15 December 2023

Environment Canterbury
Attn: James Ling – Consents Planner
PO Box 325
Christchurch 8140

Via Email: james.ling@ecan.govt.nz

Kia ora James,

Request for Further Information - CRC241000, CRC241001 and CRC241002

I refer to:

1. Christine Butler's letter of 15th November 2023 to Boffa Miskell requesting further information in relation to the above application; and
2. Your email of 5th December 2023 granting an extension of time from 6th December 2023 to 15th December 2023 to respond to the request.

Please find below responses to your requests.

1. **Description of the Proposal**

a. Please provide clarification on how the Applicant proposes to avoid unintended waste entering the site, including fly tipping?

A 3m high bund will be progressively constructed along Aylesbury Road. Furthermore, the Site will be fully fenced with a gate that will be locked when the quarry is not operating. All vehicles entering the site will have to pass the site office. It is not intended to allow members of the public to bring waste material to the site and fly tipping will be precluded by the security measures described.

b. Please provide a backfill management plan

We apologise, a Draft Soil Management Plan prepared by PDP was missed from the appendices provided to Environment Canterbury ('ECan') in the Dropbox folder. We have attached it to this response (*Attachment 1*) as it addresses the management of backfill.

c. Please provide a Site Rehabilitation Management Plan

Site rehabilitation is partly addressed by the Draft Soil Management Plan as well as the

Landscape Strategy on page 17 of the Landscape Graphic Supplement and Figure 1 in the Plan Set in Appendix 5.

d. **Please provide clarity of whether ongoing groundwater monitoring is to be undertaken, and**
e. **If groundwater monitoring is to be undertaken, please provide a detailed description of the proposed groundwater monitoring and response plan.**

Background groundwater quality monitoring will begin in January 2024. This will be undertaken in accordance with the attached Proposed Groundwater Monitoring and Response Plan (*Attachment 2*).

2. HAIL sites

a. **Please provide DSI reports for the identified HAIL sites; and**
b. **Please provide a robust SMP fully addressing how the HAIL sites will be progressively managed.**

Having taken advice from our contaminated land advisors PDP, we still consider that the DSIs should be undertaken progressively prior to each stage of quarrying commencing, so we will get a time-sensitive picture of the areas of contamination, their nature and extent. If we complete DSIs now, we will also have to complete another DSI before we commence each stage of quarrying as the land will in the meantime continue to operate as a farm (i.e. there is potential for on-going and new fertiliser storage, offal pits and fuel storage etc).

It is worth noting that the progressive quarrying of the quarry, coupled with the size of the wider site, means the first of the three DSI areas will not be reached for 15-20 years with the remaining two areas not reached for 40-50 years.

Furthermore, we are not convinced that the HAIL areas pose a '*high risk because they were not characterised, or the extents were not delineated*' as stated in the s92 request. They are HAIL activities typically associated with normal farming operations and the areas are shown on the figure provided in the PDP contaminated land report. The risks associated with these HAIL activities are not considered by PDP to be high and their risks can be easily addressed prior to starting each stage.

Any soil impacts would be localised and dealt with prior to starting earthworks. Groundwater migration is the only pathway that could cross over stage boundaries, and this could be addressed through installation of groundwater monitoring wells and a monitoring programme, which would be undertaken as part of the wider quarrying activity – refer to the Proposed Groundwater Monitoring and Response Plan (*Attachment 2*).

The management of the HAIL sites will also be addressed in the draft conditions of consent to be provided to ECan after the submission period has closed.

3. Discharge to Air

a. Please provide detailed responses to all the comments throughout the attached Air Quality Assessment Review.

Please refer to the attached response prepared by PDP.

We consider that this addresses in full, all the matters set out in the s92 request for further information. If you have any queries, please do not hesitate to contact me.

Kind regards,

Dan McGregor
Senior Project and Resource Advisor
Winstone Aggregates / Burnham 2020 Ltd
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ATTACHMENT 1 – Draft Soil Management Plan

Draft Soil Management Plan

Prepared for

Burnham 2020 Ltd

July 2023

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Quality Control Sheet

TITLE	Soil Management Plan – Burnham Farm
CLIENT	Burnham 2020 Ltd
VERSION	Final
ISSUE DATE	July 2023
JOB REFERENCE	C04096500
SOURCE FILE(S)	C04096500_Draft soil management plan.docx

DOCUMENT CONTRIBUTORS

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SIGNATURE

Peter Callander

Limitations:

This report has been prepared by Pattle Delamore Partners Limited (PDP) on the basis of information provided by Burnham 2020 Ltd and others (not directly contracted by PDP for the work), including Environment Canterbury. PDP has not independently verified the provided information and has relied upon it being accurate and sufficient for use by PDP in preparing the report. PDP accepts no responsibility for errors or omissions in, or the currency or sufficiency of, the provided information.

This report has been prepared by PDP on the specific instructions of Burnham 2020 Ltd for the limited purposes described in the report. PDP accepts no liability if the report is used for a different purpose or if it is used or relied on by any other person. Any such use or reliance will be solely at their own risk.

Executive Summary

This document is intended to be used by Winstone Aggregates for the management of soils on Burnham Farm that are affected by their quarrying activity.

The purpose of this report is to provide a description of the soil management strategy to rehabilitate the soils to an equivalent standard following gravel extraction so as to:

a) Ensure that the removal, management, and placement of soil avoids or minimises impacts on the soil properties prior to and following placement, and that the re-established soil retains the versatility of the original soil on the site, and

b) Ensure that soil management activities avoid potential adverse effects on the surrounding environment.

Key points

- Soil placement is the single most important operation in the restoration process. The soil must be placed under optimal conditions to specified depths on a platform graded to design levels.
- The aim of the soil rehabilitation is to provide a soil that has similar or better (less stones) physical properties as the soil before quarrying. These physical properties include: well drained, moderate over rapid permeability suitable for irrigated pasture production.
- The reinstated soil will have at least 200mm depth of subsoil and at least 200mm depth of topsoil providing a soil profile depth of at least 400 mm with no significant barriers to plant roots.
- The site is to be progressively stabilised i.e.; each active stage must be remediated as the excavation commences for the next stage. The area of irrigation at the bottom of the pit will also progressively expand.
- Within three years following full establishment of the pasture vegetation, the soil should be capable of production similar to land that has been cultivated for cropping and re-grassed.
- A monitoring programme will be included as part of this plan and if the above are not achieved the Soil Management Plan will be adapted.

This soil management plan is intended to be a living document that will be updated as knowledge of the site increases and as technologies and practices evolve. Annual soil quality (soil condition) monitoring is recommended for the newly rehabilitated soil areas, to ensure soil quality is maintained for agricultural production. This information from this monitoring will be used to adapt this Soil Management Plan if needed.

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1.0 Soil Management Plan

1.1 Introduction

This soil management plan is intended to be a living document that will be updated as knowledge of the site increases and as technologies and practices evolve.

The purpose of the Soil Management Plan is to:

a) Ensure that the removal, management, and placement of soil avoids or minimises impacts on the soil properties prior to and following placement, and that the re-established soil retains or exceeds the soil versatility of the original soil on the site, and

b) ensure that soil management activities avoid potential adverse effects on the surrounding environment.

1.2 Key Concepts for Restoration

Key to the effective reestablishment of the soil on the gravel extraction site are careful pre-planning, adherence to the guidance provided in the Soil Management Plan, and the training of all staff involved.

The main on-ground factors that achieve successful land restoration and retain productive value of the land are preparation of the existing surface to ensure it has the appropriate contour, and careful removal and placement of the soil material and silt so they are not degraded or compacted.

Soil carbon is critical for soil health, it feeds the soil biology and helps retain soil moisture and nutrients. Average soil carbon stocks in New Zealand's agricultural soils are estimated at about 100 tonnes per hectare in the top 300mm. It is important that the topsoil is retained and applied back onto the rehabilitated areas, particularly as the reinstated subsoil (washed silt, pea gravel and other products) will be very low in soil carbon.

The reinstated soil will have at least 200mm depth of subsoil and at least 200mm depth of topsoil providing a soil profile depth of at least 400 mm with no significant barriers to plant roots.

Under the lease agreement with the farmer running the stock on the property, the soil Olsen P will need to be returned to the levels prior to quarrying. Pasture soil testing is normally to 60 cm. The reinstated subsoil will have very low levels of nutrients, and this is likely to make up 50 percent of the top 60cm of soil, therefore fertiliser will be required before or during pasture establishment.

Pasture is the best vegetation for preparing the soil for future agricultural use. The fine roots of pasture create soil structure and grow into the new subsoil to coat cracks and pores. Generally, after three years in pasture (post quarrying) and with careful stock management to avoid compaction, the new soil is suitable for a range of agricultural uses. The addition of deeper rooting pasture species for example plantain and chicory will help to increase the soil porosity and add organic material.

Temporary or permanent irrigation will be reinstalled on the rehabilitated areas, and pasture will be established as soon as possible after the soils are reinstated. Limitations for arable use should remain the same as the current land-use as the majority of the site will have slopes that are less than five degrees and be irrigated.

1.3 Gravel Extraction Staging

The site will be extracted and rehabilitated in stages. Timeframes are estimated based on projected demand and are subject to change:

• Years 1-6. Initial extraction. These areas will be used to set up the processing plant area, stockyard, and amenities for the life of the quarry – as a result they will not be rehabilitated until the site's end of life.

• Years 7-10. Extraction towards the SE corner of the site. From the start of this stage the quarry will be progressively rehabilitated.

• Years 10+. Extraction and rehabilitation in a clockwise direction around pivot #1, then into pivot #2 and finally pivot #3, as shown in Figure 1. Areas between and beside pivots will be extracted and rehabilitated with each move into new areas enabling reinstatement behind the leading edge.

