Attachment 8

Anticipated and Known Adverse Effects

Relevant to Fast-track Referral Application Form Section 3.4

Known and Anticipated Adverse Effects

1 Overview

The list of adverse effects considered, the applicable regional and district local authority with the function under the Resource Management Act 1991 (RMA) to consider that effect, and an upfront corresponding level of effect assessed is provided in Table 1.

Detailed assessments of adverse effects are in the following Sections 2 through 14.

Table 1 Actual and Potential Adverse Effects Considered, Applicable Authority and Overview of Effect Level

EFFECT ASSESSED	REGIONAL	DISTRICT	LEVEL OF EFFECT
Effects on water quality	√		Minor
Effects on water quantity	√		Negligible
Effects on aquatic ecology	√		Minor
Effects on water users	√		Less than minor
Effects on terrestrial ecology	√	√	Less than minor
Effects on land stability		√	Minor
Effects from fire and flood hazards	√	√	Less than minor
Effects on air quality and human health	√		Less than minor on environment Minor on persons (dust)
Effects of transportation		√	Negligible
Effects on Te Ngāi Tūāhuriri Rūnanga values and use	√	√	More than minor
Effects on landscape values and natural character		√	Less than minor during development.
Effects on amenity and recreation values	√	√	Less than minor
Containment failure risks	√	√	Minor

The following reports and management documents have been prepared for the Project and are referred to (titles in **Bold**) or have been relied upon in assessment of the adverse effects:

- WSP (2022). Whiterock Lime Quarry - **Hydraulic Modelling**. Rev1.
- WSP (2023). Whiterock Lime Quarry and Landfill - **High-level Transport Assessment**. Rev0.
- WSP (2024). **Waste Acceptance Criteria** for Proposed Managed Fill (Class 3) Landfill. Rev0.
- WSP (2024). Whiterock Lime Quarry and Landfill - **Geotechnical Report**. Rev2.

- WSP (2024). Whiterock Lime Quarry and Landfill - **Groundwater and Surface Water Effects Assessment**. Rev0.
- WSP (2024). Whiterock Lime Quarry and Landfill - **Landfill Slope Stability Report**. Rev0.
- WSP (2024). Whiterock Lime Quarry and Landfill - **Landfill Design Report**. Rev0.
- WSP (2024). Whiterock Lime Quarry and Landfill – **Preliminary Design Drawings**. Rev1.
- WSP (2024). Whiterock Lime Quarry and Landfill - **Stormwater Management**. Rev0.
- WSP (2024). Whiterock Lime quarry and landfill - **Ecological Impact Assessment**. Rev0.
- WSP (2024). Whiterock Limestone Quarry and Landfill - **Technical Air Quality Assessment**. Rev 2
- WSP (2024). Whiterock Lime Quarry and Landfill - **Noise Impact Assessment**. Rev 3
- WSP (2024). **Monitoring Programme and Triggers for an Action Response Plan (TARP)**. Rev A.
- WSP (2024). **Containment Risk Assessment**. Rev0.
- WSP (2024). Whiterock Lime Quarry and Landfill – **Landscape and Visual Assessment**. Rev0.
- Singers Ecological (26 February 2025). Whiterock Quarry - **Wetland assessment**. NSES Ltd Report Number 57:2024/25.
- Protranz (2024). Whiterock Lime Quarry and Landfill - **Site Management Plan**. Draft B.

2 Effects on Water Quality

2.1 Overview

Potential effects on water quality associated with the Project include the unintended leakage of leachate from the liner and the discharge of the various forms of stormwater.

A Groundwater and Surface Water Effects Assessment has been undertaken which addresses these effects in detail. A Stormwater Management Report has also been completed which addresses stormwater discharges.

The key effects considerations from these reports are discussed below.

2.2 Liner Leachate Leakage

Groundwater from the site ultimately flows to the Karetu River. The leakage of liner leachate or potential larger amounts of leachate arising from a landfill liner or infrastructure failure therefore has the potential to impact water quality in both groundwater and the Karetu River receiving environment. The eastern boundary watercourse is ephemeral for the majority of its length, and perched above the managed fill site and is unlikely to be impacted and has no material aquatic ecology values.

The Landfill Design Report provides predictions of the highest, lowest and average leachate generation for scenarios to represent a reasonable upper estimate for leachate generation. This was undertaken using HELP [1] modelling which for soil wastes graded to maximise stormwater runoff and diversion is likely to overestimate average annual leachate generation rates. This HELP model estimates leachate collection at the landfill base.

The Groundwater and Surface Water Effects Assessment estimated potential leachate leakage through the landfill liner using an analytical approach which incorporates aspects such as liner defects, wrinkles in the liner, and cases of both good and poor contact of the HDPE layer with the compacted cohesive soil liner. The approach applied a highly conservative level of head (i.e., height of water above the liner) of 0.3 m which is the thickness of the drainage layer in the design. This is conservative because the predicted daily annual average volume of leachate, at 15 m^3 per day, if evenly distributed over the entire landfill floor drainage layer footprint of 2.7 ha would have a depth of less than 1 mm.

The Groundwater and Surface Water Effects Assessment adopted a mass mixing approach to assess potential changes in contaminant concentrations in the Karetu River resulting from various scenarios. A conservative approach was applied to the mass mixing approach which assumes that all the daily leachate leakage would reach the river at a single point and at the same time and would occur during mean annual low flow (MALF) estimated at 124.6 L/s (volume past site 10,765 m^3 /day). In reality, while liner leakage entering during MALF is a likely possible scenario, modelling all the contaminants leaking at the same time in a single location is highly unlikely. In more

[1] United States EPA (Hydrologic Evaluation of Landfill Performance) [HELP] version 3.95D.

realistic natural attenuation processes, mainly dispersive mixing through groundwater, this would result in the lowering of contaminant concentrations in the groundwater along the pathway it follows. Additionally, dilution of contaminants would also become a factor.

Three conservative leakage scenarios have been assessed as follows, with results provided in Table 2:

1. Likely liner Contact Case: Tonlyn C&D [2] leachate concentrations; 300 mm head landfill liner leakage estimate from good liner contact scenario – 474 L/day
2. Worst Liner Contact Case: Tonlyn C&D leachate concentrations; 300 mm head landfill liner leakage estimate from poor liner contact scenario – 776 L/day
3. Failure Case with 100% Leachate Lost: Tonlyn C&D leachate concentrations; significant failure causes 100% of landfill leachate mixing in the river – 15 m^3 /day

Table 2 Estimated concentrations following mixing with landfill leachate. (Exceedances of guideline values shaded red. BD = Estimated concentrations were less than (<) lab detection limits as per the baseline concentrations).

	As (g/m³)	Zn (g/m³)	Cu (g/m³)	Pb (g/m³)	Al (g/m³)	B (g/m³)	Cd (g/m³)	Cr (g/m³)	Ni (g/m³)	Mn (g/m³)	NH_4-N (g/m³)
Karetu River baseline concentrations	<0.0010	0.0015	0.0006	<0.00011	0.0525	0.0245	<0.00005	0.0003	0.0004	0.0017	<0.010
Estimated Karetu River Contaminant Concentrations											
1) Likely Liner Leakage Case:	BD	0.00151	0.00060	BD	0.0525	0.0258	BD	0.00029	0.00038	0.00185	0.036
2) Worst Liner Leakage Case:	BD	0.00151	0.00060	BD	0.0525	0.0267	BD	0.00031	0.00038	0.00198	0.065
3) Failure Case with 100% Leachate Lost	BD	0.0017	0.00063	BD	0.0525	0.0669	BD	0.0015	0.00042	0.00798	1.24
Guideline Values											
ANZG 2018 95% species protection	0.0240	0.0080	0.0014	0.0034	0.055	0.94	0.0002	0.001	0.011	1.9	0.9
NZ Drinking Water Standards 2022	0.01	-	2	0.01	1	2.4	0.004	0.05	0.08	0.4	-

The assessment shows that the conservative scenarios of rates of liner leakage in the 'good' and 'poor' contact cases when mixed with the river flow (even at MALF) do not materially increase the concentrations in the river above the observed background concentrations for all contaminants except NH_4-N (ammonium). There is also no cumulative exceedance of ANZG 95% species protection [3].

