones. WCM is exposed locally beneath the Waitemata Group on the northeastern wall of the Symonds Hill Pit and is present in investigation boreholes west of the pit (including the Friedman Block area), where thicknesses exceeding approximately 13 m have been proven. The Waipapa Group greywacke comprises lightly metamorphosed, moderately strong to very strong sandstone with subordinate siltstone and rare mudstone. The greywacke is typically closely jointed and locally faulted or sheared, with weathering generally reducing with depth below the unconformity but locally deepening where faulting is present.

Figure 10: Non-conformity contact of Waitemata Group overlying the Waipapa Group greywacke in the Symonds Hill Pit (denoted by the yellow dashed line).

Structural features are described in terms of regional faults, major faults, joint sets and bedding. Within the Symonds Hill Pit, two major faults (Fault A and Fault B) have been mapped in greywacke and form boundaries between structural domains. Jointing is pervasive throughout the greywacke sequence and varies in spacing and persistence across the pit. Bedding within Waitemata Group and WCM exposures in the northern wall generally dips into the slope, whereas bedding within the greywacke is commonly indistinct due to deformation and jointing, with bedding related weakness most relevant where argillite rich intervals occur.

Waipapa Group Greywacke – Weathering Profile and Field Observations

Weathering of the Waipapa Group greywacke at Hunua Quarry is spatially variable and strongly controlled by the irregularity of the unconformity surface and the distribution of structural discontinuities, including faults, joints and crushed or sheared zones. In general, weathering decreases with depth below the unconformity; however, locally deeper weathering profiles are developed where defect density and permeability are elevated. The weathered greywacke surface forms part of the quarry overburden sequence and grades downward through progressively less weathered rock into moderately weathered, slightly weathered and ultimately unweathered greywacke.

Weathering sequence and materials encountered

Across the Symonds Hill Pit and adjacent investigation areas, the near surface profile is typically characterised by residual to completely weathered greywacke, which behaves as a soil-like material but locally retains relic rock fabric. This material is underlain by highly weathered greywacke and then by variably weathered rock mass. Residual soil and completely weathered greywacke form part of the overburden package, together with any overlying Waitemata Group and Waikato Coal Measures where present. Highly weathered greywacke is commonly brown, weakened and variably fractured, and may locally grade into zones that behave more as soil than rock, particularly where weathering has advanced along persistent discontinuities.

Moderately weathered greywacke typically comprises discoloured brown to brownish grey rock that retains significant strength but is more fractured and variable than less weathered domains. Slightly weathered greywacke is generally blue grey to blue brown, with discolouration concentrated along prominent defects, while unweathered greywacke is typically blueish grey, strong, and shows little to no discolouration, with defects commonly clean or containing hard infill. This progression in weathering state provides the primary basis for distinguishing overburden, hardfill rock and aggregate suitable resource rock.

Expression in Symonds Hill Pit exposures

Exposures within the Symonds Hill Pit demonstrate that weathering is highly non-uniform and commonly follows the defect network. Discolouration and weakening are typically concentrated along joints and faults within slightly weathered rock, while adjacent blocks may remain relatively fresh. Where major faults are present, deeper weathering profiles are commonly observed along these corridors, reflecting localised zones of enhanced permeability and alteration.

As weathering increases, joints become progressively less distinct and are effectively incorporated into the weaker weathered material. In contrast, in slightly weathered to unweathered greywacke, discrete joints remain prominent features and exert a strong influence on rock mass character and extractability.

Relationship to overburden cover and paleo topography

The base of the overburden sequence (comprising Waitemata Group, Waikato Coal Measures where present, and residual to highly weathered greywacke) is irregular and locally relief forming. This geometry reflects an ancient erosional surface developed on greywacke basement and subsequently modified by structural movement and differential erosion. Where Waitemata Group occurs in the upper benches of the northwest to northeast highwall, the basal contact is nonconformable and irregular, and increased weathering of the underlying greywacke is commonly observed immediately below the contact. Waikato Coal Measures occur locally beneath the Waitemata Group in the northeastern wall and in boreholes west of the pit and comprise weak, highly weathered carbonaceous mudstone–siltstone.

Controls on weathering depth and lateral variability

Field observations and subsurface investigations indicate that weathering depth and lateral variability are controlled by a combination of:

- **Defect density and persistence**, with deeper weathering typically associated with faulted and highly fractured zones.

- **Lithological variability**, particularly increasing proportions of siltstone and mudstone beds toward the western section of the Symonds Hill Pit and beyond the current pit shell, and the presence of altered argillite.
- **Distribution and thickness of overburden units**, especially where Waitemata Group and Waikato Coal Measures are preserved in structural lows, contributing to thicker overburden and more complex near surface profiles.

As a result, weathering boundaries are locally non-conformal with topography and cannot be reliably inferred from surface morphology alone; they require confirmation through borehole data, face mapping and ongoing reconciliation as quarrying advances.