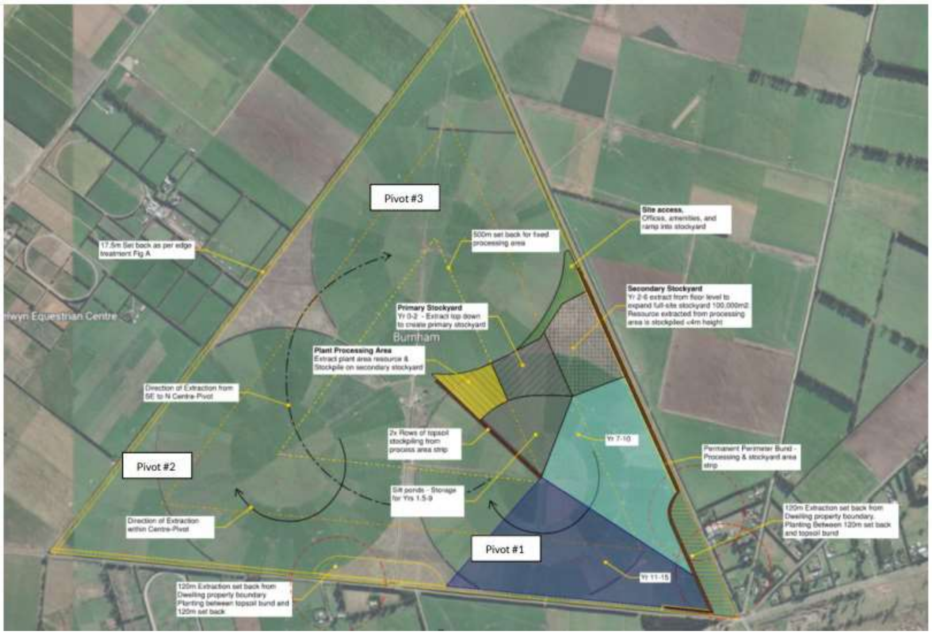

Figure 1: Quarry layout

The gravel extraction will be staged with removal of topsoil and subsoil (referred to as overburden in other reports for the site) undertaken incrementally. Staging the gravel extraction reduces the short term loss of productive land on the site and reduces the volume of soil requiring stockpiling and the time the soil is stockpiled. This in turn reduces the potential for soil degradation and soil loss (by overland flow runoff or wind).

1.3.1 Soil Removal and Placement

Before any soil removal (also referred to as lifting or stripping) activities are carried out, existing vegetation should be killed or reduced through mowing or grazing, to reduce green vegetative materials being incorporated into the soil that will be stockpiled and used to rehabilitate the site.

All topsoil material must be removed from all land prior to the commencement of any trafficking of the area and stockpiled in a secure predesignated area or applied directly to the area being rehabilitated. Where practicable, subsoil and topsoil layers are to be kept separate to enhance utilisation of this material for future rehabilitation works.

Topsoil should be recovered to the full width of the strip without mixing with the underlying subsoil (not more than 20% of the lower horizon should be exposed at the layer junction within the strip). The thickness and identification of the horizon junction must be verified before and during stripping. The full thickness of the topsoil horizon should be stripped progressively along the strip before the underlying subsoil horizon.

Topsoil is removed using an excavator and trucks or it could be removed using scrapers. The early face extraction will be excavators and later extraction is likely to include a loader conveyor. Extreme care needs to be taken to avoid shearing and compressive force on the soil (i.e., the inherent structure of the topsoil should be maintained as much as possible). New technology is likely to aid extraction but this maybe more than ten years away.

Light track-driven machinery (e.g., tracked excavators and dozers) are required for the soil removal and placement to avoid the considerable compaction and shearing of soil by large heavy rubber tyred machines (this does not preclude the use of cropping machinery, as long as any machinery does not have a detrimental compacting effect on the soil). Alternatively, flotation tyred machines could be used. Short hauls should be aimed for with minimal handling of all soil materials. This can be achieved using a designated centralised storage and service area.

All areas that are not being actively quarried will be maintained in vegetation.

There is approximately 400mm of top soils and horizon layers above the gravels and the gravels have a stone size of up to 150mm. Some of these stones are present in the topsoil and will remain in the rehabilitated soil. Trees and vegetation including large root systems, timber from the historical pine tree plantation, old fences, large stones (>150mm diameter), debris, and all obstructions of whatever kind, whether natural or artificial, encountered within the area of the works need to be removed and disposed of on-site or transported off site to an approved fill.

<u>Avoiding soil compaction</u>

For a soil to be returned to productive agricultural use, compaction needs to be minimised. Compacted soils have less porosity and hence lower drainage and aeration, lower plant available water (more prone to drought) and more resistant to plant root growth. To minimise compaction[1]:

- The dump trucks should normally only operate on the 'basal'/non-soil layer, and their wheels must not run on to the soil layers;
- The excavator should normally operate on the topsoil layer;
- The adoption of a bed/strip system avoids the need for the trucks to travel on the soil layers;
- Soil moisture is between 50% and 75% of field capacity when moved.
- Cultivation should aim to minimise the number of passes over the site to avoid soil compaction.
- If possible, cultivation and levelling of the soil surface should be along the contour.

[1] Good Practice Guide for Handling Soils in Mineral Workings Part One: Introduction July 2021 Institute of Quarrying

As an overarching principle, the handling of the topsoil material should only be undertaken when soil moisture is between 50 – 75% of the field capacity to avoid soil compaction (soil too wet) or loss of soil by wind erosion (soil too dry). Compaction is the main risk to being able to return the soil to a usable condition. Soil moisture levels can be determined by either the probes/tapes installed in the existing pasture areas on the property or using the soil plasticity test[2].

1.3.2 Soil Storage

1.3.2.1 Phase 1 (Years 1 - 6)

These areas will be used to set up the processing plant area, stockyard, and amenities for the life of the quarry – as a result they will not be rehabilitated until the site's end of life Initially topsoil and overburden will be used to create permanent bunding. Excess topsoil stripped from the processing and stockpile areas will be stockpiled in windrows along the boundary of the first extraction area. The topsoil should be stored in separate stockpiles from any soil taken from lower down in the profile (referred to as subsoil).

1.3.2.2 Phase 2 (Years 7 – 10 start of rehabilitation)

Where possible topsoil will be moved directly from the areas that are about to be quarried to the rehabilitated areas to avoid double handling and storage of topsoil. Where the soils are to be directly replaced (without storage in mounds), the initial strip of the topsoil will have to be stored temporarily to access the lower subsoil layer and enable the sequential movement of materials. The stored topsoil material would normally be placed on top of the subsoil layer.

If there is additional topsoil, areas that are suitable for the temporary stockpiling of topsoil materials need to be identified as part of pre-planning and scheduling. Stockpiles should be kept for as short a period as possible to minimise loss of soil structure and soil biology. Soils in the temporary stockpile areas will also need to be protected from compaction, degradation, and soil loss (as dust).

Monitoring of stockpiles will be required to ensure wind is not creating dust plumes. This can be managed by wetting the soil surface using a water cart or sprinklers. For any longer term topsoil stockpiles, the stockpile should be covered or vegetated with grass to reduce soil damage and loss caused by wind and rain.

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[2] A useful field method of deciding whether a soil is sufficiently dry to be moved safely is the spade test: plasticity is determined by hand-rolling a sample from the relevant horizon on the back of a spade to see if a thread of 3 mm diameter can be formed without crumbling. If a thread can be formed the soil is too wet for working (Ramsay, 1986).

Where possible soil used to re-establish soil structure on rehabilitated extraction faces will be used from nearby bunds, to minimise material handling. However, any appropriate soils may be used provided that the re-established soil structure is equivalent to the soil structure on the site before quarry activities occurred.

1.3.3 Phase 3 (Years 10+)

Extraction and rehabilitation in a clockwise direction around pivot number 1, then into pivot 2 and finally pivot 3. Areas between and beside pivots will be extracted and rehabilitated as the quarry moves past them. (Figure 1)

1.4 Soil Rehabilitation

1.4.1 Preparation of the Receiving Surface

The receiving soil surface should be levelled to provide an even surface. Light track-driven machinery (e.g., tracked excavators and dozers) or flotation tyred machinery should be used to prepare the receiving surface to minimise soil compaction.

Cultivation should avoid creating concentrated areas of compaction (e.g., wheel track lines up and down the slope), and aim to minimise the number of passes over the site.

Soil removal and placement is not to take place during heavy rainfall (50mm in 24 hours) or if there is ponding of rainfall.

1.4.2 Boundary slope

Quarry extraction cut faces will be pulled back to a maximum 1:2 batter slope, the soil structure reinstated, and vegetated with native plantings, which will be fenced to exclude stock. Temporary irrigation may be provided over these areas to establish plantings. Vegetation is intended to provide an ‘ecological’ ring around the perimeter of the Site.

1.4.3 Subsoil

The subsoil is permitted up to within 200mm of the final land surface and a minimum soil thickness (topsoil and subsoil) of 400mm is required over the quarry base. The final re-established subsoil profile should be predominantly fine matrix soil materials, free of rocks and other coarse materials. The depth of subsoil will vary across the site. The deeper the quarry the more silt will be available for rehabilitation, therefore the depth of the subsoil will be greater in the northern corner where groundwater is deeper.

The following properties are required for the subsoil material:

- Silts either in slurry form or placed using dump trucks and earthworks machinery.

- The subsoil may include organic forestry residue and dead pasture material that was in the soil from the extraction site and stockpiled sub soil. This site came out of forestry in 2008/2009 and some forestry residues remain, large logs/roots will be removed.
- The subsoil material will not contain rocks.
- The subsoil material can include up to 35% by volume of gravels (moderately gravelly)[3] of 6-20 mm diameter[4] with fine soil matrix materials. The current subsoil predominately has 10 % or less stones in the top 400mm with about 10% of the soil having up to 35% stones. The intention is to replicate this in the rehabilitated soil with the majority of the soil having 10% or less stones.
- In areas where the depth of the rehabilitated soil is deeper than 400mm additional small stones and gravel can be added as a layer over the base if there is no alternative use for them.

1.4.4 Topsoil properties

The topsoil should occupy the upper 200-400 mm of the final re-established soil profile. This is to ensure the final re-established soil profile has a topsoil that has organic matter, nutrients, and fine matrix soil materials similar to the original soil profile.