However, chromium and NH_4-N would exceed guideline values for 95% species protection (ANZG, 2018) in the unlikely case of a liner failure or storage leakage, and aluminium (Al) is close to exceedances of the guideline values for 95% species protection (ANZG, 2018). NH_4-N originates from the anaerobic decomposition of green waste within a landfill. Due to no green waste being accepted at the Whiterock Managed Fill site, this NH_4-N exceedance is unlikely to ever occur. Also,

2 A landfill site in Gisborne that is considered to be the most representative of the proposed Whiterock Managed Fill site. Tonlyn is a Class 2 C&D landfill that accepts contaminated soils that meet the Class A Toxicity Characteristic Leaching Procedure (TCLP) criteria limits.

3 ANZG. (2018). *Australian and New Zealand Guidelines for Fresh and Marine Water Quality.* – Adopted as Karetu River is a 'Hill-fed Lower' class river.

the increase in NH_4-N from baseline for the 'good' and 'poor' contact scenarios is likely to be over-represented. The Land and Water Regional Plan (LWRP) limits and National Policy Statement for Freshwater Management "B" Band (95% species protection) specify an annual median of 0.3 and >0.03 and ≤0.24 g/m^3 for NH_4-N - it is unlikely these would be exceeded given green waste or wood waste is not accepted at the facility.

No scenarios are estimated to exceed NZ Drinking Water Standards [4].

Leachate quality monitoring (occurring monthly on commencement of filling) in the leachate pond is proposed to validate the modelling assessments, and the assumptions relating to the lesser strength of NH_4-N with the inert only waste accepted and non-acceptance of green waste. As outlined in Section 5.5 below, continuous groundwater quality monitoring of the underdrainage system will also occur. Should electrical conductivity (and other parameters) in groundwater indicate any leachate leakage and a subsequent risk, underdrainage water will be redirected to the leachate pond until the leachate risk and cause has been addressed.

Leachate quality and continual underdrainage monitoring, quarterly monitoring of wells and the Triggers for an Action Response Plan (TARP) for any changes from a normal state is expected to avoid potential for long term risks to freshwater fauna within the Karetu River as far as practicable.

Overall, given the very low probability of a total failure occurring, and accounting for the Class 1 liner proposed for this Class 3 inert waste types, the monitoring being implemented, and TARP proposed, the risk of leachate leakage occurrence is considered as acceptable and the resultant effect on aquatic ecology will be less than minor.

In the context of the likely leachate concentrations from the inert waste, the Class 1 liner, baseline water quality conditions, the results of conservative modelling under a range of scenarios and taking into account the monitoring and controls proposed, the actual and potential effects on water quality have been mitigated.

2.3 Stormwater Discharge

The principal high probability risks to water quality associated with the discharge of stormwater from the Project are associated with increased concentrations of Total Suspended Solids (TSS), turbidity and metal containing contaminants from buildings.

Management strategies for stormwater management are summarised in Attachment 2 (Project Description & Activities).

The discharge of metal containing contaminants is limited to stormwater arising from zinc-coated iron roofing on existing buildings at the site. Currently the roofs are unpainted. The painting and maintenance of these roofs as a source control is estimated to result in a 91% reduction in zinc yield [5].

[4] Taumata Arowai, 2022

[5] Using the Auckland Council Version 2 (2010) Contaminant Load Model from a combined roof area of 2,700m^2

A conservative [6] mass mixing assessment was also undertaken to assess the zinc loading into the Karetu River from onsite buildings after painting during intermittent storm events. Results indicate a discharge quality of 0.00612 g/m³ being below the ANZG 2018 95% species protection guideline value of 0.008 g/m³. Provided the roofs remain painted over time, the existing zinc baseflow concentrations (possibly leaching from impacted soils) in the Karetu River downstream may reduce over time. The Project therefore has the potential to result in a positive long-term effect on surface water quality through a reduction of zinc in surface water.

The discharge of construction phase stormwater from a large catchment of quarry and landfill disturbance works presents a high risk to surface water quality if not managed appropriately for the relative scale and nature of the various activities occurring on site.

As part of the Erosion and Sediment Control Plan (ESCP) the Sediment Retention Ponds (SRPs) will be designed and sized to achieve sediment and suspended solids removal. Additionally, the pH range currently observed in surface water (pH 7.8 dry and pH 8.8 wet weather) in the Karetu River [7] is already naturally above a neutral state being in a low alkaline state (refer Figure 1) due to the extensive limestone geology in the catchment.

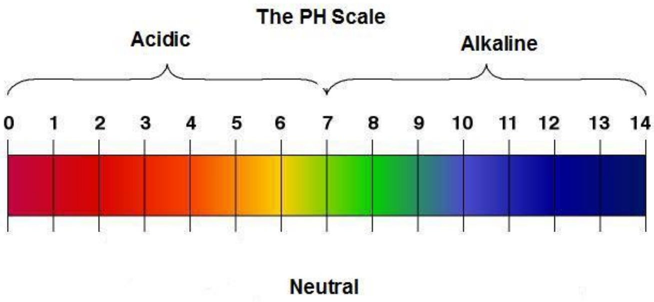

Figure 1 pH scale.

Run-off of lime impacted stormwater from the quarry could increase the pH in the Karetu River, although this is shown to be already high naturally given the limestone geology in the catchment, so the impact is expected to be minimal. The water monitoring programme proposed (refer Attachment 2) and proposed conditions) will include monitoring of pH in the discharge from the SRPs.

Through implementation of formal erosion sediment controls that will be constructed and maintained in accordance with Environment Canterbury's online Erosion and Sediment Control Toolbox (ESCT), it is expected that sediment loads from the site will be reduced compared to the current situation.

There is a low probability risk for contamination of stormwater from inadequate isolation of areas being filled with the managed fill or through leachate seepage. The resultant scenario effects have already been assessed in the leachate section above.

Electrical conductivity (EC) monitoring has been added to the SRP monitoring requirements as a basic leachate contamination indicator. Additionally, environmental wet weather monitoring of the Karetu River is also proposed to have twice annual water quality monitoring of trace metals

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[6] Refer to Section 4.3.3 Stormwater Management in Appendix C for the assumptions used in the assessment.

[7] The LWRP sets a pH range for the Karetu River at 6.5 – 8.5 pH units.

and metalloids that will also be able to determine any unforeseeable migration of leachate in stormwater to surface water.

2.4 Summary

Only in the highly unlikely event of total failure of the liner and 100% leachate loss, using the mass mixing approach, would there realistically be a cumulative exceedance of the ANZG 2018 95% species protection guideline values for chromium. All other scenarios and contaminants showed no exceedances other than for ammonium which is not a likely contaminant resulting from the inert types of waste accepted at this managed fill site. All modelled scenarios showed no exceedances of the NZ Drinking Water Standards from potential leachate leakage.

Stormwater discharges are expected to be mitigated with respect to both metals and sediment loads through adoption of appropriate source controls and ESC measures for the site. Overall, when considering the very low probability of a total failure and the associated controls that will be in place, the effect of the ongoing quarry and proposed managed fill site development and operation on water quality is assessed as being minor.

3 Effects on Water Quantity

3.1 Overview

Potential effects on both groundwater and surface water quantity are assessed within this section.

The Groundwater and Surface Water Effects Assessment addresses effects of the managed fill site development on groundwater quantity. The Stormwater Management report addresses the effects of the development on surface water quantity.

The current quarrying activities and operations and processing plant area will broadly remain unchanged in terms of imperviousness and construction phase stormwater will not materially increase in rate and volume. Additionally, the SRPs have an attenuation function (to achieve water quality outcomes), so construction phase stormwater is not considered to have any material water quantity effects.