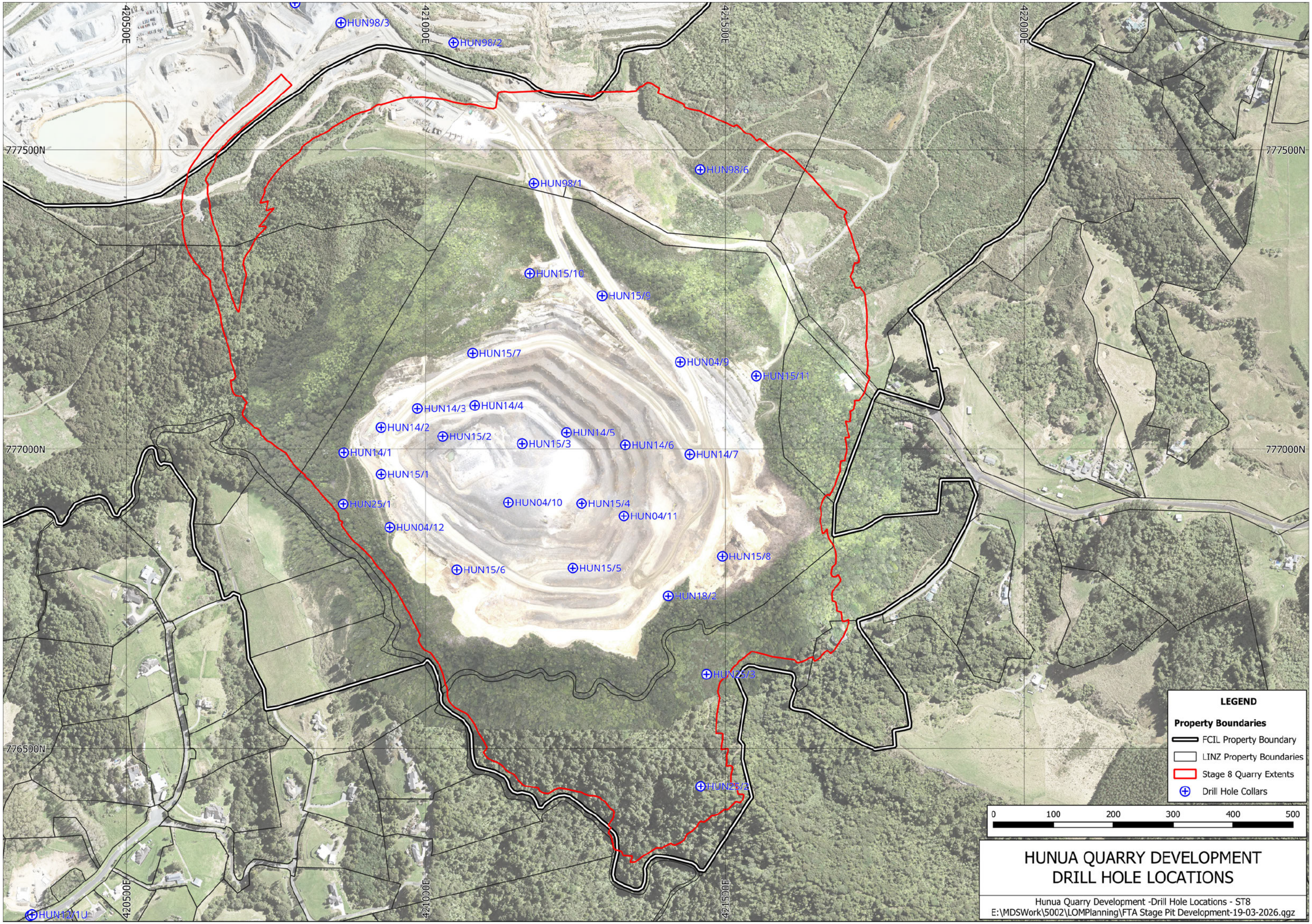
Examples from recent investigations

Investigations south of the Symonds Hill Pit within the Mangapū Tributary diversion area illustrate the observed variability in weathering profiles. At the crest location (HUN25/2), a typical greywacke profile was encountered, with slightly weathered greywacke at depth transitioning into fresh greywacke further downhole. At the mid-slope location (HUN25/3), residual and completely weathered materials were present near surface, underlain by highly weathered greywacke, with moderately weathered greywacke persisting to the base of the hole. Test pits at lower elevations encountered completely to highly weathered greywacke at their final depths. These profiles are consistent with an overall decrease in weathering with depth, combined with significant local variability related to slope position, drainage and proximity to fractured ground.

Implications for geological interpretation

The observed weathering patterns confirm that weathering surfaces represent materially significant boundaries controlling rock behaviour and quarry use categories. Overburden thickness and stripping requirements are sensitive to local thickening of residual to highly weathered greywacke and to the irregularity of the basal overburden contact. Zones of deeper weathering aligned with fault corridors and argillaceous domains are likely to produce greater variability in rock mass characteristics and aggregate yield, and are therefore important considerations in geological modelling, resource estimation and extraction planning.

Appendix B: Drill Hole Location Plan



HUNUA QUARRY DEVELOPMENT
DRILL HOLE LOCATIONS
Hunua Quarry Development -Drill Hole Locations - ST8
E:\MDSWork\5002\LOMPlanning\FTA Stage Pit Development-19-03-2026.qgz
LEGEND
Property Boundaries
FCIL Property Boundary
LINZ Property Boundaries
Stage 8 Quarry Extents
Drill Hole Collars
0
100
200
300
400
500
420500E
421000E
421500E
422000E
777500N
777000N
776500N
HUN98/3
HUN98/2
HUN98/1
HUN98/6
HUN15/10
HUN15/9
HUN15/7
HUN04/9
HUN15/11
HUN14/3
HUN14/4
HUN14/2
HUN15/2
HUN14/5
HUN15/3
HUN14/6
HUN14/7
HUN14/1
HUN15/1
HUN25/1
HUN04/10
HUN15/4
HUN04/11
HUN04/12
HUN15/8
HUN15/6
HUN15/5
HUN18/2
HUN25/3
HUN25/2