The following properties are recommended for the topsoil material:

- Topsoil removed from the extraction site and stockpiled should be used.
- Coarse organic materials are not permitted in the topsoil (tree roots and forestry residues).
- The topsoil may include up to 10% (by volume) of organic material provided it is thoroughly mixed with the other soil material. If the topsoil is stripped from one area and immediately applied to a rehabilitation zone it may contain organic material from the pasture.
- The topsoil material may have some stones and gravels present in the topsoil that was stockpiled/removed from the extraction site or from contamination from the subsoil or storage of silt, however no stones/gravel should be intentionally added.

[3] Milne JDG, Clayden B, Singleton PL, Wilson AD. 1995. Soil Description Handbook. Lincoln, New Zealand, Manaaki Whenua Press. 157p. (p46).

[4] Milne JDG, Clayden B, Singleton PL, Wilson AD. 1995. Soil Description Handbook. Lincoln, New Zealand, Manaaki Whenua Press. 157p. (p45).

The restored topsoil and sub soil combined should ideally achieve the following outcomes:

i. A minimum of 400 mm of plant growth medium with little or no limitations to root penetration.

ii. Soil strength to be such that there is no serious limitation to cultivation and movement of machinery, i.e., no visually obvious contrasting compacted layers within the restored soil profile, especially between the subsoil and the topsoil, and no visually obvious compaction or sealing between the topsoil and subsoil.

iii. Be at least moderately well or well drained where the inherent soil drainage characteristics of the land allow.

1.5 Sequence of soil placement

Soil placement is the single most important operation in the restoration process. The soil must be placed under optimal conditions to specified depths on a platform graded to design levels.

The platform design determines the future landform and must consider materials available, groundwater levels, erosion hazard, slope criteria for restored land use, aspect, microclimate, aesthetics, and most importantly, drainage (Ramsay, 1986). Final slopes of five or less degrees are considered optimal for cropping and horticultural purposes. Due to the scale of the property the new floor will have a less than five degree slope.

Once the shape of the existing land surface has been attained, the soil materials need to be placed using light track-driven machinery or flotation tyred machinery.

Between the placed subsoil and topsoil, the surface needs to be ripped along the contour (if any) or otherwise treated to reduce any subsurface compaction and eliminate slippage surfaces and root restricting or water perching layers. Sharp interfaces between texturally contrasting materials must be avoided.

Topsoil placement operations need to be carried out when the soil materials are in a dry condition. Vehicular traffic and soil handling should be kept to a minimum and all soil compaction needs to be rectified by appropriate tillage/ripping treatments prior to establishment of a plant cover. Special care is required to avoid continually using the same vehicle tracks when redistributing the soil materials, or if this is not possible then the excessively tracked areas should be ripped.

The topsoil material needs to be distributed in such a way as to achieve an approximately uniform stable thickness over the whole area.

Any exposed soil surfaces require protection from wind erosion. Light surface wetting of the soil topsoil via irrigation is an acceptable method. All areas that are not being actively quarried will be maintained in vegetation.

1.6 Irrigation and Pasture Establishment

The farm currently is fully irrigated by three centre pivots, single span towable pivots and set sprinklers. The existing centre pivots will remain in place for as long as possible. Irrigation will be installed at the bottom of the pit prior to the soil and grass rehabilitation.

The newly formed boundary slopes will not be irrigated by centre pivots' end guns to avoid topsoil being washed off. Low application rate irrigation (either temporary or permanent) will be installed to establish and maintain newly sown pasture.

The irrigation water is available from CPWL from September to April, this water will extend the timeframe when soil conditions are suitable for rehabilitation and allow new grass to be sown as soon as possible following the topsoil placement. This will prevent dust and soil cracking.

The site is to be progressively stabilised i.e.; each active stage must be remediated as the excavation commences for the next stage. The area of irrigation at the bottom of the pit will also progressively expand.

1.7 Soil health

The aim of the restoration is to have a healthy well-functioning soil. There are a number of indicators for a healthy soil including good soil structure, appropriate water storage and drainage, readily available plant nutrients and a populations of earthworms and microorganisms.

Storage of topsoil in bunds over a number of years is likely to reduce the soil biology. Topsoil that is not required for bund development will require storage in Phase 1. The introduction of specific microorganisms into soils has been performed for many decades. There is a range of commercially available products that enhance the soil biology and should aid the soil rehabilitation process if soils do need to be stored. The use of these products will be assessed before the first stage is rehabilitated.

From Phase 2 onwards soil will be moved from the areas about to be quarried to the rehabilitated site as soon as possible, minimising the storage time and protecting the soil biology.

1.8 Nutrient and Pasture Management after Soil Rehabilitation

Following the placement of the new soil profile, a nutrient management specialist should advise on fertiliser and lime applications, as determined by soil tests, to ensure the Olsen P and soil pH are the similar to before extraction.

Phosphorus leaching can occur after phosphate fertiliser is applied to pasture and crops. To reduce the risk of P loss the farm will use the following good management practices:

- The farm will have a soil testing and monitoring programme to ensure phosphate fertiliser is applied at optimal rates to minimise leaching.
- Only irrigate to meet the moisture needs of the plant and avoiding drainage. Varying the depth of irrigation on a daily basis can minimise the quantity of drainage, which are minimised further by adjusting applications according to weather forecasts. Compared to uniform rate irrigation, the use of variable depth has been shown to decrease P losses by up to 80% (McDowell, 2017)
- The timing of fertiliser or effluent P application to soil can influence P loss, mainly because of the effect soil moisture can have on the propensity for the generation of P leaching. P fertiliser will not be applied to soil at or close to field capacity or if heavy rain is predicted, or in the months of May to September included.
- The use of lower water soluble P fertilisers if higher rates of phosphate fertiliser are required.
- The rehabilitated pasture area will use deeper rooting pasture species to take up phosphorous in the subsoil.

Suitable pasture species for the local conditions should also be sown. Pasture roots help create soil structure and penetrate the subsoil. This helps ensure the cracks needed for drainage and air supply in the soil are kept open. Ideally deeper rooting species such as plantain and chicory should be included with a mixture of grass and clover species to help build soil structure.

Re-vegetation to pasture should be undertaken as soon as practicable after topsoil placement. This will minimise possible deterioration of soil structure and development of erosion problems on bare cultivated soils. Weather permitting, seeding should occur within two weeks following topsoil placement.

To improve the soil structure a mixture of pasture species is recommended, including grasses, clovers and deeper rooting plantain and chicory.

Pasture establishment may be required outside the irrigation season to minimise dust If pasture is established in winter months cool season active species will be used (for example Italian Ryegrass) and permanent species may need to be drilled into the area later.

To encourage the rapid recovery of the soil structure, only light weight stock such as sheep and Calves/Rising 1 year cattle will be grazed on the pastures and no stock grazed in July and August in the first year after sowing the new pastures. A management system which promotes grass harvesting (hay and/or silage) over the first two years after rehabilitation is to be encouraged. This helps prevent recompacting the soil. Across the grazed area of the property the stocking rate will remain at the same level as the current stocking. Good management of wet soil to avoid degradation of soil structure will be important, especially managing stock movement on the soils during wet periods when the soil is saturated and susceptible to pugging and compaction.

Areas of obviously impeded drainage, which show by way of surface ponding, should be examined to establish if any moisture restricting layer exists and appropriate ripping or subsurface aeration undertaken to shatter such compacted layers.

1.9 Reducing dust

Soil management related potential for dust is associated with soil removal and placement, soil storage, transport, and post placement management. Mitigations are provided in the dust mitigation section of the Air Quality Assessment for storage and transport. This property has existing irrigation and will re-establish irrigation for the final placement of soil and to establish pasture, reducing the risk of dust problems.

The existing shelter belts will be retained, and any gaps planted and there will be a 120m setback, planted in native vegetation, from neighbouring housing.

Table 1: Summary of mitigations to reduce dust during soil removal and placement
Soil removal and placement
All exposed areas are monitored, stabilised, and wetted to ensure dust is not objectionable beyond the property boundary.
Irrigation will be used in dry conditions to reduce the dust levels before removal and after soil placement (rehabilitation)
Areas are incrementally backfilled at regular intervals and re-grassed with suitable grass species as soon as possible, or the soil stabilised until ready to be re-grassed. This will limit potential for dust generation by minimising exposed surfaces.
Post placement management
Revegetation using grass to prevent bare soil and sheet (surface) erosion.
Addition of nutrients (fertiliser) to increase fertility and promote and maintain even revegetation and to return the soil fertility to the levels prior to quarrying.
Soil moisture management via irrigation and soil moisture monitoring to promote and maintain revegetation.

2.0 Summary of Soil Disturbance Activities

Any soil disturbance (as part of any activity) is likely to result in disruption to soil properties. Soil disturbance or disruption can occur with any land use practice (e.g., cultivation for cropping). Adherence to the Soil Management Plan (most importantly during the removal and placement of the subsoil and topsoil materials) will ensure the effects are minimised and are no more than the soil disturbance effects resulting from land use practices such as cultivation for cropping, forest harvesting and intensive pastoral use.

The effects on soil properties are likely to be predominantly soil physical effects related to soil compaction, loss of soil structure and degradation of soil aggregates during removal, transport and storage, and compaction of the soil material during placement. In turn, these can lead to impeded soil drainage (reducing air and water flow pathways in the soil), reduced soil water storage capacity, and reduced soil pores for biological activity. Soil fertility is not considered to be of primary concern as this can be remedied with the addition of fertiliser. If the steps set out in the Soil Management Plan, summarised in Table 2 below are followed, then effects on soil properties following restoration will be minimised.

A summary of the key aspects of the soil management plan is provided in the table below.

Table 2: Summary of Soil Disturbance Activities
Soil Removal
Where practicable, subsoil and topsoil layers are to be kept separate to enhance utilisation of this material for future rehabilitation works.
Handling of the topsoil material when soil moisture is 50 -75% of field capacity. This helps maintain soil aggregates and avoid soil smearing and compaction. Soil moisture content can be determined by either soil moisture probes/tapes or hand held device or plasticity test (hand rounding soil to see if a thread of 3 mm diameter can be formed without crumbling or is too wet to form easily)
This site came out of forestry in 2008/2009 and some forestry residues remain, large logs/roots will be removed.
Soil placement
Handling of the topsoil material when soil moisture is 50 -75% of field capacity. This helps maintain soil aggregates and avoid soil smearing and compaction.
Sequential replacement of the soil material to approximate the original subsoil and topsoil. This will maintain air and water flow pathways similar to an undisturbed soil profile.