3.2 Groundwater Quantity

The impervious lining of the managed fill site will reduce rainfall recharge to groundwater over an approximate 4 ha area, and the cap may influence groundwater levels and surface and flows due to reducing rainfall infiltration and localised replenishment of groundwater.

Existing conditions are drawing on the aquifer beneath the site when groundwater is pumped out to control onsite pond water levels. The larger quarry pit excavations and seepage drainage in general (and latterly the pumping of the quarry pit pond) has drawn down the groundwater table beneath the site and in the surrounding area. The quarry pit pond is to be backfilled, and the fill site has been designed so that the base (i.e., the liner at the bottom) is at least 1 m above the existing groundwater table. Therefore, groundwater will be allowed to rise, but will be controlled via an underdrainage system to maintain groundwater to at least 1 m below the bottom geomembrane liner.

Numerical modelling indicates the current drainage rate (32 m^3/day) will remain unchanged as a result of the Project.

While the drainage rate will be unchanged and groundwater will rise to a small degree, a reduction of rainwater infiltration will however occur beneath the landfill footprint. The resultant net drawdown effect has been modelled as depicted in Figure 2.

Groundwater levels will be drawn down by more than 0.1 m up to a maximum distance of 700 m to the east of the site where several wetlands and streams are present. See Figure 2 for the location of these wetlands and streams.

Modelling predicts a reduction of groundwater baseflows from the current state (with the exisntg pit pond) to these eastern wetlands and streams caused by a reduction in rainfall recharge and the underdrainage system as follows:

- Lower wetland (southern end of the site): 19% (0.06 L/s or 5 m^3 per day) loss
- Stream 1 (south of the site): 2% loss

— All other streams and upper wetland: No change.

Subsequent modelling applying a pre-quarry pit state showed a 55% loss of baseflow to the lower wetland.

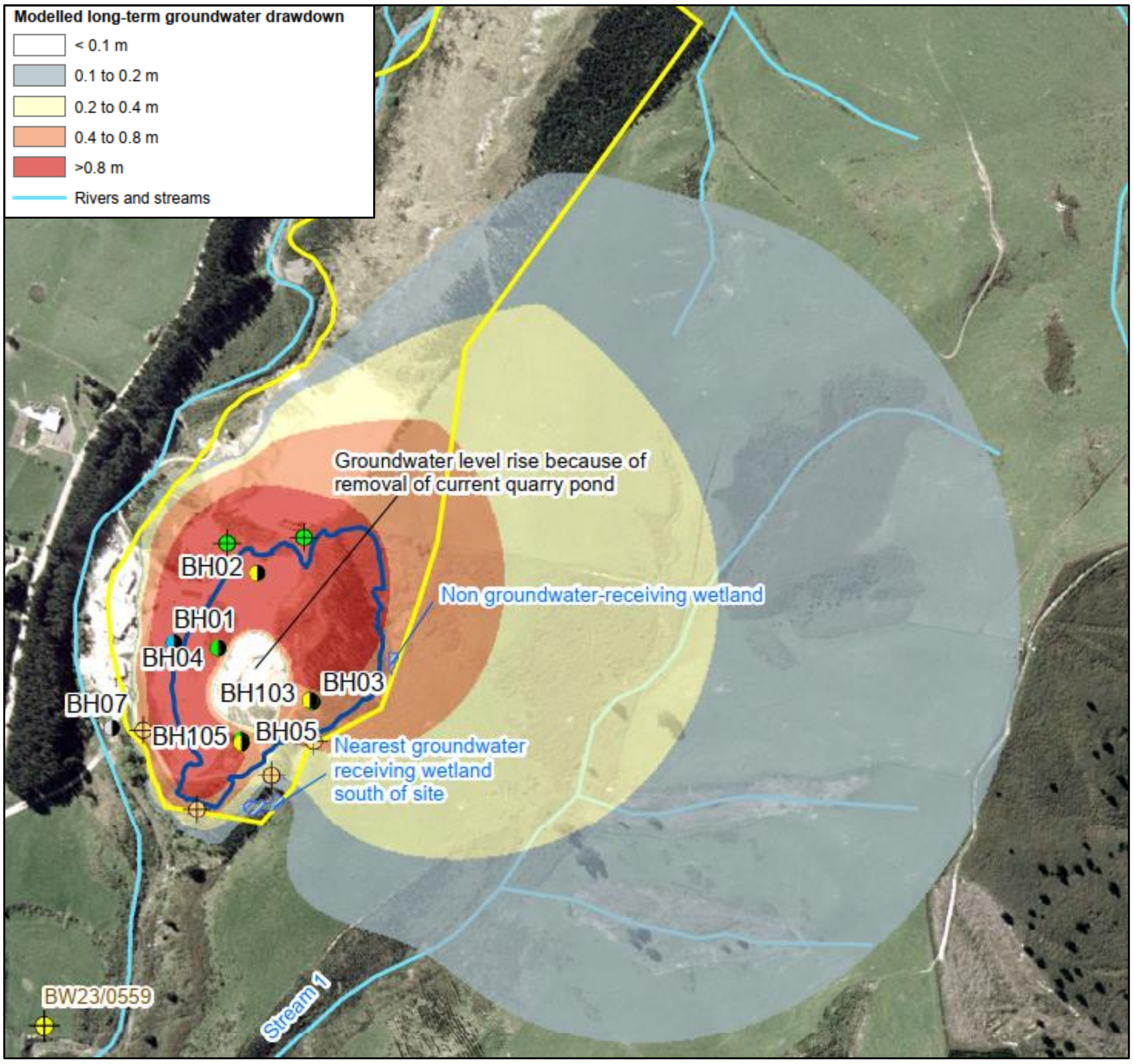

Figure 2 Modelled long term groundwater drawdown.

The modelled reduction will however be gradual and take several years to fully manifest itself, therefore the resultant effect on seepage flows to streams in practice may not be measurable. It is anticipated the only noticeable effect will be on the lower wetland. Wetland remediation is proposed (refer Section 6.3).

An increase in drainage rate (up to 74 m^3/day) via temporary site dewatering may also occur during the construction phases of the managed fill site to install the underdrainage system (and discharged to the river). This is expected to be very short term in duration (several weeks) and will not lead to a noticeably different reduction in baseflows to nearby wetlands and streams.

3.3 Surface Water Quantity

In accordance with the LWRP definitions, the take of shallow groundwater for domestic use has a direct hydraulic connection to surface water given the manhole gallery ("bore') is only 1.5 m in depth and within 15 m of the Karetu River. The LWRP Regional Rule 5.111 provides for a permitted activity pathway for surface water takes of rates less than 5 L/s and a volume of 2 m^3/day which is proposed. The application of a permitted baseline is appropriate in this instance, as the groundwater water take will effectively be from the Karetu River.

3.4 Stormwater Quantity

The contoured rehabilitated site to a more natural form will reduce stormwater runoff rates and volumes directly to the Karetu River, but will increase rates and volumes to the eastern boundary watercourse that flows into the Karetu River. No material net increases in stormwater quantity are considered to occur during the development,

The Stormwater Management Report assesses the site area of the contributing catchment for rainfall runoff to the eastern watercourse will increase by 16% (from current situation). When accounting for the stabilised vegetation cover above the capping layer, the overall contributing flow during a 10% AEP storm event to the eastern watercourse will remain similar to the existing state and will be in line with pre quarrying (1940s).

Proposed discharge outlets from clean water diversion channels to the eastern boundary will be stabilised to minimise localised erosion within the eastern watercourse while the proposed riparian margin enhancement planting will further prevent potential scouring and erosion within the watercourse.

3.5 Summary

The potential effects of the managed fill site development on groundwater, surface water in the Karetu river and surface flows to the eastern watercourse in the longer term are considered less than minor without any mitigation.

4 Effects on Aquatic Ecology

4.1 Overview

The Project includes various activities that have the potential to affect aquatic ecology values identified within the Karetu River as discussed in the Ecological Impact Assessment. These activities include landfill waste exposure risks, bed disturbance associated with construction activities, and discharges from stormwater. These effects are assessed under the corresponding subsections below.

The leachate leakage impacts within the water quality Section 2 included comparison against the ANZG 2018 95% species protection for aquatic ecosystems. The effects from leachate leakage are not repeated or reassessed within this section however are considered in the overall effect on aquatic ecology.

4.2 Landfill Waste Exposure

Potentially severe rainfall events could erode intermediate cover exposing areas of compacted waste that could be entrained in runoff and end up as bed load in the Karetu River. The design of the managed fill site, including the: minimum slopes of the landfill form, intermediate cover grade, and design depth, compaction and content of intermediate cover, stormwater controls with 100-year Annual Recurrence Interval (ARI) event capacity, has considered this risk.

Additionally, there will be temporary stabilisation techniques and SRPs in place until the intermediate cover is fully stabilised with grass. Weekly inspections for the duration of the managed fill operation, pre forecast wet weather inspections of the cover and stormwater controls will ensure the cover is adequately stabilised and erosion resistant via good coverage of healthy and uniform grass vegetation.

4.3 Bed Disturbance from Construction Activities

Construction activities in the bed and margins of Karetu River including for the removal of an existing ford crossing, installation of a one lane bridge, and the placement of new outfall structures (if required) have the potential to cause temporary elevated sediment within the Karetu River.

Elevated sediment will result in a temporary decrease in water clarity, potentially influencing the behaviour of invertebrates, fish, macrophyte growth. It also has the potential to compromise the feeding abilities of visual feeders and clog the gills of fish and invertebrates.

The magnitude of effect depends on the duration and scale of bed disturbance and the resultant concentration of TSS relative to the receiving environment. Construction works will be undertaken outside of flowing water once temporary instream diversion methods have been established.

The scale and duration of instream works is negligible and is expected to affect a limited number of fish. Stream biota in this catchment already has some ability to cope with occasional decreases in clarity as a result of naturally occurring high flows from storm events.

Given the scale of instream works and corresponding duration, a potential TSS increase is likely to be consistent with a small storm event. Currently, access to the site is via a ford crossing. Therefore, the receiving environment is already subjected to potential short-term decreases in water clarity. In the context of the baseline environment and scale of proposed activities, the proposed short term and small-scale instream works will be minor only.

Removal of the ford and the inclusion of a bridge structure over the river is expected to have a short-term adverse effect and a long-term positive effect on freshwater fauna within the Karetu River. This is through the removal of vehicle movements through the waterway and the need for ongoing maintenance of the ford. Additionally, removal of the rock armouring associated with the ford is expected to improve fish passage through removal of this barrier.

Overall, the proposed bridge installation and subsequent removal of the existing ford will have positive effects for aquatic ecology.

4.4 Stormwater Discharges

Currently unmanaged stormwater from compacted hardstand areas and other areas of the site will be transporting limestone sediment into the Karetu River. Improved quarry pit and disturbed soil erosion and sediment control / stormwater management collection and discharge via SRPs, with possibly new outfalls into the Karetu River (for roofs and haul road management) will reduce the offsite mobilisation and migration of sediments from the existing aggregate hardstand. Additionally, the painting of galvanised iron roofs onsite will minimise heavy metals (mainly zinc) entering the Karetu River.

Minimising sediment and heavy metals from entering the river from existing infrastructure and activities will reduce existing impacts to the Karetu River on substrate and freshwater fauna habitat, which is expected to have a permanent positive effect to freshwater fauna within the Karetu River.

Stormwater from the ongoing quarrying and proposed managed fill site construction will be treated via onsite SRPs prior to conveyance into the Karetu River. This proposed management will minimise sediment runoff to Karetu River, which will be an improvement compared to baseline conditions where sediment and limestone have been observed entering and accumulating within Karetu River.

The proposed erosion sediment controls and stormwater management (mainly via source control) for the site is expected to have long-term positive effects on freshwater habitat quality and availability, indirectly benefiting freshwater fauna.

Ecological health monitoring of macroinvertebrates and fine sediment in the Karetu River is proposed to validate the performance of the controls, as well as wet weather monitoring for TSS, turbidity and visual clarity.

4.5 Summary

The adverse effects for each activity on aquatic ecology are minor.

5 Effects on Existing Water Users

The Groundwater and Surface Water Effects Assessment addresses effects on existing water users. Potential effects to water users have the potential to arise with respect to both reduced quantity and quality of water within the Karetu River.

Two registered water takes within 2 km of the site draw water from the Karetu River and are hydraulically connected to shallow groundwater. Neither of these takes are within the 0.1 m net drawdown contours (Figure 2) caused by the landfill liner reducing the rainfall recharge of the previous quarry pit. Therefore, no measurable groundwater drawdown or well interference effects will occur in these takes.

Unregistered but known shallow water supply wells or infiltration galleries supplying landowners adjoining the Karetu River are located further downstream and are unlikely to be affected by the minor groundwater drawdown given they are outside the modelled interference (refer Figure 2).

The shallow ground water take directly connected to the Karetu River is within a direct surface water take permitted activity threshold.

No adverse water quantity effects are anticipated on the aforementioned takes.

Water quality could be potentially impacted if uncontrolled leachate from the managed fill site enters the Karetu River which in theory could affect downstream water takes. However, as assessed above (Section 2), there are still no exceedances of the NZ Drinking Water Standards even under the highly unlikely total failure of the liner event. This represents a scenario of 100% of the daily landfill leachate entering the river in an instance and under low flow conditions, also considered highly unlikely.

Stormwater discharges from the site affecting water quality will also be negligible with respect to human health. There are no takes within proximity of the site which would be affected by turbidity while zinc is not a toxicant of concern for human health as it does not have a maximum acceptable value in the Drinking Water Standards for New Zealand Regulations 2022.

Potential adverse effects on water users relative to the site from both a water quantity and quality perspective are considered to be less than minor. Notwithstanding this, a water quality monitoring programme is proposed (refer Attachment 2) which includes monitoring to detect any leachate entering groundwater at the landfill and migrating off site, and implementation of mitigation measures to minimise the risks of water quality effects.

6 Effects on Terrestrial Ecology

6.1 Overview

The Environment Institute of Australia and New Zealand (EIANZ) guidelines for undertaking an Ecological Impact Assessment were used to assess ecological impacts of the Project. An Ecological Impact Assessment was undertaken which provides a comprehensive assessment of all ecological values pertaining to the site and immediate surrounds. A further Wetland Assessment was undertaken to assess the impacts on the wetlands near the site.

6.2 Vegetation General

Earthworks associated with the managed fill site development and track widening is likely to result in the clearance of scattered exotic shrubs and some amenity plantings around the fringes of the existing excavated area equating to approximately 5 ha. Previous bund improvements to manage flood risk associated with the Karetu River required the removal of a small number of exotic trees and shrubs.

Due to the minor shift away from the existing baseline condition of the site, the magnitude of effect is however low with changes arising from the loss or alteration of vegetation within the site being discernible. On closure of the managed fill site, the vegetation cover across the site will be substantially increased and well in excess of the 5 ha removed during the construction phase.

In combination with negligible baseline values, the increase of vegetation cover at Project completion, the addition of stock exclusion fencing around the Significant Natural Area (SNA) and proposed enhancement planting around riparian margins with indigenous planting, the resultant effect on vegetation is considered positive with there being a net gain.

6.3 Wetlands

Quarrying to date, through drawdown of groundwater via a pit pond, has been estimated to have reduced groundwater levels to the lower wetland. The upper wetland is perched above the ground water level and is unlikely to have been affected.