Table 2: Summary of Soil Disturbance Activities
Minimise soil handling and where possible in phase 2 onwards move soil directly from the newly stripped areas to the area to be rehabilitated.
The dump trucks should operate on the 'basal'/non-soil layer, and their wheels must not run on to the soil layers The excavator should operate on the topsoil layer The adoption of a bed/strip system avoids the need for the trucks to travel on the soil layers
Soil storage
If soil needs to be stored, minimise the time stored to protect the soil structure and soil biology.
Vegetation of long term soil stockpiles with grass to protect from wind and water (rain).
Transport
Short hauls should be aimed for with minimal handling of all soil materials to help retain soil aggregates.
Whether possible the transport of soil using vehicles is minimised, by using conveyors and by locating silt ponds and storage areas close to where the silt/soil will be used for rehabilitation.
Preparation of receiving surface
The receiving soil surface should be levelled to provide as even a surface as is possible. .
Use of light track-driven machinery or flotation tyred machinery should be used to minimise soil compaction.
Cultivation for pasture establishment should avoid creating concentrated areas of compaction (e.g., wheel track lines up and down the slope).
Cultivation should aim to minimise the number of passes over the site to avoid soil compaction.
Fill and soil properties
Coarse organic materials should be avoided or removed from the soil material before placement.
If soil is stored minimise the inclusion of organic material (<10% by volume) to minimise anaerobic conditions in the soil from decomposition.

Table 2: Summary of Soil Disturbance Activities
Soil placement
Sequential placement of fill, subsoil, and topsoil to approximate an undisturbed soil profile
Use of light track-driven machinery for soil placement to minimise soil compaction and degradation of soil aggregates.
Post placement management
Revegetation using grass to develop soil structure. This will increase the ability of the soil to store air and water, improve moisture movement and improve soil biological activity.
Addition of nutrients (fertiliser) to increase fertility and promote and maintain even revegetation.
Soil moisture management via irrigation to promote and maintain revegetation.

3.0 Soil Management Training

Soil management training of all staff involved, and activities monitoring is undertaken to ensure the effective reestablishment of the soil on the gravel extraction site.

3.1 Soil removal

Operator performance in the lifting phase is important, and on-site guidance on soil horizon recognition and on machine routing, is required.

3.2 Soil placement

Operator performance in the placement phase is crucial, and additional details will be provided in the Soil Management Plan

The staged and incremental reinstatement of the excavated area allows for iterative checking and refinement of placement procedures to ensure the quality of the replaced soil profile. Annual inspection in the first three years following the start of the Phase 2, of by a Soil Scientist or Rural Professional.

Assessment should include (but is not limited to) the following:

- Visual assessment of the placed soil profile, examining for abrupt horizon boundaries, compacted layers, smeared layers, visual evidence of restricted water movement. Additionally, confirmation of the presence and % content of gravels and soil colour (using a Munsell soil colour chart) should be recorded for the fill (if feasible), the subsoil, and topsoil.
- Topsoil and subsoil samples for soil chemical analysis.

4.0 Monitoring and Recording

Monitoring is undertaken to ensure the effective reestablishment of the soil on the gravel extraction site.

4.1 Fill and soil material

Fill and soil material details are logged and include:

- Class of material
- Name of supplier
- Name of the transporter
- Vehicle type and registration number
- Weight
- Fill/soil material inspector and approver name(s)
- Date

4.2 Soil storage

Soil storage (soil stockpile) details are logged and include:

- Date stockpiled
- Class of material
- Stockpile maximum height

4.3 Soil placement

Assessment should include (but is not limited to) the following:

- Visual assessment of the placed soil profile, examining for abrupt horizon boundaries, compacted layers, smeared layers, visual evidence of restricted water movement. Additionally, confirmation of the presence and % content of gravels and soil colour (using a Munsell soil colour chart) should be recorded for the fill (if feasible), the subsoil, and topsoil.
- Topsoil and subsoil samples for soil chemical analysis.

4.4 Post placement soil monitoring

Within three years following full establishment of the pasture vegetation, the soil should be capable of production similar to land that has been cultivated for cropping and re-grassed. As the pasture establishes over the first year, soil properties will improve due to the positive impacts of the pasture cover. These will include development of soil aggregates and soil biological activity.

In general, soil properties are likely to change more rapidly in the first few years following re-establishment, and then slow as the soil settles towards longer term equilibrium conditions.

Under established land use, soil quality changes commonly occur over decades depending on the intensity of land use, at which point contemporary land management practices are likely to have a greater impact on the soil rather than the soil property changes associated with the reestablishment of the soil.

Annual soil quality (soil condition) monitoring is recommended for newly rehabilitated soil areas for the first three years following the completion of the rehabilitation areas, to ensure soil quality is maintained for agricultural production. This information from this monitoring will be used to adapt the Soil Management Plan if needed.

The assessment of soil, beyond indicators of soil fertility, provides greater insight into the health of the soil and can help to guide management for improved soil performance. A 'miniVisual Soil Assessment' (VSA) has been adapted for New Zealand farmers and is based on the visual assessment of key soil 'state' and plant 'performance' indicators of soil quality, presented on a score card. VSA has been selected as an appropriate monitoring tool for this site for the following reasons:

- monitors soil structure, turbidity and porosity;
- includes soil biology (earthworm count);
- is simple to do and can be carried out by a farmer or Rural Professional;
- is usually carried out annually in spring for pasture farming.

To allow comparative assessment of the soil quality of the re-established soil following extraction, soil monitoring should include baseline sampling and analysis of the original soils on the site. Additionally, a control site in a paddock on an undisturbed site will be included in ongoing soil monitoring to differentiate between the effects of contemporary land use management and effects associated with the reestablishment of the soil.

Annual monitoring using VSA of selected soil properties in the topsoil and subsoil in the areas rehabilitated within the last three years is planned, from the start of Phase 2.

A detailed soil monitoring schedule/plan should be developed, and assessment undertaken by a suitably qualified person. The following provides guidance for inclusion in a soil monitoring plan.

To allow comparative assessment of the soil quality of the re-established soil following extraction, soil monitoring should include baseline sampling and analysis of the original soils on the site. Additionally, a control site in an adjoining undisturbed site that will not be quarried (suggest under pivot 3 in area that will be last to be quarried) should be included in ongoing soil monitoring to differentiate between the effects of contemporary land use management and effects associated with the reestablishment of the soil.

Initially, annual monitoring of selected soil properties in the topsoil and subsoil following re-establishment is recommended. This should be undertaken by a rural professional for the first three years following re-establishment and then every 3 to 5 years.

The suggested soil properties are commonly used to assess the impacts of land management on soils under a given land use. They should not be considered definitive (i.e., alternative soil properties for monitoring can be considered) but do provide a research based representation of soil chemical, biological and physical condition (soil quality). There are a range of soil properties that could be monitored, Winstone propose to monitor the following:.

Table 3 : Suggested Soil Properties to Monitor

Term	Definition	Target range for Agricultural production	Timing
miniVSA	See score card includes soil biology, soil structure and porosity	Score >3	Spring after rehabilitation
pH*	A measure of the acidity or alkalinity of a soil.	5.5 – 6.3[1]	Before regrassing
Total carbon	A measure of the total amount of all forms (organic and inorganic) of carbon in the soil.	>2.5%	
Anaerobically mineralisable nitrogen	A laboratory measure of the amount of nitrogen that can readily be supplied to plants through the decomposition of soil organic matter. An indicator of soil biological activity.	50 – 250 ug/N/g [1]	
Olsen P[2]	A measure of the amount of phosphorus available for plant and microbial uptake.	20 – 30 and equal or better than before quarrying	Spring before quarrying and after rehabilitation

Table 3 : Suggested Soil Properties to Monitor			
Term	**Definition**	**Target range for Agricultural production**	**Timing**
Bulk density	Bulk density gives a measure of how densely a soil is packed. Soils typically have about half of their volume comprised of voids (pore spaces). If these voids are lost through compaction, bulk density increases.	0.6 - 1.4 Mg/m3	Before regrassing

Notes

1. *Provisional Targets for Soil Quality Indicators in New Zealand*
2. *Required in the lease agreement for the rehabilitated area to be the same as prior to quarrying.*

5.0 References

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Appendix A: Title

Cropping farm soil quality - mini visual soil assessment (miniVSA) method

There are many functional benefits of maintaining or building soil quality. These include improvements in root development, drainage, water holding capacity and reduced runoff risk. Soil quality is positively correlated with yield.

Equipment
Spade, tarpaulin, 2 x clear containers (1-2 L), 2 L water, score sheet, camera (photos are an important tool to compare differences over time).

When to sample
Be consistent with the time of the year that you carry out the assessment. The best time is early spring when there is enough moisture for earthworms to be active. If the soil is very wet, wait for it to drain for a few days.

Where to sample
Select the paddock/s that you want to monitor. Identify two areas in the paddock (avoiding wheel tracks) and an undisturbed area near the paddock (e.g. a grass verge) to carry out the VSA.

Who to sample
Anyone can carry out a MiniVSA to see how soils respond to different stages of the rotation and management decisions BUT results are relative and can only be used for on-farm comparisons (e.g. to compare the same paddock over time or different paddocks on the farm at different stages of the rotation). This test works best when carried out by the same person who can ‘get their eye in’ for the farm.

Observations
- Where in the paddock you have dug the hole.
- How easy was it to dig, were there any hard layers (pans) or visible surface crusting? Use a pocket knife to feel for tightness down the profile.
- If there are roots, how far do they go down? If there is a compacted layer you might see roots grow out at a right angle or just clean stop. Do they have a rhizosheath (a layer of soil and microbes stuck to the root) or are the roots bare?
- Are there any mottles in the top soil (an indication of compaction and/or water logging)?

1. Dig a hole using the farmer spade method (Figure 1) in an undisturbed area of the paddock e.g. a grass verge

Place the soil on a tarp. Record the soil’s texture if you know it. Fine texture (silt and clay) have a greater capacity to hold organic matter than coarse/light (sand) texture soils. Record any general observations (refer to lower left panel).

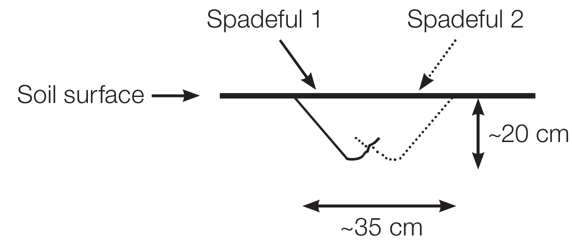

Figure 1. The farmer spade method.

2. Score structure and porosity

Scoring an undisturbed area near the paddock of interest provides a point of comparison as it represents what the soil can look like. Part clods by hand and look for signs of nutty aggregates as opposed to smooth compacted faces. Use clods from the top 5-7 cm when scoring. Put aside a clod from the top 5-7 cm for the turbidity test.

Score based on the description of soil structure and porosity outlined in Table 1 below. Score to half values if appropriate (e.g. 1.5). Refer to Figures 2 and 3 for examples of a high and low score.

Table 1. Soil structure and porosity score guide.

Condition	Description	Score
Good condition	Good distribution of nutty aggregates with no significant clodding.	2
Moderate condition	Soil contains some nutty aggregates but also a significant proportion of coarse firm clods and/or fine non-aggregated soil.	1
Poor condition	Very few nutty aggregates. Soil dominated by coarse compacted, very firm clods and/or fine non-aggregated soil.	0

Figure 2. A high score (2) may look like the sample above.

Figure 3. A low score (0) may look like the sample above.

3. Repeat steps 1 and 2 in the paddock

4. Score turbidity

Partially fill the clear containers with water and gently submerge a clod from the top 5-7 cm from the undisturbed verge in one container and from the hole dug in the paddock in the other container. If there is something growing, use this to lower the clod into the container. Let the soil sit for a minute and observe. If the behavior of the paddock soil is very similar to the undisturbed soil this is a good sign (the undisturbed soil is in the containers to the right in Figure 4)*. The cloudier the water becomes with suspended soil (i.e. becomes turbid), the lower the score. Take a photo and save for future reference. Score based on the descriptions in the turbidity table (Table 2).

Table 2. Turbidity score guide.

Condition	Description	Score
Good condition	Low turbidity. Water remains clear or has a similar turbidity to the undisturbed soil.*	2
Moderate condition	Medium turbidity. Water becomes cloudy but it does not happen immediately (within 1 minute).	1
Poor condition	High turbidity. Water immediately becomes cloudy with suspended matter compared to the undisturbed soil.	0

* Minimal pore spaces due to extreme compaction may also result in low turbidity. Refer to observation notes and score 2 if you suspect low turbidity is a result of compaction (if it is, give a score of 0).

High score **Low score**

Figure 4. Samples showing the difference between a high and low turbidity score.

5. Score earthworms

Sort through the soil sample taken using the farmer spade method (Figure 1) and count the number of earthworms. Look around the roots since earthworms often reside amongst the roots just below the shoot. Score based on Table 3. To convert to earthworms per m^2, multiply the number of earthworms found in the soil sampled using the 'farmer spade method' (Figure 1) by 16.

Table 4. Earthworm score guide.

Total earthworm count	Score
>8	2
4-8	1
2-4	0.5
<2	0

6. Total your scores

On the score sheet add up 1, 2 and 3 for each site in the paddock (aim to do two sites in the paddock) and for the undisturbed soil. Where two sites where scored in the paddock add the totals from site One and Two and divide by 2.

How are you tracking?

5-6	
3-4	
1-2	

Compare contrasting paddocks on the farm, e.g. paddocks with different tillage histories, paddocks that have been winter grazed compared to those that have not, paddocks in a depletive stage of the rotation compared to those in a more restorative stage (i.e. where there has been less soil disturbance and more below ground returns of organic matter from roots).

Cropping farm soil quality - visual soil assessment score sheet

Date:	Assesor:
Paddock name:	
Current crop:	Establishment method:
X crop:	Establishment method:
Soil type:	
Soil texture:	
Soil moisture and seasonal conditions:	

	Site one	Site two	Undisturbed site
General comments *Draw a map of where in the paddock you dig the holes*			
1. Structure and porosity score			
2. Turbidity score			
3. Earthworm score			
Total score per site (add 1, 2 and 3)			
Average score for paddock (Site one plus Site two total score divided by 2)			
Earthworms/m^2	Multiply the number of earthworms found in the soil sampled using the 'farmer spade method' by 16. Site one: Site two:		

ATTACHMENT 2 – Proposed Groundwater Monitoring and Response Plan

Proposed Burnham Quarry - Groundwater Monitoring and Response Plan

- Prepared for

Burnham 2020 Ltd

- November 2023

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Quality Control Sheet

TITLE	Proposed Burnham Quarry – Groundwater Monitoring and Response Plan
CLIENT	Burnham 2020 Ltd
VERSION	Draft
ISSUE DATE	November 2023
JOB REFERENCE	C04096400
SOURCE FILE(S)	C04096400GWMRP.docx

DOCUMENT CONTRIBUTORS

Prepared by

SIGNATURE

Tom Garden Peter Callander

Reviewed and Approved by

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Limitations:

This report has been prepared by Pattle Delamore Partners Limited (PDP) on the basis of information provided by Burnham 2020 Ltd [and] [others (not directly contracted by PDP for the work)], including Environment Canterbury. PDP has not independently verified the provided information and has relied upon it being accurate and sufficient for use by PDP in preparing the report. PDP accepts no responsibility for errors or omissions in, or the currency or sufficiency of, the provided information.

This report has been prepared by PDP on the specific instructions of Burnham 2020 Ltd for the limited purposes described in the report. PDP accepts no liability if the report is used for a different purpose or if it is used or relied on by any other person. Any such use or reliance will be solely at their own risk.

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6.0	Limitations	4

1.0 Introduction

Burnham 2020 Ltd owns the 362 ha property known as Burnham Farm, shown in Figure 1. It proposes to progressively quarry the property to provide aggregate for construction projects. This report has been prepared by Pattle Delamore Partners Ltd, at the request of Burnham 2020 Ltd, to describe the groundwater monitoring that will be undertaken during the operating life of the quarry and the response to that monitoring information.

2.0 Monitoring Bores

Burnham 2020 Ltd have already installed a network of five shallow monitoring bores which are being used to gather background information about groundwater levels at the site. The location of the boreholes is shown in Figure 1 and their details are summarised in Table 1.

Table 1: Details of Shallow On-Site Monitoring Bores

Bore ID	Depth (m bgl[1])	Screened interval (m bgl[1])	Date drilled	Start of transducer record
M36/5785	27.7	24.7 – 27.7	Unknown (prior to 25/10/2006)	14/4/2022
BX23/1342	37.13	7.06 – 37.13	24/8/2022	9/9/2022
BX23/1343	34.19	4.11 – 34.19	30/8/2022	9/9/2022
BX23/1398	23.20	3.20 – 23.2	27/3/2023	10/05/2023
BX23/1399	31.68	3.50 – 31.68	28/3/2023	10/05/2023

Notes:
1. *Metres below ground level.*

Figure 1: Site location, and the location of shallow monitoring bores.

3.0 Groundwater Level Monitoring

The quarry will be operated to keep above the highest historical groundwater level. The on-site monitoring is therefore used to establish a correlation with longer term groundwater levels provided by Environment Canterbury, as reported in Appendix C of Appendix 14 of the AEE (Boffa Miskell 2023). This will be achieved by the following on-site monitoring regime:

- Transducers in all bores initially;
- Reducing to manual monitoring in 3 bores, once a reliable correlation is established to the 2 remaining bores with transducers.
- Annual review of monitoring records and updated correlation to ECan records to ensure that quarry floor levels remain above historical high groundwater levels

The response to this groundwater level monitoring will be to provide a time series plot of the recorded groundwater levels to Environment Canterbury (ECan) in an annual report. These will be compared to an annual survey of the quarry floor elevation to provide information on the separation distance between the quarry floor and groundwater levels. Any modification to future excavation depths will also be provided to ECan based on this monitoring information.

4.0 Groundwater Quality Monitoring

The groundwater quality of the area is typical of the central Canterbury Plains with shallow bores in particular showing the effects from the surrounding agricultural land use resulting in elevated concentrations of nitrate-Nitrogen and occasional detections of *E. coli.* These effects are described in Appendix 14 of the AEE (Boffa Miskell 2023). The quarry activity will represent a change in land-use activity that will potentially alter the groundwater quality in a localised manner, with the most notable change being a reduction in nitrate sources in the quarry area. The post-quarry land-use impacts on groundwater quality may also be different to current activities as it will be occurring closer to the water table than is currently the case.

Therefore, groundwater quality monitoring will be carried out at quarterly intervals from the following bores:

- BX23/1342
- BX23/1343
- BX23/1399
- Either BX23/1398 or M36/5785 depending on which of these 2 bores allows a sample to be collected closest to the water table

The depth to water in each bore shall be measured prior to purging and sampling. Each sample shall be analysed for the following parameters:

- pH (calibrated field meter and lab measurement)
- Electrical conductivity
- Turbidity
- Total Dissolved Solids
- Total Alkalinity
- Free Carbon Dioxide
- Chloride
- Sulphate
- Sodium
- Potassium
- Calcium
- Magnesium
- Total Hardness

- Nitrate-Nitrogen
- Nitrite Nitrogen
- Ammoniacal Nitrogen
- Total Kjeldahl Nitrogen
- Total Nitrogen
- Dissolved Aluminium
- Dissolved Arsenic
- Dissolved Boron
- Dissolved Copper
- Dissolved Iron
- Dissolved Lead
- Dissolved Manganese
- Dissolved Zinc
- Total Coliforms
- Escherichia coliforms

The response to this groundwater quality monitoring will be to provide the monitoring results to Environment Canterbury (ECan) in an annual report. The report will include a commentary on the trends in groundwater quality that are occurring.