If the Project proceeds, mainly through a managed fill liner and cap preventing direct recharge of groundwater, and groundwater level control, the projected percentage reduction of groundwater to the lower wetland is expected to have a cumulative decline totalling 51% compared to the pre-quarrying state. The reduction will be 44% compared to the 2023 state that already accounts for some reduction. If a further decline in groundwater flow does occur, this is likely to occur after five years of the stage 1 liner being fully installed and preventing groundwater recharge.

A Wetland Assessment has been undertaken, the more recent delineation in November 2024 showed that in the lower wetland, groundwater upwellings influences the hydrology in the lower 20% extent of the wetland. This covers an area of approximately 230 m^2 where there is the permanent wetness, of the total 1,330 m^2 lower wetland extent.

The Wetland Assessment advises that given that most of the upper part of the lower wetland extent is not connected or dependent on groundwater and that intermittent wetland rautahi sedgeland has been recovering, it is not expected that a reduction in the total wetland extent will occur with further reduction of ground water baseflows. A fall in the groundwater height or reduction in baseflow volumes potentially may result in a minor contraction of the extent of permanently wet habitat (20% area). The potential effect of this would likely result in a decrease in the permanently wet part and a subsequential increase of intermittently wet part.

Given the predicted effects, the main issue to be addressed is the potential loss of ecological values that would be restricted to the small number of indigenous plants within the 230 m^2 area (20% area) of permanently wet habitat. Applying the National Policy Statement for Freshwater Management 2020 (NPS-FM) effects hierarchy, remediation is the most appropriate action, to enhance and maintain indigenous biodiversity values associated with the area of permanently wet habitat.

Further restoration of the other parts of the wetland and its fringes is also proposed to address impacts of previous stock grazing due to poor fencing and forestry removal causing damage to the lower wetland, and the upper wetland.

With the implementation of the Wetland Restoration Plan activities, including the recommendations above and the indigenous plantings described in the Project Description and Activities (Attachment 2) the effects of the Project and previous activities are considered to be remediated.

6.4 Avifauna (Birds)

In combination with an existing low ecological value and a resultant negligible magnitude of effect on avifauna, a pre-mitigated level of effect on avifauna is assessed as very low. Avifauna utilising the SNA to the north are not expected to experience any disturbance from proposed activities due to the distance from the Project site.

Notwithstanding a very low level of effect on avifauna, bird management protocols will be incorporated into the overarching ecology management plan for the project. Protocols will include an Accidental Discovery Protocol (ADP) for all 'Threatened' and 'At Risk' species that could utilise vegetated habitats onsite during development. Example protocols will likely include site walkovers pre-vegetation clearance.

6.5 Herpetofauna (Lizards)

A Lizard Management Plan (LMP) has been developed to manage impacts to indigenous lizards and their habitat associated with the Project. The NPS-FM effects management hierarchy has been applied to avoid, minimise, and remediate adverse effects as well as appropriate management pursuant to the Wildlife Act 1953 and key principles for lizard salvage and transfer in New Zealand.

An authorisation (107310-FAU) has been issued under the Wildlife Act subject to conditions and the approved LMP.

Management measures include a variety of methods for the active capturing of indigenous lizards which will sufficiently minimise the risk to lizards during construction works associated with the Project. Releasing lizards into an existing SNA to be protected in perpetuity by a registered conservation covenant under the Reserves Act 1977 ensures their protection. Habitat creation and site remediation requirements outlined within the LMP and pursuant to the Ecological Impact Assessment will result in the creation of high-quality lizard habitat far in excess of that to be lost due to the Project. Fencing around the lizard release area and lizard habitat creation area will ensure long-term protective benefit to the lizards, while also benefiting indigenous vegetation within the SNA located on 170 Quarry Road.

When the LMP is implemented in full it is expected to result in a positive conservation outcome and an overall net gain for indigenous lizards on-site.

6.6 Summary

Overall, the effects on terrestrial ecology are considered to be less than minor.

7 Effects on Land Stability

A Geotechnical assessment and Landfill Slope Stability assessment have been completed for the Project to inform the potential effects on land stability including the risks associated with seismic hazard.

No large-scale areas of instability have been observed onsite nor have any karstic features, such as sink holes. Onsite overburden/spoil material is considered very stiff and in accordance with the New Zealand Geotechnical Society guideline for the field classification and description of rock and soil for engineering purposes. Indications are that there is not a significant proportion of cobbles or boulders that may present difficulties for construction or achieving required compaction. Reuse of onsite materials is therefore suitable.

Parameters for pit slopes including batter face angles, bench height and width, and overall slope angles for different material have been recommended and incorporated within the preliminary design. Further geotechnical stability analysis will occur during detailed design for each stage based on the proposed excavation/filling arrangement in relation to the engineered fill on the side slopes of the landfill. Detailed design will also assess how the placement of waste can achieve waste stability during construction and operation, as well as during closure and post closure.

In relation to seismic hazards, there are no New Zealand standards or geotechnical design guidance developed specifically for the seismic design of landfills, particularly the acceptable permanent slope displacement criteria. An Importance Level 3 structure has therefore been adopted based on Table 3.2 in NZS 1170.0:2002. A design working life of 100 years has been used.

The return period for fault rupture of the active faults in the receiving environment is in the order of hundreds of thousands of years. A fault rupture is therefore very unlikely during the design life of the landfill and unlikely to affect any containment structures.

The United States Environmental Protection Agency (USEPA, 1995) guidance for seismic stability and deformation analysis is the industry standard and considers permanent displacements in the order of up to 0.15 m (150 mm) are generally acceptable for the design of geosynthetic liner systems.

Slope stability assessments using GeoStudio software indicate the proposed final landfill face, access track and the leachate pond slope achieves the acceptable factor of safety (FoS) under both static and serviceability limit state (SLS) seismic cases. Under the damage control limit state (DCLS) case for the final landfill slope under a worst-case scenario [8] modelling however returned a displacement of up to 180 mm. While an exceedance of the USEPA 150 mm guideline, the stability assessment states:

> *Given the broad range of possible displacements and the conservative parameters used, the minor exceedance for the worst-case scenario (i.e., 180 mm vs the 150 mm guideline) is deemed acceptable.*

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[8] Cross Section 01 (Final Landfill Slope) steepest section running NW-SE.

In terms of general land stability, these displacements are not considered notable, however they do generate risks of liner failure and increase risk of leachate leakage.

The potential for development of significant leachate head in high sloping wall areas is however unlikely. The potential leakage rate for leachate defects in the highwall liner is lower than in floor areas.

The worst-case scenario for leachate leakage under a seismic event is therefore displacement around the leachate pond. Under the DCLS, the FoS for the slope beneath the leachate pond are less than the normally accepted 1.0. However, the estimated marginal exceedance of <10 mm displacement is assessed as acceptable.

The leachate pond is double lined which includes a between liner leakage collection layer comprising Geonet (3-dimentional drainage structure that does not crush). The Geonet will direct any leakage through the primary geomembrane liner (top geomembrane) to a leak detection and collection system, and will limit potential leachate head buildup on and therefore leakage through the secondary liner.

A modelled scenario of a total liner failure case (i.e. DCLS) returned effects on water quality that do not exceed NZ drinking water standards with only two parameters exceeding the ANZG 2018 95% species protection.

The risks of a liner rupture (including pond liner) due to seismic displacement are also considered within the Containment Risk Assessment along with the design mitigation.

Based on further geotechnical stability analysis occurring in detailed design, a very low probability of seismic occurrence and resulting marginal exceedance of the DCLS for the final landfill slope and leachate pond, the adverse effect is assessed as minor.

Furthermore, independent peer review of the final designs of the landfill construction will be carried out by a Suitably Qualified Environmental Practitioner (SQEP) in landfill design while additional stability analysis will occur during detailed design (refer to the Project Description - Attachment 2).

In the event of an earthquake, procedures to be followed will be outlined within a certified Site Management Plan (SMP) (refer to Attachment 2 for more details).

The potential for existing landslides to move further and enter the quarry area is considered to be low risk, on the basis that the slope between the landslides and quarry is considerably flatter than the slope that the landslides have previously moved on.

8 Effects from Fire and Flood Hazards

8.1 Fire Hazard

Fire hazard risk at the site could eventuate from the unexpected combustion of landfill waste material, operation of the onsite kiln or from externally induced wildfires on surrounding property.

Unlike municipal landfills, the proposed managed fill site will be receiving a high content of incombustible material such as soils and gravels. The lack of putrescible material will significantly reduce the risk of high temperatures that can be generated within a municipal landfill. Municipal landfills also receive a very wide range of wastes and there are reports of fires from lithium batteries that can catch fire in the moist environment of a municipal landfill. This potential risk is limited as lithium batteries would not meet the acceptance criteria for the proposed managed fill site. It is also noted that fuel sources such as plantation forestry have been removed to the immediate east of the site, and grass will be regularly cut within the site to reduce the grass fire risk.

The most effective strategy to be adopted for firefighting within the managed fill footprint will therefore be to smother the fuel sources.

The Project includes the permanent presence of large earth moving machinery that can be quickly utilised to address any fire. Experience from other sites suggest that the availability of large earth moving equipment is one of the most important resources that can be used to fight fires, and the lack of availability of earth moving equipment is often a major impediment to firefighters dealing with fires in rural areas.

For fires occurring outside of the landfill footprint such as within buildings on the lower terrace of the site, adequate onsite water storage and couplings for the delivery of water for firefighting purposes will be available.

Water storage near the landfill footprint can be provided as additional firefighting controls for the waste. Gypsum products are a prohibitive waste material therefore the application of large volumes of water to the sorted inert C&D waste will not have the potential to generate hydrogen sulfide.

Based on the waste types received and firefighting resources available at the site and the onsite controls outlined within the SMP, the effects associated with fire hazard are considered to be less than minor.

8.2 Flood Hazard

Flood risk from the Karetu River to the site has been modelled [9] under 50 year, 100 year and 250 year ARI events with and without climate change (refer Figure 3).

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[9] Using NZVD2016 vertical datum and GD2000 Mt Pleasant Circuit projection.

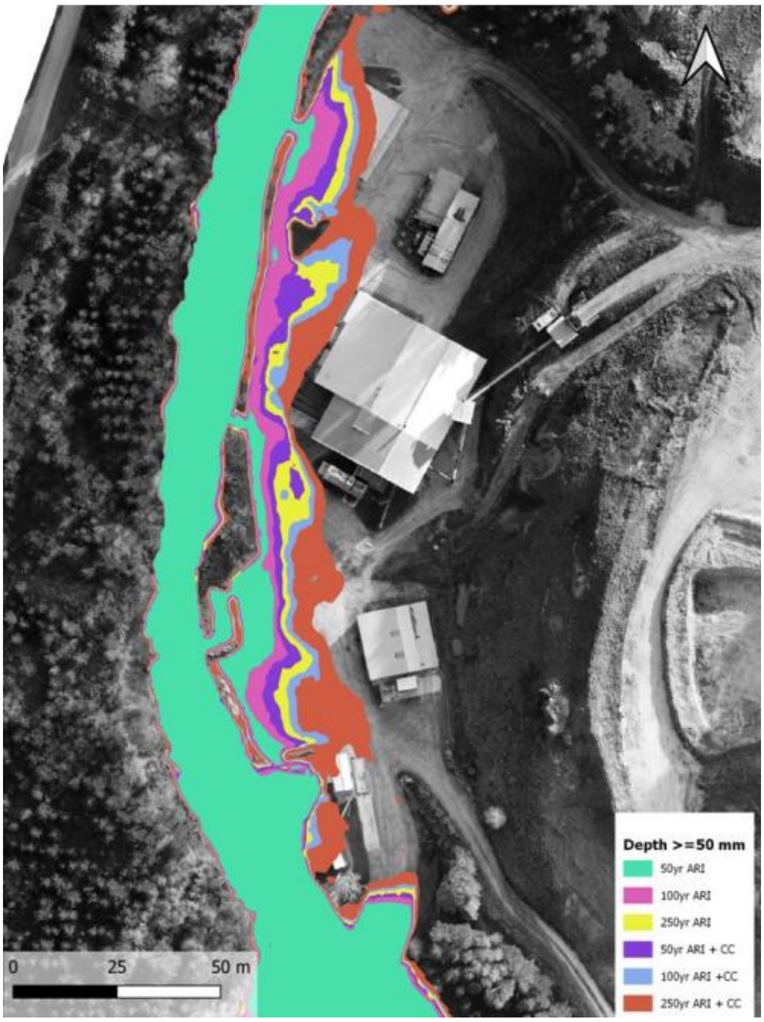

Figure 3 Flood modelling from Karetu River

When incorporating building floor levels into the model, there is a minimum of ~200 mm freeboard during the 100 year ARI existing climate event. The modelled surface elevations exceed the floor level in the northern building under a 100 year ARI climate change event. Modelling also indicated a portion of the trafficable area on the western boundary would have flood depths greater than 50 mm in 50 year ARI event both with and without climate change. However, it is expected that the reinstatement of the existing bund along the western boundary has alleviated flooding of these areas or diverted flows away from buildings.

With only a single building (used for extracted lime storage) partially susceptible to flood risk during a 100 year ARI climate change scenario, and as the risk can be suitably mitigated through onsite bund improvements, the risk is considered acceptable with a resultant minor effect.

There is no flood risk to the active quarry and landfill area due to the approximate 20 m elevation difference. The SMP also provides a flood contingency procedure in case access to the site for standard heavy vehicles to cart leachate off site via the access bridge is compromised or in the unlikely event bridge access is prevented for a period of weeks or more. There are numerous feasible options to regain access and remove stored leachate if it was at risk of exceeding contingency storage.

The effects associated with flood risk are considered to be less than minor.

9 Effects on Air Quality and Human Health

9.1 Overview

A Technical Air Quality assessment of the effects on air quality was undertaken.

The surrounding land use is dominated by rural activities, predominantly agriculture and forestry. A review of the receiving environment identified two residential dwellings to the west within 250 m of the site boundary that are likely to be sensitive receivers.

The nearest is approximately 100 m from the site's western boundary, adjacent to the existing processing plant and approximately 200 m away from the closest point of the quarry/landfill face.

Other dwellings are more than 500 m away and not expected to be affected by site operations.

A weather station with an anemometer [10] to measure wind speed and direction will be installed at least 6 m above natural ground level with continuous data recording. The site manager / landfill operator will have real time access to data to inform site operations (e.g., dust suppression requirements). Risk levels associated with increased wind events will be managed in accordance with the wind speed trigger and response identified in Table 3.

Table 3 Wind speed restriction triggers

Category / Risk Level	Wind Speed	Notification Actions	Response
Calm to light / None	< 4 m/s (<14.4 km/hr)	N/A	N/A
Gentle / Low	4 - 5 m/s (14.4 - 18 km/hr)	Brief Operational Staff Real time - weather station - inbuilt alert system text & email	Prepare for mitigation and actions, visual inspection of dust discharges and implement water application for dust suppression if required
Moderate to Fresh / Medium	5 to 10 m/s	Brief Operational Staff and Drivers /	Receipt, handling, spreading, and compaction of asbestos waste is to cease (refer specific

[10] Installed in accordance with AS/NZD 3580.14:2014 Methods for sampling and analysis of ambient air – Part 14: Meteorological monitoring for ambient air quality monitoring applications.