5.0 References

Boffa Miskell Limited 2023. *Burnham Farm Limited Renewal of Water Permit – CRC222536: Application for Resource Consent and Assessment of Environmental Effects*. Report prepared by Boffa Miskell Limited for Burnham Farm Limited

6.0 Limitations

This memorandum has been prepared by Pattle Delamore Partners Limited (PDP) on the basis of information provided by Burnham 2020 Limited and others (not directly contracted by PDP for the work) including McMillan Drilling Limited. PDP has not independently verified the provided information and has relied upon it being accurate and sufficient for use by PDP in preparing the memorandum. PDP accepts no responsibility for errors or omissions in, or the currency or sufficiency of, the provided information.

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ATTACHMENT 3 – Response to Air Quality Assessment Review

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solutions for your environment

15 December 2023

Dan McGregor
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Greenlane
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Dear Dan

RESPONSE TO SECTION 92(1) (RMA) INFORMATION REQUEST IN REGARD TO RESOURCE CONSENT CRC241000, CRC241001 & CRC241002

1.0 Introduction

Burnham 2020 Limited (Operated by Winstone Aggregates) (Winstones) has applied to the Canterbury Regional Council (ECan) for a resource consent for discharges to air from its proposed aggregate quarry. ECan has requested additional information in relation to this application and Winstones has engaged Pattle Delamore Partners Limited (PDP) to prepare and respond to the air quality related questions.

The s92 request for further information was presented as questions marked up in a PDF version of the air quality assessment. Given that some of the questions require detailed responses, PDP has responded in the following letter.

2.0 Responses

The ECan questions and PDP's responses are set out below.

Page 1 Question 1 - This is a very large quarry.

While the overall size of the site is large (360 hectares) a maximum of 40 hectares of the site will be actively used for quarry operations (quarry pit, processing plant, silt management, and stockpiles) at any one time. The remainder of the site (~320 hectares) will continue to be used for farming and land will be progressively returned to farming once quarried.

Page 1 Question 2 - This is a very small separation distance. I would recommend increasing this separation distance.

The 100 m separation distance from the closest dwelling is similar to the separation distances operating at other quarries the PDP is aware of. Provided the monitoring and mitigation measures that are described in the air quality assessment are implemented, PDP considers that quarrying activities should be able to be undertaken without causing adverse effects at these locations. It is noted that the quarrying activities will only be within a 100 metres of the relevant properties for a limited duration given the size of the quarry.

Page 2 Question 1 - Which location had the BAM?

The BAM was located on the eastern boundary of the site at the location shown on Figure 2 of the air quality assessment.

Page 3 Question 1 - Where was the weather station located? What was/is the height of the weather station mast?

The weather station was co-located with the dust monitors on the eastern boundary of the site as shown in Figure 2 of the air quality assessment. The wind sensors are located at a height of approximately 6 metres.

Page 3 Question 2 - Background PM_{10} and $PM_{2.5}$ levels were measured for the Royden Quarry application. The Royden Quarry background levels were generally higher than those measured here. More consistent with the first portion of the Eastern monitoring location. In short, I think the measured background concentrations are a little lower than I would have expected.

PDP has reviewed the background concentrations used in the Royden Quarry application based on a monitoring programme commissioned by ECan around the quarries in the Yaldhurst area. The background dust concentrations for the Royden Quarry application indicated that "*background PM_{10} concentrations vary, can be elevated occasionally, with levels approaching the NES for PM_{10} of 50 µg/m³ (24-hour average). However, $PM_{2.5}$ concentrations remain comparatively low, and are less than half of the WHO guideline of 25 µg/m³ (24-hour average)*". The reported 1-hour average concentrations also indicated that the concentrations were below the Ministry for the Environment dust nuisance trigger value of 150 µg/m³.

There are a number of reasons why dust concentrations may vary between locations, but PDP notes that the data used for the Roydon Quarry assessment is based on data collected at Yaldhurst and while they used a background site from that study, it will still be influenced by the surrounding quarries and therefore would be higher than a true background site. Regardless of this, if the background concentrations used for the Royden Quarry application was adopted for this site, this would not change the conclusions of the assessment.

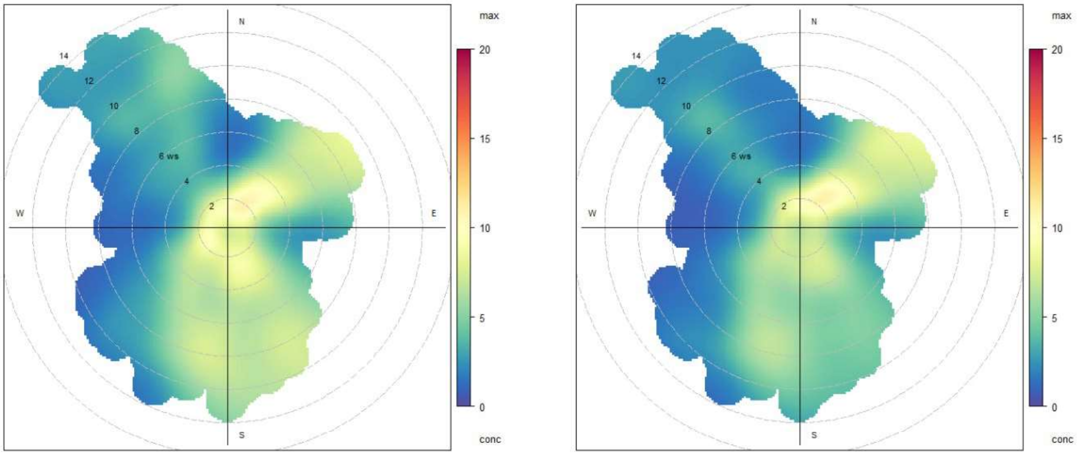
Page 4 Question 1 - There is a big gap in the eastern monitor dataset, what happened there? There is also a big step change in the monitoring data, is this the difference between the BAM and nephelometers?

The BAM which was located at the eastern monitoring site stopped working at the end of October 2022 and was swapped for a nephelometer at the next quarterly service in December, hence the (approximately) two month data gap. The difference in the data is, as suggested, the acknowledged difference in measurements between the BAM and nephelometer technologies.

Page 5 Question 1 – Is this a plot for all of the data from the eastern monitor? Was there a similar pattern in polar plots for the other monitoring sites?

Yes, the polar plot in the assessment contains all of the data from the eastern monitor.

Figure 1below shows the data from the southern and western polar plots. These monitors indicate the highest dust concentrations occur from the northeast at lower wind speeds. They also show elevated concentrations from the south. Given that the eastern monitor is picking up higher concentrations to the northwest and the western monitor is indicating elevated concentrations to the northeast this could indicate the same source however these occur during different windspeeds which may indicate the source is closer to the western dust monitor given the lower wind speeds in which elevated dust concentrations occur.



Southern Dust Monitor   Western Dust Monitor

Figure 1: Polar plots for the Southern and Western Dust Monitors

Page 6 Question 1 - Were the Partisol filters sent to a lab for analysis of RCS content or have you assumed all PM_4 is RCS?

Yes, the Partisol filters were sent to Greencap for Crystalline Silica analysis using X-ray diffraction.

Page 8 Question 1 - As far as I can see the Lincoln weather station does not directly measure evaporation rates. Where did you get this data from? Or did you calculate it based on other measured variables?

The data is a calculation based on rainfall and Penman potential evapotranspiration data from the Lincoln weather station. Using this data, a dry day was assumed when the Penman potential evapotranspiration rate exceed the daily rainfall.

Page 10 Question 1 - Is this September to July of 2019 and 2020? Comparing with the on-site measured data between September to July of 2022 - 2023?

Yes, that is correct. In Figure 8 the windrose from the site is based on September to July of 2022 – 2023 and the windrose using the WRF dataset is based on September to July of 2019 and 2020.

Page 11 Question 1 - What is the mast height of the site AWS? How close was it situated to the boundary hedge?

The mast height is approximately 6 metres and is located approximately 15 metres from the inside of the hedge on the eastern boundary.

Page 11 Question 2 - Based on your Table 2 breakdown of wind speeds the only wind directions which have 0% of winds above 5 m/s are east and southeast winds. (which do not blow towards the nearest receptors. Can you please confirm that your assessment of wind frequencies towards the closest receptors is based on the right wind directions?

In section 2.4 of the air quality assessment there was a typographical error in the text which stated, "*winds from the north northwest to the south have the potential to transport dust to the closest receptors along the southern boundary and southeast corner of the site, and these winds have speeds in excess of 5 m/s between **0 and 5.2** percent of the time*". This should have stated strong winds occur between **0.8 and 7.1** percent of the time. However the frequency of winds used later in the assessment are based on the correct values and therefore there is no change to the conclusions.

Page 11 Comment - Yes, but the standardised wind speed triggers used to assess and control dust emissions are based on wind speeds measured at 10 m above ground level.

Yes, agree.

Page 14 Question 1 - I am particularly concerned about potential adverse dust effects on 'R1" receptors as there is a large number of receptors in this corner and these are downwind during the most frequent high wind speed conditions. I consider that the proposed 100m setback from these receptors is too small. Would the applicant consider increasing this separation distance to 250m to be more consistent with other quarries? Or place a limit on activities which can occur between 250m and 100m of these receptors (i.e. aggregate extracted from this zone can only be undertaken with the use of conveyor belt transfer (no haul roads, restricted operating area to xx ha, handling of overburden only to occur during wetter months of the year, etc)?

While the proposed quarry design has dwellings within 100 metres of quarrying activities PDP considers that with the appropriate mitigation measures in place, dust can effectively be controlled primarily through the use of water and appropriate quarrying techniques. Additionally, the site will operate a continuous dust monitor between the source of dust and the receptors identified as R1. This instrument will be capable of sending out alerts, which means if dust concentrations become elevated additional mitigation or cessation of work can be implemented prior to nuisance effects occurring.

In addition to what was discussed in the air quality assessment, Winstones is willing to implement additional water control in this location in the form of additional watercarts, as well as no handling of overburden within 250 metres of a dwelling during the summer months.

Page 14 Question 2 - Are these separation distances and buffers incorporating a 20m curtilage area around the dwellings? Applying this curtilage is standard practice.

The distances in Table 3 of the Air Quality Assessment do not include the curtilage area around the dwellings.