Category / Risk Level	Wind Speed	Notification Actions	Response
	(18 - 36 km/hr)	Contractors prior if forecast Real time - weather Station - inbuilt alert system text & email	triggers in Section 9.4). Operators to use dust mitigation measures for non-asbestos containing waste and cleanfill operations as appropriate
Strong to Gale / High	10 to 20 m/s (36 - 72 km/hr)	Brief Operational Staff and Drivers / Contractors prior as will be forecast Real time - weather Station - inbuilt alert system text & email	In addition to above, tipping of light weight material to the landfill face to cease until appropriate mitigation methods can be undertaken. Wetting of waste soils at the source prior to dispatch to Whiterock
Strong Gale + / Very High	>20 m/s (> 72 km/hr)	Brief Operational Staff and Drivers / Contractors prior as will be forecast. Real time - weather Station - inbuilt alert system text & email	All landfilling must cease immediately, and the landfill may be required to close

The primary discharge into air from the site is considered to be particulate matter (dust) associated with quarrying, managed waste filling, and lime processing operations. Human health risks associated with receiving asbestos at the site are also considered.

As the site will not accept putrescible waste, odour is not expected to be noticeable from the proposed managed fill site. The dryer and coal fired furnace (associated with lime processing) gives rise to finer particulate matter emissions (primarily PM_{10} and $PM_{2.5}$), as well as nitrogen dioxide (NO_2) and sulphur dioxide (SO_2) from the dryer emission control system which have also been assessed.

9.2 Limestone Drying Kiln

The fuel source for the lime drying furnace and kiln has recently been changed from coal to diesel. The diesel burning emissions are a permitted activity under the regional plan and does not require resource consent under the National Environmental Standards for Greenhouse Gas Emissions as the yearly carbon dioxide emissions classify the site as a low-emissions site.

The residual air quality effects associated with particulates from the lime drying rotary kiln emissions have yet to be fully assessed. Dispersion modelling at the closest sensitive receiver will occur and will be assessed against the Resource Management (National Environmental Standards for Air Quality) Regulations 2004 (Sep 2020) and Ambient Air Quality Guidelines (2002) being the health-based criteria designed to protect human health.

Although unlikely, if any exceedances of the criteria occur mitigation can be added such as particulate emission reduction technology.

9.3 Quarrying and Landfilling Dust

There are two residential dwellings (R1 & R2 shown on **Error! Reference source not found.**) within 250 m of the quarry / landfill area. These properties are considered to be highly sensitive. Locations beyond 250 m of the site are unlikely to experience any offensive or objectionable dust impacts given the scale of the site operations and normal mitigation measures.

A seasonal based frequency analysis of wind data has been carried out on the two residential receptors (refer Table 4). Due to separation distance and the application of good management practices and mitigation measures as outlined in the SMP, the risk of high intensity impacts is relatively low.

Based on the type of dust, it is not considered that the activity is likely to be offensive in context of the receiving environment. Predicted duration of potentially dusty winds in dry and strong wind conditions will mainly occur over a period of 1-3 hours.

Table 4 Percentage of hours a receptor is downwind of the site.

RECEPTOR	FREQUENCY OF DOWNWIND DRY HOURS (ALL WIND SPEEDS)			FREQUENCY OF DOWNWIND DRY HOURS WITH STRONG (>5 M/S) WIND CONDITIONS		
	ANNUAL TOTAL	OCT TO APR	MAY TO SEP	ANNUAL TOTAL	OCT TO APR	MAY TO SEP
R1	6 % (565 hours/year)	5 % (465 hours/year)	1 % (100 hours/year)	0.14 % (12 hours/year)	0.14 % (12 hours/year)	0
R2	5 % (456 hours/year)	4 % (384 hours/year)	1 % (72 hours/year)	0.14 % (12 hours/year)	0.14 % (12 hours/year)	0

In consideration of the FIDOL [11] factors there is the potential for low dust impacts to occur in dry and both windy and light/moderate wind conditions. Potential impacts are more likely to occur between October to April.

A conservative approach was adopted in the air quality assessment assuming that all excavated / landfill / overburden areas would be open throughout the year. This would however not be the case with extraction works and the managed fill site being progressively completed and stabilised.

Potential dust discharges from the site are likely to occur from excavation, loading, landfilling and haulage areas. Standard dust mitigation measures for quarries and landfill can readily achieve avoidance of dust effects beyond the site boundary.

[11] Frequency, Intensity, Duration, Offensiveness and Location.

The SMP will detail the low moderate and high dust generating activities, and the appropriate mitigation and actions required to be carried out to minimise any potential for offsite dust quality effects.

9.4 Asbestos

Handing and deposition of asbestos will be undertaken in accordance with the requirements of the Health and Safety at Work (Asbestos) Regulations 2016.

The SMP will outline the requirements for transporting asbestos waste material to the site which includes the lining of the waste material within 200 μm gauge plastic and wetted during loading so the moisture content of the material will be at least 15% throughout the load. Liners will be taped and then covered with retaining cover/tarpaulin before transport to the site.

Detailed procedures for the placement, compaction and covering of asbestos waste will be in the SMP. To verify the effectiveness of these procedures, monthly ambient air monitoring will be undertaken when asbestos materials are being received, tipped and deposited on site.

Asbestos will not be accepted to the site (handled, disturbed or deposited) when wind speed at the site is greater than 5 m/s (18 km/hr) averaged over a 60-minute period and / or if peak wind speed exceeds 7 m/s (25.2 km/hr) averaged over a 60-minute period. Wind speed trigger levels and responses are outlined in Table 3 and further within the SMP. Wind speeds will be informed by the onsite weather station to be installed.

With the above procedures and controls in place to protect human health at the location of asbestos material deposition (i.e. within the landfill), it is highly unlikely that there will be any migration offsite via wind dispersal or vehicles / machinery.

9.5 Summary

Overall, with the adoption of mitigation and controls outlined within the SMP and any additional mitigation determined by the rotary kiln particulate dispersion modelling the potential effects on air quality and human health will be less than minor.

The effects of the quarrying and landfilling (construction and vehicle movement) dust discharges on immediate neighbouring properties (persons) are expected to be minor.

The asbestos disposal risk has been appropriately managed, and therefore effects on human health are considered negligible (or less than minor).

10 Effects of Transportation

The operative district plan provides a basis for determining the transport effects associated with the Project and the level of traffic generation which is anticipated by the plan for each zone or activity. A High-Level Transport Assessment has been undertaken for the Project to a level of detail that corresponds to the scale of the effects that the activity may have on the environment and to which the district plan provisions anticipate within a rural zone.

The assessment included a review of crash history in the vicinity of the site to determine any existing underlying irregularities and whether the project is likely to create any new impacts or possibly exacerbate any existing issues. Due to low traffic volumes along Quarry Road, a 10 year period and an extended distance of 20 km of roading was reviewed.

Based on reported crash history (5 reported within the 10 year period) there is a trend of loss of control type crashes during hours of darkness which is not uncommon for rural roads. Notably all crashes involved light vehicles and did not involve heavy vehicles. Crash records do not reveal existing hazards that would be expected to be exacerbated by the Project.

The threshold of vehicle movements [12] that requires resource consent under the operative district plan as a high trip generating activity is where the number of movements exceeds 250 vehicles per day. This threshold sets an important permitted baseline with respect to trip generation associated with the Project.

For completeness, the proposed district plan also defines high traffic generation thresholds for activities within a rural zone as follows:

- Greater than 200 vehicle movements per day (average).
- Greater than 50 heavy vehicle movements per day (average).

The project will result on average 36 vehicle movements per day which equates to approximately 14% of the threshold that the operative district plan anticipates before consideration is given to a high trip generating activity. Based on the annual average daily traffic volumes for Quarry Road, the project is expected to result in an overall increase of 24% for vehicle movements on Quarry Road while on the Loburn Whiterock Road an increase of 18% is expected.

The proposed vehicle movements are also well below the proposed district plan thresholds.

On the basis of the activity generating a small fraction of the districts plan's high trip generating threshold, traffic impacts on the network associated with the Project are assessed as negligible.

[12] Either entering or exiting a site per day

11 Effects on Ngāi Tūāhuriri Values and Use

The Project lies within the rohe of Te Ngāi Tūāhuriri Rūnanga.