Page 14 Question 3 - I measured the distance of a dwelling in this direction to be 80m from the site boundary. I think that this closest distance to quarry should be 100m? There is a 'setback' area marked in Figure 11 ...

The figure below shows the distance of this dwelling to the site boundary to be 80m. When including the setback the total distance to the edge of the pit is approximately 167 metres.

Figure 2: Distance of Receptor R2 from the boundary and pit

Page 18 Question 1 - Can you please provide a Figure which shows the location of 'permanent bunds' versus temporary bunds.

The blue line on the eastern boundary in the Figure 3 below indicates the location of the permanent bund. The remainder of the perimeter will be screened via a grassed temporary bund which follows the staging of the quarry. The temporary bund will be continuously moving along the site boundary with material being added to the front of the bund while the end of the bund will be removed, and the material used for rehabilitation. Just to note, in Figure 3 the red line indicates the site boundary ,and the orange line indicates the batter of the quarry pit.

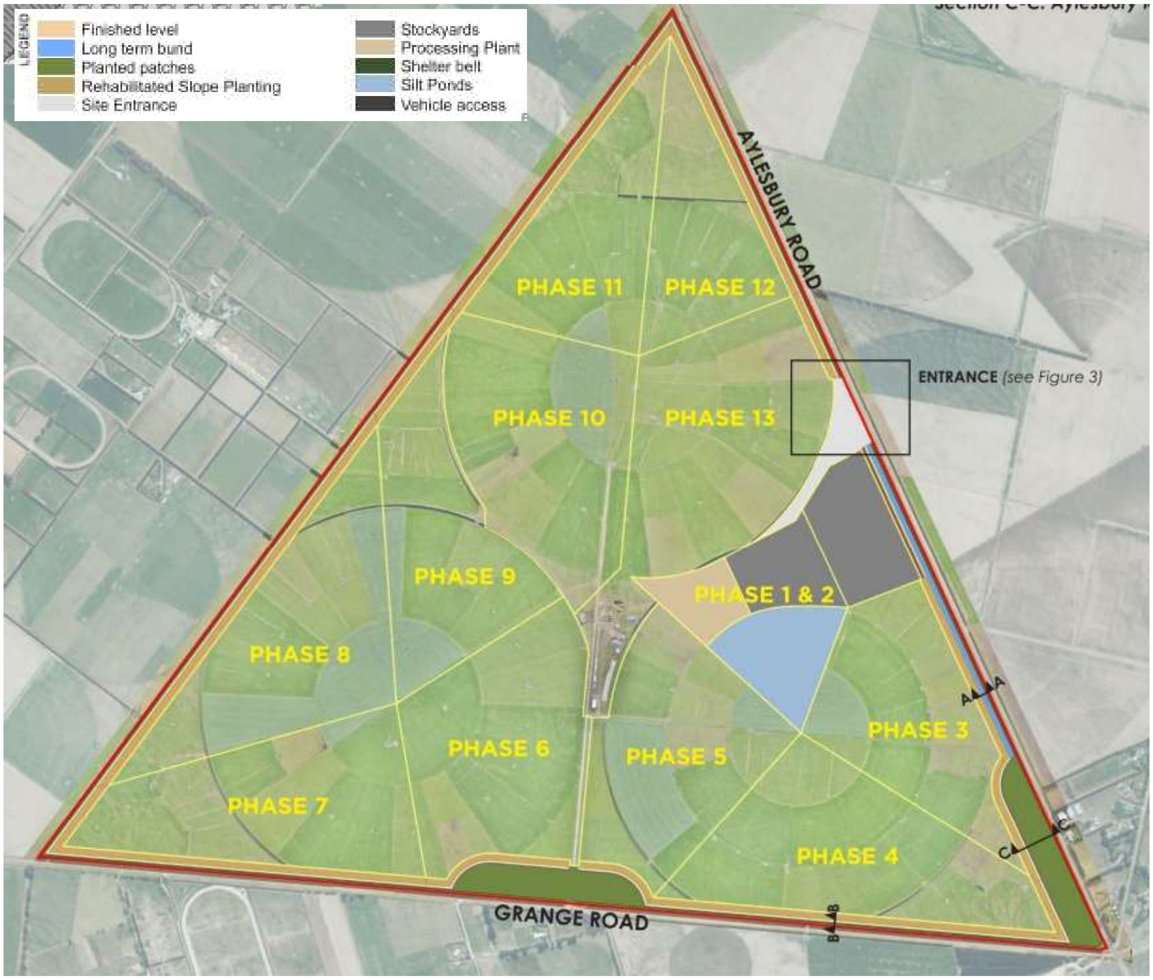


Figure 3: Site layout

Page 18 Question 2 - Will there be native planting on the permanent bund? Or will it only be grassed?

The permanent bund will be planted in native plants. Please see Figure 9 in Appendix 8a of the Application (Landscape Graphic Supplement.

Page 19 Question 1 - Can you confirm that product processing will only occur within the productions zone? i.e. there will not be any mobile processing plants operating in the extraction zones.

While the intention is for the majority of material to be processed within the production zone, from time-to-time Winstones may need to operate mobile crushers at various locations as the pit develops. These mobile crushers will not be located closer than 250 metres to a site boundary and will be fitted with dust suppressing water sprays.

Page 19 Question 2 - Is Winstones proposing a limit to the amount of open area/and or active areas which occur at any time?

The maximum proposed active area is 40 ha.

Page 19 Question 3 - I suggest that in the higher risk areas (within 250 m of a receptor) there is a restriction that stripping cannot occur in summer (dry) months. Is the applicant agreeable to such a limit?

Yes, Winstones is happy to accept a restriction that limits the stripping of overburden within 250 metres of a dwelling to times outside of the summer period.

Page 20 Question 1 - I suggest that the use of silt in site rehabilitation should not occur within 250 m of a sensitive receptor due to the higher proportion of fines in this product. Is Winstones happy to accept a condition to this effect?

Yes, Winstones is happy to accept a condition to this effect.

Page 21 Question 1 - Much of the proposed mitigation in this Section relies on water. Please provide a water balance/budget to demonstrate that Winstones has sufficient water resource for all of the aspects on-site which require water.

A renewal of the existing water permit is part of the application in which Winstones is seeking more than 1 million m^3 per annum. The following shows the approximate breakdown of water consumption used for dust suppression.

Wheel Wash 40,960 m^3

- Water consumption 1.28 m^3 per minute.
- 30 Second average cycle for truck per wash.
- 200 truck exit movements per day.
- 320 load out days per year.

Water Truck 40,960 m^3

- 10 m^3 per load.
- 8 hours operation per day.
- In operation approximately 40% of the year (i.e. weather dependant).
- 320 days operation for calculation (i.e. 128 full days operation).

Sprinklers 94,800 m^3

- 1 ha sprinklers working any one time. (areas rotated to cover larger open area on a timer system)
- 25 sprinklers working per ha
- 2.37 m^3 water per sprinkler per hour
- 5 hours per day total sprinkler time

Plant Wash Water 818,280 m^3

- 370 m^3 water absorbed into product per day.
- 558 m^3 per hour required for washing and scrubbing product and plant dust suppression
- Plant run for a 10-hour production day
- Production based on 220 days per year
- 85% plant efficiency

- 50% water reticulation with use of clarifiers. (remainder returned to ground in ponds via ground or evaporation)

Page 21 Question 2 - This period includes the summer/dry months of the year. Earlier it was stated that earthmoving/stripping would be avoided over summer months. Please clarify.

Winstones will avoid undertaking earthmoving and overburden stripping during the summer months in high-risk areas. However, for areas that are considered low risk mainly due to the distance from a sensitive receptor (greater than 250 metres), Winstones might need to undertake earthmoving and overburden stripping during the summer months. During these conditions Winstones will adopt the following mitigation measures:

- watering the surface prior to disturbing it during dry weather conditions, if required;
- minimising the amount of vegetation, overburden and soil removal to a practicable level;
- controlling vehicle speeds to 20 km/h on unconsolidated surfaces;
- dampening of haul roads; and,
- mulching, grassing and / or planting of bare areas and bunds shall be undertaken as soon as reasonably practicable.

Page 24 Question 1 - As above, will there be a limit to the amount of exposed areas on-site?

Yes, the site will be limited to 40 ha of active areas.

Page 25 Question 1 - Will product stockpiles be located within the pit? If so, will stockpiles extend from the pit floor to up to 5 m above current natural ground level? This could be very high stockpiles. Would Winstones accept a condition that product stockpiles are located within the pit and not exceed the height of the existing natural ground level?

Product stockpiles will be located within the pit. The maximum height of a stockpile measured from the stockyard floor will be 12 metres high, but most stockpiles will be 10 metres or lower as this is better from a stockpile management point of view. Given that the estimated depth of the stockyard will be 10 metres below the existing ground level, most stockpiles will be at or below the existing ground level. The largest stockpiles will be a maximum of two metres above the existing ground level, however given that most of the eastern boundary will have a permanent bund that will be between the stockyard and the nearest dwellings, and the bund is 3 metres high, the stockpiles should be well sheltered.

Page 25 Question 2 - Vegetated bund, should be minimum height of 3 m?

That is correct the bund will be a minimum of 3 metres.

Page 26 Question 1 - As above, please provide proof that there is sufficient water on-site to control dust during peak dry periods.

Please refer to the Page 21 Question 1 response.

Page 28 Question 1 - I consider that the use of boundary video camera monitoring which retains recorded imagery for a minimum of 1 month would be beneficial to Winstones from an operational visible monitoring (camera feeds could be in the site manager's office) and complaint investigation. Would Winstones consider installing boundary cameras on the bund pointed into the quarry to visualise and record the effectiveness of dust controls on the site?

At this stage, Winstones considers that daily observations by site staff in conjunction with continuous dust monitoring near the closest dwellings to the works will be sufficient to help identify any issues before they become a problem or used as part of any complaint investigation.

Page 29 Question 1 - Draft DMP says 7.5 m/s. Please clarify wind speed trigger levels.

A 5 m/s wind speed trigger will be adopted for this project. Any future updates of the Draft Management Plan will reference a 5 m/s trigger level.