Ngai Tūāhuriri oppose the project. They consider themselves adversely affected due to the proximity of the Karetu River, the impact on (and risk to) the cultural landscape, mahinga kai, taonga species and water quality. Fundamentally their position is "*The proposal is inappropriate at the head of the catchment and would diminish the mauri of the waterway*." Given Ngai Tūāhuriri (mana whenua) are the cultural experts, there are more than minor adverse effects or potentially significant adverse effects on the cultural landscape.

12 Effects on Landscape Values and Natural Character

The Project site was formed as a quarry in the early 1940's and has been progressively quarried to the present day. The character of the landscape at the site is well defined by the quarrying activity. The Project site is not located within a significant landscape overlay identified by the district plans nor located near such overlay. A Landscape and Visual Assessment was undertaken for the site and Project which is summarised below.

The Project is predominately constrained to the existing quarry area, which can only be occasionally glimpsed from Quarry Road and Taaffes Glen Road. For the Quarry Road and Taaffes Glen Road users, the effective viewing time is short and transient. This is in part due to topography and in part due to an array of shelter belts. While the Applicant has no control over the shelter belts outside of their owned property, due to the provision of shade and shelter, it can reasonably be expected that there would be no wholesale removal of these trees. Once past (north of) 144 Quarry Road, topography screens the Project from road users. At a distance, for example from the DOC tracks within the Mt Thomas Conservation Area, the changes brought about by the Project will be indiscernible.

The proposed works are of a small scale when taken in the context of the larger and complex receiving environment. Additionally, the Project will not represent significant change when compared to the current quarrying activity. Overall, the magnitude of change during the operation of the Project will be at most, low (or less than minor)

A comparison of the sites current state and the digitised visualisation of the post capping and vegetated state is provided in Figure 4. The imagery depicts a landscape transformed to a state which harmonises with the surrounding landscape. The post closure plan will specify removal of buildings on site. At the end of the Project after disestablishment, effects will be very low, with positive effects derived from the return of the landscape to a more natural form (and associated revegetation), the removal of structures, and enhancement of the SNA, wetlands and riparian environment improving the natural character.

Figure 4. Comparison of drone site images current and digitised visualisation (future)

13 Effects on Amenity and Recreation Values

13.1 Overview

Potential effects on amenity and recreational values in the receiving environment are considered to stem from nuisance activities arising during construction and operation, changes to water clarity and colour within the Karetu River and impacts on fishing values.

13.2 Nuisance Odour, Dust and Noise

Odour is not considered a materially relevant effect as the site will not accept any putrescible waste and any odorous materials if present (e.g. hydrocarbons) can quickly be covered at the tipping face of the landfill to minimise any noticeable odour.

Potential nuisance effects more relevant to the Project include emissions of noise and dust during both construction and operation of the Project.

A Noise Impact Assessment has been undertaken for the project against the operative Waimakariri District Plan and Hurunui District Plan.

The assessment identified five rural residential dwellings as potential noise sensitive receivers relevant to activities occurring on the site. The predicted noise levels at these properties are identified in Table 5.

Table 5 Predicted noise levels at potential noise sensitive receivers.

PREDICTED NOISE LEVELS	PROPERTIES				
	33 QUARRY ROAD	49 QUARRY ROAD	62 QUARRY ROAD	161 QUARRY ROAD	361 QUARRY ROAD
Phase 1: Lime extraction and access road development	37 dB $L_{Aeq,15min}$	38 dB $L_{Aeq,15min}$	38 dB $L_{Aeq,15min}$	55 dB $L_{Aeq,15min}$	27 dB $L_{Aeq,15min}$
Phase 2: Landfill, Stage 1	34 dB $L_{Aeq,15min}$	35 dB $L_{Aeq,15min}$	35 dB $L_{Aeq,15min}$	55 dB $L_{Aeq,15min}$	27 dB $L_{Aeq,15min}$
Phase 3: Landfill, Stage 2	34 dB $L_{Aeq,15min}$	35 dB $L_{Aeq,15min}$	35 dB $L_{Aeq,15min}$	55 dB $L_{Aeq,15min}$	27 dB $L_{Aeq,15min}$
Phase 4: Capping	35 dB $L_{Aeq,15min}$	37 dB $L_{Aeq,15min}$	36 dB $L_{Aeq,15min}$	55 dB $L_{Aeq,15min}$	26 dB $L_{Aeq,15min}$
Criteria	*50 dB $L_{Aeq,15min}$*	*50 dB $L_{Aeq,15min}$*	*50 dB $L_{Aeq,15min}$*	*55 dB $L_{Aeq,15min}$*	*55 dB $L_{Aeq,15min}$*
Complies?	Yes	Yes	Yes	Yes	Yes

Noise emissions are assessed as being acceptable at all five properties. The assessment states that:

> *The predicted operational noise emissions from the proposed landfill extension are predicted to comply with the Waimakariri Proposed District Plan and Hurunui District Plan noise standards during the daytime when assessed at the notional boundary of adjacent properties. Therefore, noise effects from the operation of the quarry and landfill activities are considered acceptable.*

The predicted noise levels are based on noise sources being located along the boundary of the proposed quarry/landfill area closest to the nearest properties, with all staff arriving and trucks arriving and departing site in a single 15-minute period (i.e. a worst-case scenario).

During operation, noise generating sources will be further away from the receiving properties and further screened by the terrain.

On the basis that noise from the Project is predicted to comply with the relevant district plan noise standards which were assessed under a worst-case scenario, the potential noise generated will fall within what is anticipated within the zone.

An assessment of the effects from the Project on air quality from dust was undertaken. Dust from quarrying and landfilling has also been thoroughly assessed which includes risk levels associated with increased wind events and the management response for different triggers.

Potential dust discharges from the site are likely to occur from excavation, loading, landfilling and haulage areas. Standard dust mitigation measures that are typically applied to quarries and landfills can readily achieve acceptable levels of dust discharge potentially occurring at the site.

The SMP prepared for the site details activities, mitigation and actions required to ensure appropriate management and mitigation measures are carried out to minimise any potential for offsite air quality effects (including dust) will be implemented onsite.

Overall, the Project will result in less than minor nuisance effects with respect to noise and dust.

13.3 Water Colour and Clarity

Vehicle access to the site is currently via a ford crossing within the bed of the Karetu River. Existing operations when fully operating result in up to 10 vehicle movements per day disturbing the bed of the Karetu River and giving rise to potential temporary increases in TSS and resultant reduction to water colour and clarity.

Stormwater discharges to the river will be mitigated via source controls and the SRP's with suspended solid limits. Any liner leakage that mixes with groundwater in the underlying permeable rock and then emerging in surface water will not have any impacts on water colour and clarity.

In combination with the proposed bridge crossing and implementation of source controls and erosion sediment controls (e.g. SRPs) it is expected that both sediment disturbance and loads from the site will be mitigated.

Overall impacts from the project on water colour and clarity in the Karetu River is expected to be less than minor.

13.4 Summary

Overall, the effect on amenity and recreation will be less than minor.

14 Containment Failure Risks

The landfill design and potential level of effects have been informed by several technical assessments and modelling. The key risk effect is associated with the potential for a different level of containment failure (i.e. leachate) due to a range of issues.

A Containment Risk Assessment has been undertaken which assesses the containment losses and failure mechanisms, the potential effects and corresponding design mitigation.

The possible failure mechanisms considered broadly include:

- Liner tearing or poor contact (manufacturing defect or poor construction)
- System failure or lack of intended maintenance
- Disposal of waste not meeting the WAC
- Seismic displacement resulting in a liner failure or landslide.

The preliminary design mitigation of these possible failure scenarios, and inherent detailed design process and quality assurance is set out in the Containment Risk Assessment, which will be incorporated into proposed conditions.

Overall, it is considered that the range of risks associated with the managed fill containment are low and have been demonstrated to be minor.