Page 29 Question 2 - If the current weather station mast is not 10m above ground level the values for the wind speed triggers may need to be reconsidered. I suggest that Winstones commits to a 10 m mast.

While the current mast onsite is only 6 metres, Winstones is committed to installing a 10 metres high mast once consent is granted.

Page 32 Question 1 - I assume that this is wind speeds above 5 m/s?

Yes, that is correct.

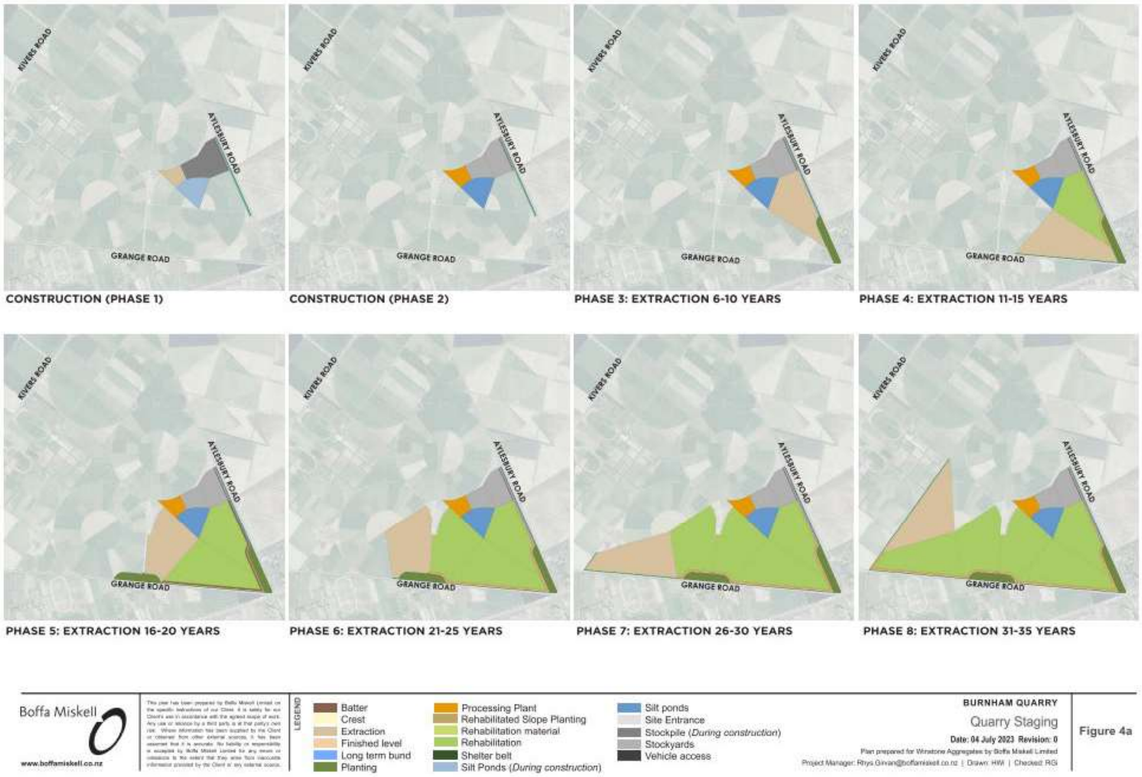
Page 33 Question 1 - I agree that these dense hedges will provide a level of mitigation. Is Winstones happy to accept a consent condition that these hedges are retained and maintained for the entire duration of the consent/quarry?

Yes, Winstones is happy to accept a condition to this effect.

Page 34 Question 1 - Earlier it has been stated that the expected lifetime of the quarry is 60 years. How far through the quarry does Winstones anticipate it will be at the end of the 35 year term (noting that it is very unlikely that ECAN will grant a 35 year term)? Essentially what I'm asking is will the quarry reach the closest points to R1, R2, R3 over the period which the consent is being applied for (potentially granted to, which could be 15-20 years max). Would it be possible to provide indicative dates for each extraction stage? I note that this might be a best guess.

Below is the indicative staging plan and the timeframes in when they are likely to occur. As shown in the images below, the quarrying will work in a clockwise direction starting near the southwest corner of the site. Receptors identified as R1 will be closest to the works between 5 and 20 years from the consent being granted, with this area of the site to be fully rehabilitated by 20 years. While work will be undertaken in this corner of the site for an approximately 15 year period, a large proportion of this work will be undertaken at a distance much greater than 250 metres from these dwellings.

Receptors R2 would be closest to the works between 15 and 30 years from when the consent is granted and Receptors R3 would be closest to the works between years 25 and 35.


KIVERS ROAD
AYLESBURY ROAD
GRANGE ROAD
CONSTRUCTION (PHASE 1)
CONSTRUCTION (PHASE 2)
PHASE 3: EXTRACTION 6-10 YEARS
PHASE 4: EXTRACTION 11-15 YEARS
PHASE 5: EXTRACTION 16-20 YEARS
PHASE 6: EXTRACTION 21-25 YEARS
PHASE 7: EXTRACTION 26-30 YEARS
PHASE 8: EXTRACTION 31-35 YEARS
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Shelter belt
Silt Ponds (During construction)
Silt ponds
Site Entrance
Stockpile (During construction)
Stockyards
Vehicle access
BURNHAM QUARRY
Quarry Staging
Date: 04 July 2023 Revision: 0
Plan prepared for Winstone Aggregates by Boffa Miskell Limited
Project Manager: Rhys.Girvan@boffamiskell.co.nz | Drawn: HW | Checked: RG
Figure 4a

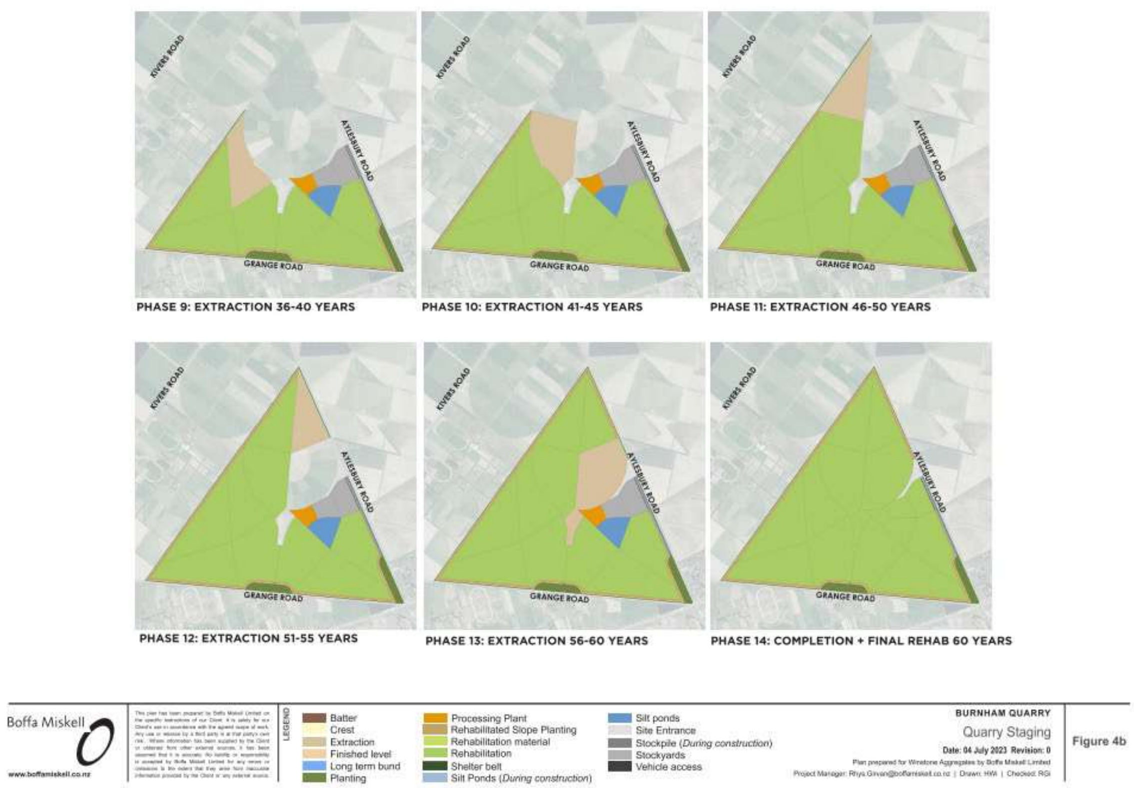
KIVERS ROAD
AYLESBURY ROAD
GRANGE ROAD
PHASE 9: EXTRACTION 36-40 YEARS
PHASE 10: EXTRACTION 41-45 YEARS
PHASE 11: EXTRACTION 46-50 YEARS
PHASE 12: EXTRACTION 51-55 YEARS
PHASE 13: EXTRACTION 56-60 YEARS
PHASE 14: COMPLETION + FINAL REHAB 60 YEARS
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Figure 4b

Page 35 Question 1 – 100m?

Our measurements show that there is 120 metres of separation between the closest dwelling and the quarry pit floor. There is approximately 100 metres between this dwelling and the start of the batter.

Page 36 Question 1 - This is a large active area, can Winstones please provide a breakdown of these active areas? i.e. xx ha in the production zone, xx ha in the extraction area, etc.

Breakdown of Active Areas	
Zone	**Hectares**
Fixed processing plant, other processing, stockpiling, unsealed customer loadout.	18
Silt processing and storage.	7
Excavation and active rehabilitation (excluding rehabilitated areas), including conveyance and unsealed accessways	15

Page 39 Question 1 - I note that this DMP is fairly generic. I'm assuming that a more detailed DMP will be provided for the hearing?

No there is no plan at this stage to provide a more detailed Dust Management Plan prior to the hearing. The intention of the draft Dust Management Plan was to provide further detail on the proposed mitigation measures and how the site will be managed and is largely based on management techniques Winstones adopts and successfully undertakes at other sites.

The Dust Management Plan will be amended accordingly based on the outcome of the hearing.

Should you have any further questions please contact the undersign below.

Your faithfully

PATTLE DELAMORE PARTNERS LIMITED

Prepared by

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Service Leader – Air Quality

Reviewed and Approved by

Andrew Curtis

Technical Director – Air Quality

Limitations

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